1.3.2 Average percentage of courses that include experiential learning through project work/field work/internship during last five years

Sl No.	Department
1	Automobile Engineering
2	Computer Science and Engineering
3	Electronics and Communication Engineering
4	Electrical and Electronics Engineering
5	Mechanical Engineering
6	Mechatronics Engineering
7	Master of Computer Applications

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(Approved by AICTE, Affiliated to APJ Abdul Kalam Technological University, Kerala)

Automobile Engineering

University Examination Pattern		
PART A:	*Analytical/problem solving SHORT questions* Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.	*8 x 5 marks=40 marks*
PART B:	*Analytical/Problem solving DESCRIPTIVE questions* Two questions from each module with choice to answer one question.	*4 x 15 marks=60 marks*
		Maximum Total Marks: 100

AM14 802 AUTOMOTIVE SAFETY & POLLUTION CONTROL

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Credits: 4

Objective

- *To create awareness in Vehicle Safety and keeping the environment free from Pollution.*

Module I (13Hrs)
INTRODUCTION
Design of the body for safety, energy equation, engine location, deceleration of vehicle inside passenger compartment, deceleration on impact with stationary and movable obstacle, concept of crumble zone, safety sandwich construction.
SAFETY CONCEPTS
Active safety: driving safety, conditional safety, perceptibility safety, operating safety passive safety: exterior safety, interior safety, deformation behaviour of vehicle body, speed and acceleration characteristics of passenger compartment on impact.

Module II (13Hrs)
SAFETY EQUIPMENTS
Seat belt, regulations, automatic seat belt tightener system, collapsible steering column, tiltable steering wheel, air bags, electronic system for activating air bags, bumper design for safety.
COLLISION WARNING AND AVOIDANCE
Collision warning system, causes of rear end collision, frontal object detection, rear vehicle object detection system, object detection system with braking system interactions. Steering and mirror adjustment, central locking system , Garage door opening system, tyre pressure control system, rain sensor system, environment information system

Module III (13Hrs)
MECHANISM OF POLLUTANT FORMATION IN ENGINES
Introduction, Pollutants, sources, formation of HC and CO in SI engines, NO formation in SI and CI engines, Particulate emission from SI and CI engines, Smoke Emission in CI engines. Effect of operating variables on emission formation.
POST COMBUSTION TREATMENTS

Text Book

1. Dale H. Besterfield, Carol Besterfield – Michna, Glen H. Besterfield, Mary Besterfield- Sacre, 2003, Total Quality Management, 3rd edition, Pearson, Education, New Delhi.

Reference Books

1. Logothetis, N. (1992), Managing for Total Quality, Prentice Hall International, Englewood Cliffs, NJ.
2. Grant E.L., Statistical Quality Control, McGraw Hill
3. Juran J.M, Gryna F.M., *Quality Planning and Analysis*, Tata McGraw Hill Publishing Company
4. Montgomery, Douglas C, 2001, *Introduction to Statistical Quality Control*, Fourth edition, John Wiley and Sons, Inc, New Delhi
5. Gerald M Smith- 2004, *Statistical Process Control and Quality Improvement*- 5th edition

Internal Continuous Assessment (Maximum Marks-50)

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Attendance and Regularity in the class

University Examination Pattern

PART A: Analytical problem solving SHORT questions — *8 x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical Problem solving DESCRIPTIVE questions — *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

AM14 804 (A) VEHICLE BODY ENGINEERING

Teaching scheme **Credits: 4**

3 hours lecture and 1 hour tutorial per week

Objectives

- *To make aware of the body design, ergonomics methods, crash testing and vehicle safety.*

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Pin - 680 597, Kerala

Text Book

1. Bester Field, Dale H, Carol Bocterfreld – Muchna, Glen H, Boeterfreld Mery Bocterfeld- Scare, 2003, *Total Quality Management*, 3rd edition, Pearson, Education, New Delhi.

Reference Books

1. Logethetis, N. (1992), *Managing for Total Quality*, Prentice Hall International, Englewood Cliffs, NJ.,
2. Grant.E.L., *Stastical Quality Control*, McGraw Hill
3. Juran J.M, Gryna I.M., *Quality Planning and Analysis*, Tata McGraw Hill Publishing Company
4. Montgomery, Douglas C, 2001, *Introduction to Statistical Quality Control*, Fourth edition, John Wiley and Sons, Inc, New Delhi
5. Gerals M Smith- 2004, *Statistical Process Control and Quality Improvement*- 5th edition

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Attendance and Regularity in the class

University Examination Pattern

PART A: *Analytical/problem solving SHORT questions* *8 x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: *Analytical/Problem solving DESCRIPTIVE questions* *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

AM14 804 (A) VEHICLE BODY ENGINEERING

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objectives

- *To make aware of the body design, ergonomics methods, crash testing and vehicle safety.*

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MODULE-I (13 hours)
Modern materials for vehicle design: Introduction, Structure and manufacturing technology of automotive materials, Mechanical and physical properties of automotive materials, Material selection for automotive components.
Body design: coach and bus body styles, typical layout of bus and coach bodies, typical layout of commercial vehicle types, passenger car body styles
Chassis design and analysis: chasis type, structural analysis by simple structural surface method, body frame construction, unitized frame and body construction, FR, FF, & MR body structure details

MODULE-II (13 hours)
Ergonomics method and tool to promote occupant accommodation: standards guidelines and recommendations, Anthropometry, 2-dimentional manikins, package drawing, Quick and dirty mock ups, vehicle seating configuration(based on SAE).
Crash testing: Human testing, Crash worthiness, Compliance testing, Component testing, Competitive race testing. The role of endurance and durability studies in the manufacturing of vehicles. :Introduction, Failure and reliability, Testing and failure prediction, importance of avoiding failures

MODULE-III (13 hours)
Introduction to vehicle safety: Basic concept of vehicle safety-underlying principles, safety factors, warning and instructions, shielding, interlocking.
Minor auto body repairs: types of body fillers and its application, repairing rust damage,
Painting: Corrosion and anticorrosion method .Paint and painting process

MODULE-IV (13 hours)
Diagnosing major collision damage: impact and its effect on a vehicle, determining the conditions of the collision, Porto power, the dozer technique, operation of conventional Porto power, operation of dozers, body bay systems (flexi-force), general repair techniques. Body alignment- straightening equipment, in-floor systems, chainless anchoring systems

Text Book

1. Pauloski- *Vehicle Body Engineering*

Reference Books

1. Robert Scharff & James.E.Duffy – *Motor Auto body repair*, Delmar Publishers
2. J. Fairbrother – *Principles and practice of Vehicle body repair*, Hutchinson
3. S.P. Page- *Body Engineering*
4. Paul Browne- *Auto care manual*
5. *Redesign of bus bodies*- Part I and Part H, C,I.R,T,, Pune
6. George A Peters & Barbara J. Peters- *Automotive vehicle safety*-SAE 2002
7. Julian happian-smith *An introduction to modern vehicle design*-SAE 2004

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Attendance and Regularity in the class

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University Examination Pattern

PART A:	*Analytical/problem solving SHORT questions*	*8 x 5 marks=40 marks*
	Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.	
PART B:	*Analytical/Problem solving DESCRIPTIVE questions*	*4 x 15 marks=60 marks*
	Two questions from each module with choice to answer one question.	
		Maximum Total Marks: 100

AM14 805 (D) VEHICLE PERFORMANCE AND TESTING

Teaching scheme **Credits: 4**
3 hours lecture and 1 hour tutorial per week

Objective
To enhance the knowledge in testing the vehicle performance and improving it.

MODULE-I (13 hours)
Laboratory testing: Basic engine parameters, Measurement of BHP, IHP, Engine testing on dynamometers, different types of dynamometers- hydraulic, eddy current etc, engine analyzers- for petrol and diesel engines, FIP calibrating and testing, exhaust gas analyzers - various types- Orsat apparatus, infrared gas analyzers, smoke meter. Vehicle testing on chassis dynamometers: two wheel & four wheel dynamometers, vehicle testing lanes - side slip testers, wheel alignment testing, wheel balancing, brake testers, head light alignment testing.

MODULE- II (13 hours)
Noise vibration and Harshness: Review of vibration fundamentals, vibration control, fundamentals of acoustics, human response to sound, automotive noise criteria, Standard noise measurement methods, Noise inside and outside the vehicle, sources of vehicle noise- intake and exhaust noise, combustion noise, mechanical noise, noise from auxiliaries, wind noises, transmission noises, brake squeal, structure noise, noise control methods.

MODULE-III (13 hours)
Vehicle performance: Methods for evaluating vehicle performance- energy consumption in conventional automobiles, performance, emission and fuel economy, Operation of full load and part conditions, effect of vehicle condition, tyre and road condition and traffic condition and driving habits on fuel economy, CAFÉ standards.

MODULE-IV (13 hours)
Road and track testing: Initial inspection, PDI, Initial free services, engine running in and durability, intensive driving, maximum speed and acceleration, brake testing on the road, hill climbing, handling and ride characteristics, safety, mechanism of corrosion, three chamber corrosion testing, wind tunnel testing, road testing, test tracks.

Text Book

1. Dr. N.K.Giri- Automotive technology – Khanna publishers, 2009

Reference Books

1. J. G. Giles- Vehicle operation and performance, Wildlife Publications, London, 1969
2. W, H. Crouse and L. Anglin- Motor vehicle inspection, McGraw Hill Book Co., 1978
3. SAE Transaction papers- 831814,820346,820367,820371 and 820375
4. Julian Happian-Smith – An introduction to vehicle design – SAE, 2004
5. Advanced automotive technology – visions of a super efficient family cartechnical paper - OTA-ETI-638, 1995

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Attendance and Regularity in the class

University Examination Pattern

PART A: *Analytical/problem solving SHORT questions* *8 x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: *Analytical/Problem solving DESCRIPTIVE questions* *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

AM14 805 (E) FINITE ELEMENT ANALYSIS

Teaching scheme **Credits: 4**

3 hours lecture and 1 hour tutorial per week

Objective

To deepen the analyzing skill in terms of finite elements

Module 0 (2 hours)

Review : Matrices and matrix operations – solution of system of linear equations – Gauss elimination. Basic equations of elasticity – strain-displacement relations – compatibility - stress-strain relationship – boundary condition – St. Venant's principle - theorem of minimum potential energy – principle of virtual work. Steady state heat conduction equation – Fourier's law – boundary conditions. (No direct questions from the above part)

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Course No.	Course Name	L-T-P -Credits	Year of Introduction
AU201	S.I. ENGINES & COMBUSTION	3-1-0-4	2016

Course Objectives

- To impart basic concepts of SI Engine and Combustion, automotive engines
- To know constructional details of engine components.
- To differentiate ideal and actual cycles
- To understand lubrication, cooling , ignition and fuel systems in SI engines.

Syllabus

I.C Engine cycles and analysis: Otto & diesel cycle, Comparison of air standard cycle & fuel air cycle - actual cycle-losses in actual cycle - Combustion in SI engines- P-θ diagram- Stages of combustions - Abnormal combustion – Knock theories - rating of fuels - Octane number, Alternative fuels - Air fuel mixture requirements – Solex Carburettor- Fuel injection systems in SI engines - Combustion System Design- Ignition System Overview - distributor less ignition - CDI & Coil on plug type of ignition system - Constructional details of engine components: Cylinders –cylinder liners, engine block, types of cylinder head - Two stroke engines: Port timing diagrams - Comparison of Scavenging Systems - Valve and valve mechanism - OHV, OHC, DOHC, variable valve timing systems - Intake system components - Intake manifold - Waste heat recovery, Exhaust mufflers - Cooling system - types of cooling systems - components of water cooling - Lubrication system - types of lubricants – properties - lubrication systems

Expected outcome.

The students will be able to

i. explain basic concepts of SI Engine and Combustion, automotive engines
ii. identify engine components and their functions
iii. differentiate ideal and actual cycles and problems
iv. analyse lubrication, cooling, ignition and fuel systems in SI engines.

Text Book:

1. M. L. Mathur, R. P. Sharma - Internal Combustion Engines, Dhanpat Rai Publications
2. R.K. Rajput, Internal Combustion Engines, Laxmi Publications
3. V Ganesan, *Internal Combustion Engine* Tata McGraw Hill Publishing Company Ltd., New Delhi 2006.

References:

1. Heinz Heisler, Advanced Engine Technology, Society of Automotive Engineers Inc
2. William H Crouse / Donald L Anglin, Automotive Mechanics , Tata McGraw-Hill Publishers
3. I.C.Engines By Lichty., McGraw Hill
4. Fuels & Combustion By Smith & Stinson., McGraw-Hill
5. John B Heywood, Internal Combustion Engine Fundamentals, McGraw Hill Publishing Company
6. Obert E.F, Internal Combustion Engine and air Pollution McGraw Hill Book company New

York.

7. Sharma S.P. Fuels and Combustion, Tata McGraw Hill Publishing Company Ltd., New Delhi.

8. A.W. Judge, Modern petrol engine, Chapman and Hall, London

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	I.C Engine cycles and analysis: Otto & Diesel cycle. Comparison of air standard cycle & fuel air cycle, effects of variation of specific heat, dissociation effect, and numerical problems related, actual cycle-losses in actual cycle - Efficiencies of real Engines	9	15%
II	Combustion in SI engines- P-θ diagram- Stages of combustions- Ignition lag. Flame Propagation- factors / engine variables affecting combustion stages. Different combustion chambers in SI engines. Abnormal combustion – Knock theories - detonation effects- factors and variables affecting knock-surface ignition. Fuels – Qualities & properties - rating of fuels - Octane number. Alternative fuels.	9	15%
FIRST INTERNAL EXAMINATION			
III	Air fuel mixture requirements – Solex Carburetor. Stochiometric and excess air calculations. Fuel injection systems in SI engines - nozzle- direct and indirect injections. MPFI systems and GDI engines. Combustion System Design - Port Injection Combustion Systems - Direct Injection Spark ignition (DISI) Introduction - Spark Ignition and Ignition Timing - Ignition System Overview - The Ignition Process - Ignition Timing Selection and Control – Battery & magneto ignition system – distributor less ignition - CDI & Coil on plug type of ignition system	9	15%
IV	Constructional details of engine components: Cylinders – cylinder liners, engine block, types of cylinder head, gasket materials. Piston - types, materials, piston rings, piston pins, connecting rod, crank shaft, flywheel, cam shaft, valve, valve mechanism, hydraulic tappets. Two stroke engines: Port timing diagrams. Symmetrical & unsymmetrical timing. Three port engine. Theoretical Scavenging processes, Scavenging parameters, Comparison of Scavenging Systems; Cross flow, loop flow, uniflow, Pre blow down, Blow down. Scavenging pumps, blowers.	9	15%
SECOND INTERNAL EXAMINATION			

V	Valve and valve mechanism: Angle of seat, Operating Conditions, operating temperatures, valve cooling, Sodium cooled valves, Valve rotators, valve seats, valve guides, , valve springs, valve clearance & timing, OHV, OHC, DOHC, variable valve timing systems – V TECH.VVT. Camshaft,-drives of cams, cam types, tappets, push rods, rocker arms Intake system components, Discharge coefficient, Pressure drop, Air filters, Intake manifold, connecting pipe. Exhaust system components: Exhaust manifold and exhaust pipe, Spark arresters, Waste heat recovery, Exhaust mufflers, Type of mufflers.	12	20%
VI	Cooling system: Necessity of engine cooling, operating temperatures, types of cooling systems: Direct air cooling, Indirect or water cooling, Liquid cooling, Pressure sealed cooling, Evaporative cooling or steam cooling, components of water cooling system, antifreeze solution, temperature gauges. Lubrication system: Functions, lubrication principles, classification of lubricants, types of lubricants, properties of lubricants, service ratings of oils, oil additives, specification of lubricants, crankcase ventilation, lubrication systems, pre-lubrication systems, effect of engine conditions on lubricating oil, consumption of lubricating oil, Components of lubrication system, Oil pressure warning system, oil pressure gauges, chassis lubrication.	12	20%
END SEMESTER EXAM			

Question Paper Pattern

Total marks: 100, Time: 3 hours

The question paper shall consist of three parts

Part A

4 questions uniformly covering modules I and II. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part B

4 questions uniformly covering modules III and IV. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part C

6 questions uniformly covering modules V and VI. Each question carries 10 marks
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

Note: In all parts, each question can have a maximum of four sub questions, if needed.

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Course code	Course Name	L-T-P - Credits	Year of Introduction
AU203	AUTO CHASSIS	3-0-0- 3	2016

Prerequisite: Nil

Course Objectives

- Study of the Constructional details and Theory of important drive line, Structural, Steering, Braking and Suspension Systems of Automobiles.
- Problem–Solving ability in Steering Mechanism, Propeller Shaft, Braking and Suspension Systems.

Syllabus

Chassis layout – vehicle frames- wheels and rims- tyres- drives- drive axles- differential – suspension system-braking systems- front and stub axles – steering mechanism.

Expected outcome.

- After this course the student must be able to explain the constructional details and the structure of drive line, steering, braking system and suspension system in a vehicle.

Text Book:

1. Kripal Singh, Automobile Engineering, Standard Publisher, New Delhi , 2006
2. R.K. Rajput, A Text–Book of Automobile Engineering, Laxmi Publications Private Limited, 2007 3.
3. N.K. Giri, Automotive Mechanics, Kanna Publishers, 2007

References:

1. Heldt P.M., Automotive Chassis, Chilton Co., New York, 1990
2. Newton Steeds and Garret, Motor Vehicles, 13th Edition, Butterworth, London, 2005.
3. Heinz Haisler, Advanced Vehicle Technology, Butterworth, London, 2005.

Course Plan

Module	Contents	Hours	Sem.ExamMarks
I	Types of Chassis layout, with reference to Power Plant location and drive, various types of frames, Loads acting on vehicle frame, Constructional details and materials for frames, Testing of frames. Types and Constructional Details of different Types of Wheels and Rims, different Types of Tyres and their constructional details.	7	15%
II	Effect of Driving Thrust, torque reactions and side thrust, Hotchkiss drive, torque tube drive, radius rods and stabilizers, Propeller Shaft, Universal Joints, Constant Velocity Universal Joints, Front Wheel drive. Final drive, different types, Double reduction and twin speed final drives, Multi–axle vehicles.	7	15%
FIRST INTERNAL EXAMINATION			
III	Construction and Design of Drive Axles, Types of Loads acting on drive axles, Full – Floating, Three–Quarter Floating and Semi–Floating Axles, Axle Housings and Types, Differential principle and types, Differential housings, Non–Slip differential, Differential locks, Final drive of Crawler, Tractors.	7	15%
IV	Need for Suspension System, Types of Suspension Springs, Constructional details and characteristics of Single Leaf, Multi–Leaf, Coil, Torsion bar, Rubber, Pneumatic and Hydro elastic Suspension Spring Systems, Independent Suspension System, Shock Absorbers, Types and	7	15%

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	Constructional details, Design of Leaf Springs.		
SECOND INTERNAL EXAMINATION			
V	Theory of Automobile Braking, Stopping Distance Time and Braking Efficiency, Effect of Weight Transfer during Braking, Theory of Drum Brakes, Leading and Trailing Shoes, Braking Torque, Constructional Details of Drum Brake and its Activators, Disc Brake Theory, Types and Construction, Hydraulic Braking System, Mechanical Braking System, Pneumatic Braking System, Power–Assisted Braking System, Servo Brakes, Retarders, Types and Construction, Anti–Lock Braking	7	20%
VI	Types of Front Axles and Stub Axles, Front Wheel Geometry, viz., Castor, Camber, King Pin Inclination and Toe–in, Condition for True Rolling Motion of Wheels during Steering, Ackerman's and Davis Steering Mechanisms, Steering Error Curve, Steering Linkages, Different Types of Steering Gears, Slip Angle, Over–Steer and Under–Steer, Reversible and Irreversible Steering, Power–Assisted Steering.	7	20%
END SEMESTER EXAM			

Question Paper Pattern

Maximum marks: 100 Time: 3 hours

The question paper shall consist of three parts

Part A

4 questions uniformly covering modules I and II. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part B

4 questions uniformly covering modules III and IV. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part C

6 questions uniformly covering modules V and VI. Each question carries 10 marks
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

Note: In all parts, each question can have a maximum of four sub questions, if needed.

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Course No.	Course Name	L-T-P - Credits	Year of Introduction
AU204	CI ENGINES & COMBUSTION	4-0-0-4	2016

Course Objectives

- To impart the basic concepts of CI Engine and Combustion
- To know about CI engine emissions and their treatments,
- To differentiate ideal and actual cycles
- To understand FI systems in CI engines

Syllabus

Diesel fuels, Properties and qualities - Combustion in CI engines, P-θ diagram - Air motion-Squish, tumble - Fuel supply system in diesel engines - Diesel injection pump types - C-AV Bosch pump, Modem distributor type pumps - Diesel filters - Advanced fuel injection system-Unit pump & injector- Common Rail (CR) Fuel Injection Systems - Sensors in CI engine - Pollutants in engines. NOx, CO, unburned hydrocarbons - Exhaust gas treatment.- Catalytic converter – Supercharging - effects of supercharging in S.I and C.I engines - Turbo charging - methods of turbo charging - cold starting devices

Expected outcome.

The students will be able to

i. To explain CI Engine and Combustion,
ii. To differentiate and analyse ideal and actual cycles
iii. To diagnose FI systems in CI engines

Text Book:

1. M. L. Mathur, R. P. Sharma - Internal Combustion Engines, DhanpatRai Publications
2. R.K. Rajput, Internal Combustion Engines, Laxmi Publications.
3. V Ganesan, *Internal Combustion Engine* Tata McGraw Hill Publishing Company Ltd., New Delhi 2006.

References:

1. Newton K, Steeds W and Garrett T.K – Motor Vehicle, Butterworth Heinemann Ltd
2. William H Crouse, Donald L Anglin, Automotive Mechanics , Tata McGraw-Hill Publishers
3. Joseph Heitner- Automobile mechanics, CBS Publishers, New Delhi
4. A.W.Judge, Modern petrol engine, Chapman and Hall, London
5. P. M. Heldt – High speed diesel engines, Chillon Co. New York.
6. Taylor, I.C.Engines, MIT Press, England
7. Lichty , I.C.Engines , McGraw Hill Publishing Co.
8. Smith & Stinson, Fuels & Combustion, McGraw-Hill Publishing Co.
9. John B Heywood, Internal Combustion Engine Fundamentals, McGraw Hill Publishing Company
10. Obert E F,Internal Combustion Engine and air Pollution McGraw Hill book company New York.
11. Sharma S.P, Fuels and Combustion, Tata McGraw Hill Publishing Company Ltd., New Delhi
12. Heinz Heisler, Advanced Engine Technology, Society of Automotive Engineers Inc.

Course Plan			
Module	Contents	Hours	Sem.ExamMarks
I	Diesel fuels, Properties and qualities, Cetane number, alternative fuels for CI engines Combustion in CI engines, P-θ diagram – parameters affecting Ignition delay, uncontrolled combustion, diesel knock - controlling methods. Diesel knock, comparison with SI knock and control. Air motion- Squish, tumble, swirl motions. Different types combustion chambers in CI engines.	9	15%
II	Fuel supply system in diesel engines: Requirements of diesel injection system, Components of diesel injection system, Diesel filters, fuel feed pump, hand pump, heavy duty air filters, Diesel injection pump types - simple and multiple unit pump, C-AV Bosch pump, Modem distributor type pumps, injection nozzles and types of injectors, Pump-Line-Injector (PLI) Systems	8	15%
	FIRST INTERNAL EXAMINATION		
III	Electronic Unit Injectors (EUI) – Advanced fuel injection system- Unit pump & injector- Common Rail (CR) Fuel Injection Systems - Electronic Diesel Control (EDC) - overview & Diagnostics. Sensors in CI engine fuel injection systems – control of fuel injection – Actuators in CRDI systems.	8	15%
IV	Thermodynamics of combustion. Combustion reaction of common fuels. Exhaust gas composition. Testing of IC engines - Indicated power – Brake Power - Volumetric efficiency – Heat balance test - Morse test. Gas Exchange Processes - Valve Flow and Volumetric Efficiency - Valve Timing - Dynamic Behavior of Valve Gear. Flue gas analysis using ORSAT apparatus – liquid fuel, gaseous fuel – combustion equations – problems	9	15%
	SECOND INTERNAL EXAMINATION		
V	Pollutants in engines. NOx, CO, unburned hydrocarbons, smoke and particulate. Sources, causes and measurement of exhaust emission, Non exhaust emissions and control methods, Emission norms Exhaust gas treatment.- Catalytic converter – Thermal reaction -Particulate trap. Flue gas analysis. Air fuel ratio from exhaust gas composition. Numerical problems	11	20%
VI	Supercharging: Introduction, Objectives of supercharging, thermodynamic cycle, effects of supercharging in S.I and C.I	11	20%

	engines, performance of the supercharged engine, supercharging limits, and methods of supercharging, superchargers. Turbo charging - methods of turbo charging and its advantages, limitations of turbo charging. Governors (mechanical, pneumatic and hydraulic governors), cold starting devices.		
END SEMESTER EXAM			

Question Paper Pattern

Total marks: 100, Time: 3 hours

The question paper shall consist of three parts

Part A

4 questions uniformly covering modules I and II. Each question carries 10 marks

Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part B

4 questions uniformly covering modules III and IV. Each question carries 10 marks

Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part C

6 questions uniformly covering modules V and VI. Each question carries 10 marks

Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

Note: In all parts, each question can have a maximum of four sub questions, if needed.

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Course No.	Course Name	L-T-P - Credits	Year of Introduction
AU206	AUTO TRANSMISSION	3-0-0- 3	2016

Course Objectives

- To impart basic knowledge in automotive transmission.
- To understand the construction and principle of operation of various types of mechanical transmission components, hydrodynamic devices, hydrostatic devices and automatic transmission system
- To design clutch and gearbox.

Syllabus

Problems on performance of automobile -Determination of gear ratios for vehicles. Different types of gearboxes -Fluid coupling-Hydrodynamic Torque converter -Construction and operation of Ford – T-model gearbox, Wilson Gear box and electromagnetic transmission-Need for automatic transmission, Principle of operation -Hydrostatic drive -Electric drive-Comparison of hydrostatic drive with hydrodynamic drive-Ward Leonard Control system

Expected outcome.

After this course, students will be able to explain about the design of clutches and gear boxes, construction of the transmission components, various types of transmission systems

Text Book:

1. 3. Newton and Steeds – "Motor Vehicle"- Illiffee Publisher- 2000.

References:

1. Design Practices, passenger Car Automotive Transmissions- SAE Hand book- 1994.
2. Crouse, W.H., Anglin, D.L., Automotive Transmission and Power Trains construction, McGraw Hill, 1992.
3. Heldt, P.M., Torque converters, Chilton Book Co., 1992.
4. Judge, A.W., Modern Transmission systems, Chapman and Hall Ltd., 1990.
5 Heinz Heisler, Modern Vehicle Technology

Course Plan

Module	Contents	Hours	Sem.ExamMarks
I	Problems on performance of automobile - such as resistance to motion, tractive effort, engine speed, engine power and acceleration. Requirement of transmission system, Different types of clutches, principle, Construction and torque capacity.	6	15%
II	Determination of gear ratios for vehicles. Different types of gearboxes such as Sliding mesh gearbox, Constant mesh gearbox and Synchromesh gearbox, gear shifting mechanisms in each.	7	15%
FIRST INTERNAL EXAMINATION			
III	Construction and operation of Ford – T-model gearbox, Wilson Gear box and electromagnetic transmission.	6	15%
IV	Fluid coupling - Principle of operation, Constructional details, Torque capacity, Performance characteristics and Reduction of drag torque. Hydrodynamic Torque converter - Principle of operation, Constructional details and Performance characteristics. Multistage torque converters.	7	15%

	Polyphase torque converters. Converter coupling		
SECOND INTERNAL EXAMINATION			
V	Need for automatic transmission, Principle of operation. Hydraulic control system for automatic transmission. Chevrolet "Turboglide" Transmission. Continuously Variable Transmission (CVT) – Types – Operations.	8	20%
VI	Hydrostatic drive - Various types of hydrostatic systems, Principles of Hydrostatic drive system. Advantages and limitations. Comparison of hydrostatic drive with hydrodynamic drive, Construction and Working of typical Janny hydrostatic drive. Electric drive - Principle of operation of Early and Modified Ward Leonard Control system. Advantages & limitations.	8	20%
END SEMESTER EXAM			

Question Paper Pattern

Total marks: 100, Time: 3 hours

The question paper shall consist of three parts

Part A

4 questions uniformly covering modules I and II. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part B

4 questions uniformly covering modules III and IV. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part C

6 questions uniformly covering modules V and VI. Each question carries 10 marks
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

Note: In all parts, each question can have a maximum of four sub questions, if needed.

Course code	Course Name	L-T-P – Credits	Year of Introduction
AU307	VEHICLE BODY ENGINEERING	3-0-0-3	2016

Prerequisite : Nil

Course Objectives

- To impart knowledge on the design of vehicle body to give maximum comfort for the passengers
- To discuss the methods of stream lining vehicle body to minimize drag

Syllabus

Classification of coach work types, vehicle aerodynamics, vehicle body design parameters, vehicle body design terms, vehicle ergonomics, body structure types, vehicle stability, and load distribution in vehicles.

Expected outcome.

- The students will be able to do vehicle body design giving maximum passenger comfort and producing minimum drag.

Text Book:

1. Giles J Pawlowski, Vehicle body engineering Business books limited, 1989
2. Sydney F Page, "Body Engineering" Chapman & Hall Ltd, London, 1956

References:

1. Pope , "Wind tunnel testing" , John Wiley & Sons , 2nd edition, New York, 1974
2. Braithwaite,J.B., Vehicle Body building and drawing, Heinemann Educational Books Ltd., London 1977
3. Dieler Anselm., The passenger car body, SAE International, 2000
4. Giles,G.J., Body construction and design, Illiffe Books Butterworth & Co., 1971.
5. John Fenton, "Vehicle body layout and analysis", Mechanical Engg. Publication ltd, London.
6. Paul Browne – Auto care manual.
7. Redesign of bus bodies – Part 1 and Part 2 C. I. R. T., Pune.

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Classification of coachwork type: styling forms, coach and bus body style, layout of cars, buses and coach with different seating and loading capacity, commercial vehicle types, Vans and Pickups. Terms used in body building construction - Angle of approach, Angle of departure, Ground clearance, Cross bearers, Floor longitudes, posts, seat rail, waist rail, cant rail, Roof stick, Roof longitude, Rub rail, skirt rail, truss panel, wheel arch structure, wheel arch, post diagonals, gussets. Basic dimension: Regulations as per ARAI, driver's seat, passengers seat, visibility.	7	15%
II	Aerodynamics: Basics, Vehicle drag and types, Various types of forces and moments, effects of forces and moments, various body optimization techniques for minimum drag, Principle of wind tunnel technology, flow visualization techniques, tests with scale models, aerodynamic study for heavy vehicles Interior Ergonomics: Introduction, ergonomics system design, Seating dimensions ,seat comfort, suspension seats, split frame seating, back passion reducers, dash board instruments, electronic displays, commercial vehicle cabin ergonomics, mechanical package layout, goods vehicle layout.	7	15%

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FIRST INTERNAL EXAMINATION			
III	Vehicle Body Materials: Aluminium alloys, Steel, alloy steels, plastics, Metal matrix composites, structural timbers - properties, glass reinforced plastics and high strength composites, thermoplastics, ABS and styrenes, load bearing plastics, semi rigid PUR foams and sandwich panel construction. Paints adhesives and their properties, corrosion and their prevention	7	15%
IV	Load distribution: Type of body structures, Vehicle body stress analysis, vehicle weight distribution, Calculation for static, symmetrical, longitudinal & side loads, stress analysis of bus body structure under bending and torsion. Vehicle Stability: Introduction, Longitudinal, lateral stability, vehicle on a curvilinear path, critical speed for toppling and skidding. Effect of operating factors on lateral stability, steering geometry and stabilization of steerable wheels, mass distribution and engine location on stability	7	15%
SECOND INTERNAL EXAMINATION			
V	Noise and vibration: Noise characteristics, Sources of noise, noise level measurement techniques, Body structural vibrations, chassis bearing vibration, designing against fatigue, methods of noise suppression Safety: Impact protection basics, Physics of impact between deformable bodies, Design for crash worthiness, occupant and cargo restraint, passive restraint systems, side impact analysis, bumper system, energy absorbent foams, laws of mechanisms applied to safety.	7	20%
VI	Introduction to CFD technology, fluidic design considerations, effect of air dams on front bumpers, effect of projected accessories on body, wind tunnel testing of car body, parameters considered for wind tunnel testing, introduction to software simulation of car body structures. Visibility, regulations, drivers visibility, methods of improving visibility, Window winding and seat adjustment mechanisms	7	20%
END SEMESTER EXAM			

Question Paper Pattern

Maximum marks: 100 Time: 3 hours

The question paper shall consist of three parts

Part A
4 questions uniformly covering modules I and II. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part B
4 questions uniformly covering modules III and IV. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part C
6 questions uniformly covering modules V and VI. Each question carries 10 marks
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

Note: In all parts, each question can have a maximum of four sub questions, if needed

Course code	Course Name	L-T-P – Credits	Year of Introduction
AU364	VEHICLE PERFORMANCE AND TESTING	3-0-0-3	2016

Prerequisite : Nil

Course Objectives

- To provide knowledge about various Vehicle Performance Characteristics.

Syllabus

Laboratory testing, Dynamometers, Wheel balancing & Wheel alignment, NVH, Vehicle performance, fuel economy, road and track testing, corrosion testing, chassis dynamometers.

Expected outcome:

- The students will become aware of the various testing methods of automobiles and the various equipments used for the testing of vehicles.

Text Books:

1. J. G. Giles – Vehicle operation and performance, Wildlife Publications, London, 1969.
2. SAE Transaction papers – 831814, 820346, 820367, 820371, 820375

References

1. Dr. N.K.Giri- Automotive technology – Khanna publishers, 2009
2. W. H. Crouse and L. Anglin – Motor vehicle inspection, McGraw Hill Book Co. 1978.

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Laboratory testing: Basic engine parameters, Measurement of BHP, IHP- Engine testing on dynamometers, different types of dynamometers- hydraulic, eddy current etc.	7	15%
II	Engine analyzers- for petrol and diesel engines, FIP calibrating and testing, exhaust gas analyzers - various types- Orsat apparatus, infrared gas analyzers, smoke meter; Wheel alignment testing, Wheel balancing	7	15%
FIRST INTERNAL EXAMINATION			
III	Noise vibration and Harshness: Review of vibration fundamentals, vibration control, fundamentals of acoustics, human response to sound, automotive noise criteria, Standard noise measurement methods, Noise inside and outside the vehicle, sources of vehicle noise- intake and exhaust noise, combustion noise, mechanical noise, noise from auxiliaries, wind noises, transmission noises, brake squeal, structure noise, noise control methods.	7	15%
IV	Vehicle performance: Methods for evaluating vehicle performance- energy consumption in conventional automobiles, performance, emission and fuel economy, Operation of full load and part conditions, effect of vehicle condition, tyre and road condition and traffic condition and driving habits on fuel economy, CAFÉ standards.	7	15%
SECOND INTERNAL EXAMINATION			
V	Road and track testing: Initial inspection, PDI, Initial free services, engine running in and durability, intensive driving,	7	10%

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	maximum speed and acceleration, brake testing on the road, hill climbing, handling and ride characteristics, safety, mechanism of corrosion, three chamber corrosion testing, wind tunnel testing, road testing, test tracks.		
VI	Vehicle testing on chassis dynamometers: two wheel & four wheel dynamometers, vehicle testing lanes - side slip testers, brake testers, head light alignment testing	7	20%
END SEMESTER EXAM			

Question Paper Pattern

Maximum marks: 100 Time: 3 hours

The question paper shall consist of three parts

Part A
4 questions uniformly covering modules I and II. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part B
4 questions uniformly covering modules III and IV. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part C
6 questions uniformly covering modules V and VI. Each question carries 10 marks
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

Note: In all parts, each question can have a maximum of four sub questions, if needed

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Computer Science and Engineering

COURSE NO.	COURSE NAME	CREDITS	YEAR OF INTRODUCTION
MA 101	**CALCULUS**	**4**	**2016**

Course Objectives

In this course the students are introduced to some basic tools in Mathematics which are useful in modelling and analysing physical phenomena involving continuous changes of variables or parameters. The differential and integral calculus of functions of one or more variables and of vector functions taught in this course have applications across all branches of engineering. This course will also provide basic training in plotting and visualising graphs of functions and intuitively understanding their properties using appropriate software packages.

Syllabus

Single Variable Calculus and Infinite series, Functions of more than one variable, Partial derivatives and its applications, Calculus of vector valued functions, Multiple Integrals.

Expected outcome

At the end of the course the student will be able to (i) check convergence of infinite series (ii) find maxima and minima of functions two variables (iii) find area and volume using multiple integrals (iv) apply calculus of vector valued functions in physical applications and (v) visualize graphs and surfaces using software or otherwise.

Text Books

(1)Anton, Bivens, Davis: Calculus, John Wiley and Sons, 10thed

(2)Thomas Jr., G. B., Weir, M. D. and Hass, J. R., Thomas' Calculus, Pearson

References:

1. Sengar and Singh, Advanced Calculus, Cengage Learning, Ist Edition
2. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley India edition, 10thed.
3. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, New Delhi.
4. N. P. Bali, Manish Goyal, Engineering Mathematics, Lakshmy Publications
5. D. W. Jordan, P Smith. Mathematical Techniques, Oxford University Press, 4th

Edition. 6. A C Srivastava, P K Srivasthava, Engineering Mathematics Vol 1. PHI Learning Private Limited, New Delhi.

	COURSE NO: MA101	L-T-P:3-1-0	
	COURSE NAME: CALCULUS	CREDITS:4	
MODULE	CONTENT	HRS	END SEM. MARK %
I	**Single Variable Calculus and Infinite series** **(Book I –sec 9.3,9.5,9.6,9.8)** Basic ideas of infinite series and convergence - Geometric series- Harmonic series-Convergence tests-comparison, ratio, root tests (without proof). Alternating series- Leibnitz Test-Absolute convergence, Maclaurins series-Taylor series - radius of convergence. (For practice and submission as assignment only: Sketching, plotting and interpretation of hyperbolic functions using suitable software. Demonstration of convergence of series bysoftware packages)	9	15%
II	**Partial derivatives and its applications(Book I –sec. 13.3 to 13.5 and 13.8)** Partial derivatives–Partial derivatives of functions of more than two variables - higher order partial derivatives - differentiability, differentials and local linearity - The chain rule – Maxima and Minima of functions of two variables - extreme value theorem (without proof)-relative extrema .	5 4	15%

	FIRST INTERNAL EXAM		
III	**Calculus of vector valued functions(Book I-12.1,12.2,12.4&12.6,13.6 &13.7)** Introduction to vector valued functions-parametric curves in 3-space Limits and continuity – derivatives - tangent lines – derivative of dot and cross product-definite integrals of vector valued functions- unit tangent-normal- velocity-acceleration and speed–Normal and tangential components of acceleration. Directional derivatives and gradients-tangent planes and normal vectors (For practice and submission as assignment only: Graphing parametric curves and surfaces using software packages)	 3 3 3	15%
IV	**Multiple integrals** **(Book I-sec. 14.1, 14.2, 14.3, 14.5)** Double integrals- Evaluation of double integrals – Double integrals in non-rectangular coordinates- reversing the order of integration- Area calculated as a double integral- Triple integrals(Cartesian co ordinates only)- volume calculated as a triple integral- (applications of results only)	 4 2 2 2	15%
	SECOND INTERNAL EXAM		
	Topics in vector calculus **(Book I-15.1, 15.2, 15.3)** Vector and scalar fields- Gradient fields –	 2	

V	conservative fields and potential functions – divergence and curl - the ∇ operator - the Laplacian ∇^2, Line integrals - work as a line integral- independence of path-conservative vector field – (For practice and submission as assignment only: graphical representation of vector fields using software packages)	2 2 2 2	20%
VI	**Topics in vector calculus (continued)** **(Book I sec., 15.4, 15.5, 15.7, 15.8)** Green's Theorem (without proof- only for simply connected region in plane), surface integrals – Divergence Theorem (without proof for evaluating surface integrals) , Stokes' Theorem (without proof for evaluating line integrals) (All the above theorems are to be taught in regions in the rectangular co ordinate system only)	 2 2 3 3	20%
END SEMESTER EXAM			

Open source software packages such as gnuplot, maxima, scilab ,geogebra or R may be used as appropriate for practice and assignment problems.

TUTORIALS: Tutorials can be ideally conducted by dividing each class in to three groups. Prepare necessary materials from each module that are to be taught using computer. Use it uniformly to every class.

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Course No.	Course Name	L-T-P-Credits	Year of Introduction
PH100	**ENGINEERING PHYSICS**	**3-1-0-4**	**2016**

Course Objectives

Most of the engineering disciplines are rooted in Physics. In fact a good engineer is more or less an applied physicist. This course is designed to provide a bridge to the world of technology from the basics of science and to equip the students with skills in scientific inquiry, problem solving, and laboratory techniques.

Syllabus

Harmonic Oscillations: Damped and Forced Harmonic Oscillations. Waves: One Dimensional and Three Dimensional waves, Interference: Interference in thin films (Reflected system) Diffraction: Fraunhofer and Fresnel Diffraction, Grating, Polarization of Light: Double refraction, production and detection of polarized light, Superconductivity: Properties and Applications. Quantum Mechanics: Schrodinger Equations- Formulation and Solution, Operators, Applications. Statistical Mechanics: Microstates and macro states Maxwell - Boltzmann, Bose-Einstein and Fermi Dirac statistics. Fermi level and its significance. Acoustics: Intensity of sound, Reverberation and design concepts, Ultrasonics: Production, Detection and Applications, NDT methods, Lasers: Properties, Working Principles, Practical Lasers. Photonics: Basics of Solid State lighting, Photo detectors, Solar Cells, Fiber Optics.

Expected outcome

Familiarity with the principles of Physics and its significance in engineering systems and technological advances.

References:

- Aruldhas, G., Engineering Physics, PHI Ltd.
- Beiser, A., Concepts of Modern Physics, McGraw Hill India Ltd.
- Bhattacharya and Tandon, Engineering Physics , Oxford India
- Brijlal and Subramanyam, A Text Book of Optics, S. Chand & Co.
- Dominic and Nahari, A Text Book of Engineering Physics, Owl Books Publishers
- Hecht, E., Optics, Pearson Education
- Mehta, N., Applied Physics for Engineers, PHI Ltd
- Palais, J. C., Fiber Optic Communications, Pearson Education
- Pandey, B. K. and Chathurvedi, S., Engineering Physics, Cengage Learning
- Philip, J., A Text Book of Engineering Physics, Educational Publishers
- Premlet, B., Engineering Physics, Mc GrawHill India Ltd
- Sarin, A. and Rewal, A., Engineering Physics, Wiley India Pvt Ltd
- Sears and Zemansky, University Physics , Pearson
- Vasudeva, A. S., A Text Book of Engineering Physics, S. Chand & Co

Web:

www.physics.org

www.howstuffworks.com
www.physics.about.com

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Harmonic Oscillations: Differential equation of damped harmonic oscillation, forced harmonic oscillation and their solutions- Resonance, Q factor, Sharpness of resonance- LCR circuit as an electrical analogue of Mechanical Oscillator (Qualitative)	5	15%
	Waves: One dimensional wave - differential equation and solution. Three dimensional waves - Differential equation & its solution. (No derivation) Transverse vibrations of a stretched string.	4	
II	Interference: Coherence. Interference in thin films and wedge shaped films (Reflected system) Newton's rings-measurement of wavelength and refractive index of liquid Interference filters. Antireflection coating.	5	15%
	Diffraction Fresnel and Fraunhofer diffraction. Fraunhofer diffraction at a single slit. Plane transmission grating. Grating equation - measurment of wavelength. Rayleigh's criterion for resolution of grating- Resolving power and dispersive power of grating.	4	
FIRST INTERNAL EXAM			
III	Polarization of Light: Types of polarized light. Double refraction. Nicol Prism. Quarter wave plate and half wave plate. Production and detection of circularly and elliptically polarized light. Induced birefringence- Kerr Cell - Polaroid & applications.	4	15%
	Superconductivity: Superconducting phenomena. Meissner effect. Type-I and Type-II superconductors. BCS theory (qualitative). High temperature superconductors - Applications of superconductors.	5	
IV	Quantum Mechanics: Uncertainty principle and its applications- formulation of Time dependent and Time independent Schrödinger equations- physical meaning of wave function- Energy and momentum Operators-Eigen values and functions- One dimensional infinite square well potential .Quantum mechanical Tunnelling (Qualitative)	6	15%
	Statistical Mechanics: Macrostates and Microstates. Phase space. Basic postulates of Maxwell- Boltzmann, Bose-Einstein and Fermi Dirac	3	

	statistics. Distribution equations in the three cases (no derivation). Fermi Level and its significance.		
SECOND INTERNAL EXAM			
V	Acoustics: Intensity of sound- Loudness-Absorption coefficient - Reverberation and reverberation time- Significance of reverberation time- Sabine's formula (No derivation) -Factors affecting acoustics of a building.	3	
	Ultrasonics: Production of ultrasonic waves - Magnetostriction effect and Piezoelectric effect - Magnetostriction oscillator and Piezoelectric oscillator - Detection of ultrasonics - Thermal and piezoelectric methods-Applications of ultrasonics - NDT and medical.	4	20%
VI	Laser: Properties of Lasers, absorption, spontaneous and stimulated emissions, Population inversion, Einstein's coefficients, Working principle of laser,Optial resonant cavity. Ruby Laser, Helium-Neon Laser, Semiconductor Laser (qualitative). Applications of laser, holography (Recording and reconstruction)	5	
	Photonics: Basics of solid state lighting - LED – Photodetectors - photo voltaic cell, junction & avalanche photo diodes, photo transistors, thermal detectors, Solar cells- I-V characteristics - Optic fibre-Principle of propagation-numerical aperture-optic communication system (block diagram) - Industrial, medical and technological applications of optical fibre. Fibre optic sensors - Basics of Intensity modulated and phase modulated sensors.	5	20%
END SEMESTER EXAM			

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Course No.	Course Name	L-T-P Credits	Year of Introduction
EE100	**BASICS OF ELECTRICAL ENGINEERING**	**2-1-0-3**	**2016**

Course Objectives

To impart a basic knowledge in Electrical Engineering with an understanding of fundamental concepts.

Syllabus

Elementary concepts of electric circuits, Kirchhoff's laws, constant voltage and current sources, Matrix representation; Magnetic circuits, energy stored in magnetic circuits, Electromagnetic induction, Alternating current fundamentals; AC circuits, phasor representation of alternating quantities- rectangular, polar; Three phase systems, star and delta connection; Generation of power, power transmission and distribution; Transformers, Electric Machines-DC Machines, AC Motors.

Expected outcome

The course will enable the students to gain preliminary knowledge in basic concepts of Electrical Engineering.

References Books:

- Bhattacharya, S. K., Basic Electrical & Electronics Engineering, Pearson
- Bird, J., Electrical Circuit Theory and Technology, Routledge, Taylor & Francis Group
- Del Toro,V.,Electrical Engineering Fundamentals, Prentice Hall of India.
- Hayt, W. H., Kemmerly, J. E., and Durbin, S. M., Engineering Circuit Analysis, Tata McGraw Hill
- Hughes, Electrical and Electronic Technology, Pearson Education
- Mehta, V.K. and Mehta,R., Basic Electrical Engineering, S. Chand Publishing
- Parker and Smith, Problems in Electrical Engineering, CBS Publishers and Distributors
- Sudhakar and Syam Mohan, Circuits and Networks Analysis and Synthesis, Tata McGraw Hill
- Suresh Kumar, K. S, Electric Circuits and Networks, Pearson Education

Course Plan

Module	Contents	Hours	Sem. Exam. Marks
I	Elementary concepts of electric circuits: Kirchhoff's laws, constant voltage and current sources-Problems	**2**	**15%**
	Formation of network equations by mesh current and node voltage methods-matrix representation-solution of network equations by matrix methods-problems	**3**	
	star-delta conversion(resistive networks only-derivation is not needed)-problems	**1**	

II	Magnetic Circuits: MMF, field strength, flux density, reluctance(definition only)-comparison between electric and magnetic circuits	2	15%
	Energy stored in magnetic circuits, magnetic circuits with air gap-Numerical problems on series magnetic circuits	2	
	Electromagnetic Induction: Faraday's laws, lenz's laws- statically induced and dynamically induced emfs-self inductance and mutual inductance, coefficient of coupling (derivation not needed)	2	
FIRST INTERNAL EXAMINATION			
III	Alternating Current fundamentals: Generation of alternating voltages-waveforms, frequency, period, average , RMS values and form factor of periodic waveform(pure sinusoidal)-Numerical Problems	2	15%
	AC Circuits: Phasor representation of alternating quantities-rectangular and polar representation	1	
	Analysis of simple AC circuits: concept of impedance, power and power factor in ac circuits-active, reactive and apparent power	2	
	solution of RL,RC and RLC series circuits-Numerical problems	2	
	Three phase systems: Generation of three phase voltages-advantages of three phase systems, star and delta connection (balanced only), relation between line and phase voltages, line and phase currents	3	
	three phase power measurement by two wattmeter method (derivation is not required) - Numerical problems	1	
IV	Generation of power: Block schematic representation of generating stations- hydroelectric power plants	1	15%
	Block schematic representation of Thermal and nuclear power plants	1	
	Renewable energy sources: solar, wind, tidal and geothermal (Block diagram and working only- No Problems)	1	
	Power transmission: Typical electrical power transmission scheme-need for high voltage transmission-(Derivation is not needed, No Problems)	1	
	Power Distribution: substation equipments, primary and secondary transmission and distribution systems- feeder, service	1	

	mains		
SECOND INTERNAL EXAMINATION			
V	Electric Machines: DC Generator and Motor-Construction-working principle- Back EMF	**2**	**20%**
	Types of motor-shunt, series, compound (short and long)- principle of operation of dc motor, applications-numerical problems (voltage -current relations only)	**3**	
	Transformer: Construction of single phase and three phase Transformers (core type only)-EMF equation and related numerical problems	**2**	
	Losses and efficiency of transformer for full load –numerical problems (no equivalent circuit)	**2**	
VI	AC Motors: Three phase induction motor-squirrel cage and slip ring induction motor	**1**	**20%**
	Working principle-synchronous speed, slip and related numerical problems. (no equivalent circuit)	**1**	
	AC Motors: Construction, principles of operation of single phase induction motor (no equivalent circuit)	**1**	
	Starting methods in single phase induction motors -split phase and capacitor start	**2**	
END SEMESTER EXAMINATION			

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Course No:	Course Name	L-T-P Credits	Year of Introduction
EC100	**BASICS OF ELECTRONICS ENGINEERING**	2-1-0-3	2016

Course Objectives

1) To get basic idea about types, specification and common values of passive and active components.
2) To familiarize the working of diodes, transistors, MOSFETS and integrated circuits.
3) To understand the working of rectifiers, amplifiers and oscillators.
4) To get a basic idea about measuring instruments
5) To get a fundamental idea of basic communication systems and entertainment electronics

Syllabus

Evolution and Impact of Electronics in industries and in society, Familiarization of Resistors, Capacitors, Inductors, Transformers and Electro mechanical components, PN Junction diode: Structure, Principle of operation, Zener diode, Photo diode, LED, Solar cell, Bipolar Junction Transistors: Structure, Principle of operation, characteristics, Rectifiers and power supplies: Half wave and full wave rectifier, capacitor filter, zener voltage regulator, Amplifiers and Oscillators: common emitter amplifier, feedback, oscillators, RC phase shift oscillator, Analogue Integrated circuits: operational amplifier, inverting and non-inverting amplifier, Electronic Instrumentation: digital multimeter, digital storage oscilloscope, function generator, Radio communication: principle of AM & FM, Super heterodyne receiver, Satellite communication: geo-stationary satellite system, Mobile communication: cellular communications, Optical communication: system, principle of light transmission through fiber, Entertainment Electronics: Cable TV, CCTV system.

Expected Outcome

Student can identify the active and passive electronic components. Student can setup simple circuits using diodes and transistors. Student will get fundamental idea about basic communication systems and entertainment electronics.

Text Books:

- Bell, D. A., Electronic Devices and Circuits, Oxford University Press
- Tomasy, W., Advanced Electronic Communication system, PHI Publishers

References Books

- Boylested, R. L. and Nashelsky, L., Electronic Devices and Circuit Theory, Pearson Education
- Frenzel, L. E., Principles of Electronic Communication Systems, Mc Graw Hill
- Kennedy, G. and Davis, B., Electronic Communication Systems, Mc Graw Hill

- Rajendra Prasad, Fundamentals of Electronic Engineering, Cengage Learning

Course Plan

Module	Contents	Hours	Sem. Marks
I	Evolution of Electronics, Impact of Electronics in industry and in society.	1	10%
	Resistors, Capacitors: types, specifications. Standard values, marking, colour coding.	3	
	Inductors and Transformers: types, specifications, Principle of working.	2	
	Electro mechanical components: relays and contactors.	1	
II	PN Junction diode: Intrinsic and extrinsic semiconductors, Principle of operation, V-I characteristics, principle of working of Zener diode, Photo diode, LED and Solar cell.	4	20%
	Bipolar Junction Transistors: PNP and NPN structures, Principle of operation, input and output characteristics of common emitter configuration (npn only).	3	
FIRST INTERNAL EXAM			
III	Rectifiers and power supplies: Block diagram description of a dc power supply ,Half wave and full wave (including bridge) rectifier, capacitor filter, working of simple zener voltage regulator.	4	15%
	Amplifiers and Oscillators: Circuit diagram and working of common emitter amplifier, Block diagram of Public Address system, concepts of feedback, working principles of oscillators, circuit diagram & working of RC phase shift oscillator.	4	
IV	Analogue Integrated circuits: Functional block diagram of operational amplifier, ideal operational amplifier, inverting and non-inverting Amplifier.	3	15%
	Digital ICs: Logic Gates.	1	
	Electronic Instrumentation: Principle and block diagram of digital multimeter, digital storage	2	

	oscilloscope, and function generator.		
SECOND INTERNAL EXAM			
V	Radio communication: principle of AM & FM, frequency bands used for various communication systems, block diagram of super heterodyne receiver.	3	20%
	Satellite communication: concept of geo-stationary Satellite system.	2	
VI	Mobile communication: basic principles of cellular communications, concepts of cells, frequency reuse.	2	20%
	Optical communication: block diagram of the optical communication system, principle of light transmission through fiber, advantages of optical communication systems.	2	
	Entertainment Electronics Technology: Basic principles and block diagram of cable TV, CCTV, DTH system.	2	
END SEMESTER EXAM			

Note: Analysis is not required in this course.

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Pampady, Thiruvilwamala, Thrissur Dt
Pin 680 597 Kerala

Course No.	Course Name	L-T-P-Credits	Year of Introduction
BE100	ENGINEERING MECHANICS	3-1-0-4	2016

Course Objectives

1. To apply the principles of mechanics to practical engineering problems.
2. To identify appropriate structural system for studying a given problem and isolate it from its environment.
3. To develop simple mathematical model for engineering problems and carry out static analysis.
4. To carry out kinematic and kinetic analyses for particles and systems of particles.

Syllabus

Statics: Fundamental concepts and laws of mechanics; Force systems; Principle of moments; Resultant of force and couple systems; Equilibrium of rigid body; Free body diagram; Equilibrium of a rigid body in three dimension; Support reactions; Properties of surfaces and solids - Centroid, Moment of inertia, Polar moment of inertia, Mass moment of inertia, Product of inertia and Principal moment of inertia; Theorems of Pappus – Guldinus; Friction; Principle of virtual work.

Dynamics: Rectangular and cylindrical coordinate system; Combined motion of rotation and translation; Newton's second law in rectilinear translation; D' Alembert's principle; Mechanical vibration; Simple harmonic motion; Spring-mass model.

Expected outcome

1. Students will be able to apply and demonstrate the concepts of mechanics to practical engineering problems.
2. Students will be able to determine the properties of planes and solids.
3. Students will be able to apply fundamental concepts of dynamics to practical problems.

Text Books:

- Shames, I. H., Engineering Mechanics - Statics and Dynamics, Pearson Prentice
- Timoshenko, S. & Young D. H., Engineering Mechanics, McGraw Hill

References Books:

- Babu, J., Engineering Mechanics, Pearson Prentice Hall
- Beer and Johnson, Vector Mechanics for Engineers - Statics and Dynamics, Tata McGraw Hill Publishing Company Limited
- Benjamin J., Engineering Mechanics, Pentex Book Publishers and Distributors
- Bhavikkatti, S. S., Engineering Mechanics, New Age International Publishers
- Hibbeler, R. C., Engineering Mechanics: Statics and Dynamics. Pearson Prentice Hall
- Kumar, K. L., Engineering Mechanics, Tata McGraw Hill Publishing Company Limited
- Merriam J. L. and Kraige L. G., Engineering Mechanics – Vol. I and II, John Wiley
- Rajasekaran S. and Sankarasubramanian, G., Engineering Mechanics, Vikas Publishing House Private Limited
- Tayal, A. K., Engineering Mechanics- Statics and Dynamics, Umesh Publications

Course Plan			
Module	**Contents**	**Hours**	**Sem. Exam Marks**
I	Statics: Fundamental concepts and laws of mechanics – Rigid body – Principle of transmissibility of forces	2	15%
	Coplanar force systems - Moment of a force – Principle of moments	2	
	Resultant of force and couple system	4	
	Equilibrium of rigid body – Free body diagram – Conditions of equilibrium in two dimensions – Two force and three force members.	3	
II	Types of supports – Problems involving point loads and uniformly distributed loads only.	5	15%
	Force systems in space – Degrees of freedom – Free body diagram – Equations of equilibrium – Simple resultant and Equilibrium problems.	4	
FIRST INTERNAL EXAM			
III	Properties of planar surfaces – Centroid and second moment of area (Derivations not required) - Parallel and perpendicular axis theorem – Centroid and Moment of Inertia of composite area.	3	15%
	Polar Moment of Inertia – Radius of gyration – Mass moment of inertia of cylinder and thin disc (No derivations required).	2	
	Product of inertia – Principal Moment of Inertia (conceptual level).	3	
	Theorems of Pappus and Guldinus.	1	
IV	Friction – Characteristics of dry friction – Problems involving friction of ladder, wedges and connected bodies.	6	15%
	Definition of work and virtual work – Principle of virtual work for a system of connection bodies – Problems on determinate beams only.	4	
SECOND INTERNAL EXAM			
V	Dynamics: Rectangular and Cylindrical co-ordinate system	1	20%
	Combined motion of rotation and translation – Concept of instantaneous centre – Motion of connecting rod of piston and crank of a reciprocating pump.	4	
	Rectilinear translation – Newton's second law – D'Alembert's Principle – Application to connected bodies (Problems on motion of lift only).	4	
VI	Mechanical vibrations – Free and forced vibration - Degree of freedom.	1	20%
	Simple harmonic motion – Spring-mass model – Period – Stiffness – Frequency – Simple numerical problems of single degree of freedom.	7	
END SEMESTER EXAM			

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Course No:	Course Name	L-T-P Credits	Year of Introduction
BE110	*ENGINEERING GRAPHICS	1-1-3-3	2016

*As this course is practical oriented. the evaluation is different from other lecture based courses.

Points to note:

(1) End semester examination will be for 50 marks and of **3 hour** duration.

(2) End semester exam will include all modules except Module IV.

(3) 100 marks are allotted for internal evaluation: first internal exam 40 marks, second internal exam 40 marks(CAD Lab Practice) and class exercises 20 marks.

(4) The first internal exam will be based on modules I and II and the second internal exam will be a practical exam in CAD based on Module IV alone. Second internal exam may be conducted at the end of the semester.

Course Objectives

To enable the student to effectively communicate basic designs through graphical representations as per standards.

Syllabus

Introduction to Engineering Graphics; Orthographic projections of lines and solids, Isometric projection, Freehand sketching, Introduction to CAD, Sections of solids, Development of surfaces, Perspective projection.

Expected outcome

Upon successful completion of this course, the student would have accomplished the following abilities and skills:

1. Fundamental Engineering Drawing Standards.
2. Dimensioning and preparation of neat drawings and drawing sheets.
3. Interpretation of engineering drawings
4. The features of CAD software

References Books:

- Agrawal, B. and Agrawal, C. M., Engineering Drawing, Tata McGraw Hill Publishers
- Anilkumar, K. N., Engineering Graphics, Adhyuth Narayan Publishers
- Benjamin, J., Engineering Graphics, Pentex Publishers
- Bhatt, N., D., Engineering Drawing, Charotar Publishing House Pvt Ltd.
- Duff, J. M. and Ross, W. A., Engineering Design and Visualization, Cengage Learning, 2009
- John, K. C., Engineering Graphics, Prentice Hall India Publishers
- Kirstie Plantenberg, Engineering Graphics Essentials with AutoCAD 2016 Instruction, 4^{th} Ed., SDC Publications
- Kulkarni, D. M., Rastogi, A. P. and Sarkar, A. K., Engineering Graphics with AutoCAD, PHI 2009
- Luzadder, W. J. and Duff, J. M., Fundamentals of Engineering Drawing, PHI 1993
- Parthasarathy, N. S., and Murali, V., Engineering Drawing, Oxford University Press
- Varghese, P. I., Engineering Graphics, V I P Publishers
- Venugopal, K., Engineering Drawing & Graphics, New Age International Publishers

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	6 exercises Introduction to Engineering Graphics: Need for engineering drawing. Drawing instruments; BIS code of practice for general engineering drawing. Orthographic projections of points and lines:-Projections of points in different quadrants; Projections of straight lines inclined to one of the reference planes, straight lines inclined to both the planes; True length and inclination of lines with reference planes; Traces of lines.	14	20%

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II	12 exercises Orthographic projections of solids:-Projections of simple solids* in simple positions, projections of solids with axis inclined to one of the reference planes and axis inclined to both the reference planes.	11	20%
FIRST INTERNAL EXAM			
III	12 exercises Isometric Projections:-Isometric projections and views of plane figures simple* and truncated simple* solids in simple position including sphere and hemisphere and their combinations. Freehand sketching: Freehand sketching of real objects, conversion of pictorial views into orthographic views and vice versa.	09	20%
IV	6 exercises Introduction to Computer Aided Drafting - familiarizing various coordinate systems and commands used in any standard drafting software - drawing of lines, circle, polygon, arc, ellipse, etc. Creating 2D drawings. Transformations: move, copy, rotate, scale, mirror, offset and array, trim, extend, fillet, chamfer. Dimensioning and text editing. Exercises on basic drafting principles, to create technical drawings. Creation of orthographic views of simple solids from pictorial views. Creation of isometric views of simple solids from orthographic views. Solid modelling and sectioning of solids, extraction of 2D drawings from solid models. (For internal examination only, not for University Examination).	15 (Additional hours are allotted in U slot for CAD practice)	Internal
SECOND INTERNAL EXAM (**to be conducted only after finishing CAD Practice.**)			
V	9 exercises Sections and developments of solids: - Sections of simple* solids in simple vertical positions with section plane inclined to one of the reference planes - True shapes of sections. Developments of surfaces of these solids.	12	20%

VI	6 exercises Intersection of surfaces: - Intersection of prism in prism and cylinder in cylinder - axis bisecting at right angles only. Perspective projections: - perspective projections of simple* solids.	09	20%
*Triangular, square, pentagonal and hexagonal prisms, pyramids, cones and cylinders.			
END SEMESTER EXAM			

Note:

1. First angle projection is to be followed.
2. CAD Practice is mandatory and shall be conducted in the time slot allotted for U slot in addition to 15 hours allotted for Module IV

Question Paper Pattern: Question Paper shall contain **eight** questions of 10 marks each out of which **five** questions are to be answered as explained below. **The duration of examination is 3 hours.**

Part A: **Three** questions from Modules I & II out of which **two** are to be answered.
Part B: **Five** questions from Modules III, V & VI out of which **three** are to be answered.
The questions are to be answered in A4 size booklet containing grid/plain sheets supplied by the university. Drawing sheets are not needed.
The evaluation of answers shall be based on the correctness of solution, judging the knowledge of student in concepts and principles of Engineering Graphics. Accuracy and neatness shall not be criteria for evaluation.

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Course No.	Course Name	L-T-P-Credits	Year of Introduction
BE102	DESIGN AND ENGINEERING	2-0-2-3	2016

Course Objectives

The purpose of this course is:-

1. To excite the student on creative design and its significance;
2. To make the student aware of the processes involved in design;
3. To make the student understand the interesting interaction of various segments of humanities, sciences and engineering in the evolution of a design;
4. To get an exposure as to how to engineer a design.

Syllabus

Design and its objectives; Role of science, engineering and technology in design; Engineering as a business proposition; Creative design and the Design Process; Design evaluation and communication of designs; Design for function and strength; Material selection and design detailing; Role of standards in design Engineering the design; Design for "X"; Product centered and user centered design; Aesthetics and ergonomics; Concepts of value engineering, concurrent engineering and reverse engineering in design; Culture based design; Modular design; Design optimization needs; User interface; Intelligent and autonomous products; Internet of things; Advanced products and human psychology; Life cycle design; Product and its environment; Design as a marketing tool; Products and IPR; Product liability.

Expected outcome

The student will be:-

- Able to appreciate the different elements involved in good designs and to apply them in practice when called for.
- Aware of the product oriented and user oriented aspects that make the design a success.
- Will be capable to think of innovative designs incorporating different segments of knowledge gained in the course;
- Students will have a broader perspective of design covering function, cost, environmental sensitivity, safety and other factors other than engineering analysis.

References Books:

- Balmer, R. T., Keat, W. D., Wise, G., and Kosky, P., Exploring Engineering, Third Edition: An Introduction to Engineering and Design - [Part 3 - Chapters 17 to 27], ISBN-13: 978-0124158917 ISBN-10: 0124158919
- Dym, C. L., Little, P. and Orwin, E. J., Engineering Design - A Project based introduction - Wiley, ISBN-978-1-118-32458-5
- Eastman, C. M. (Ed.), Design for X Concurrent engineering imperatives, 1996, XI, 489 p. ISBN 978-94-011-3985-4 Springer
- Haik, Y. And Shahin, M. T., Engineering Design Process, Cengage Learning, ISBN-13: 978-0-495-66816-9
- Pahl, G., Beitz, W., Feldhusen, J. and Grote, K. H., Engineering Design: A Systematic Approach, 3rd ed. 2007, XXI, 617p., ISBN 978-1-84628-319-2
- Dieter and Schmidt, Engineering Design, McGraw Hill Education(India) Edition 2013

- Voland, G., Engineering by Design, ISBN 978-93-325-3505-3, Pearson India

Web pages:

1. E-Book (Free download): http://opim.wharton.upenn.edu/~ulrich/designbook.html
2. http://www2.warwick.ac.uk/fac/sci/wmg/ftmsc/modules/modulelist/peuss/designforx/design_for_x_notes_section_5.pdf

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Design and its objectives; Design constraints, Design functions, Design means and Design from; Role of Science, Engineering and Technology in design; Engineering as a business proposition; Functional and Strength Designs. Design form, function and strength;	L2	15%
	How to initiate creative designs? Initiating the thinking process for designing a product of daily use. Need identification; Problem Statement; Market survey-customer requirements; Design attributes and objectives; Ideation; Brain storming approaches; arriving at solutions; Closing on to the Design needs.	L3	
	An Exercise in the process of design initiation. A simple problem is to be taken up to examine different solutions-Ceiling fan? Group Presentation and discussion.	P4	
II	Design process- Different stages in design and their significance; Defining the design space; Analogies and "thinking outside of the box"; Quality function deployment-meeting what the customer wants; Evaluation and choosing of a design.	L2	15%
	Design Communication; Realization of the concept into a configuration, drawing and model. Concept of "Complex is Simple". Design for function and strength. Design detailing- Material selection, Design visualisation- Solid modelling; Detailed 2D drawings; Tolerancing; Use of standard items in design; Research needs in design; Energy needs of the design, both in its realization and in the applications.	L3	
	An exercise in the detailed design of two products (Stapler/ door/clock)	P4	
FIRST INTERNAL EXAM			
III	Prototyping- rapid prototyping; testing and evaluation of design; Design modifications; Freezing the design; Cost analysis.	L2	15%
	Engineering the design – From prototype to product. Planning; Scheduling; Supply chains; inventory; handling;	L3	

	manufacturing/construction operations; storage; packaging; shipping; marketing; feed-back on design.		
	List out the standards organizations. Prepare a list of standard items used in any engineering specialization. Develop any design with over 50% standard items as parts.	P4	
IV	Design for "X"; covering quality, reliability, safety, manufacturing/construction, assembly, maintenance, logistics, handling; disassembly; recycling; re-engineering etc. List out the design requirements(x) for designing a rocket shell of 3 meter diameter and 8 meter length.	L4	15%
	Design mineral water bottles that could be packed compactly for transportation.	P4	
SECOND INTERNAL EXAM			
V	Product centred and user centred design. Product centred attributes and user centred attributes. Bringing the two closer. Example: Smart phone. Aesthetics and ergonomics.	L2	20%
	Value engineering, Concurrent engineering, Reverse engineering in design; Culture based design; Architectural designs; Motifs and cultural background; Tradition and design; Study the evolution of Wet grinders; Printed motifs; Role of colours in design.	L4	
	Make sharp corners and change them to smooth curves-check the acceptance. Examine the possibility of value addition for an existing product.	P6	
VI	Modular design; Design optimization; Intelligent and autonomous products; User interfaces; communication between products; autonomous products; internet of things; human psychology and the advanced products. Design as a marketing tool; Intellectual Property rights – Trade secret; patent; copy-right; trademarks; product liability.	L3	20%
	Group presentation of any such products covering all aspects that could make or mar it.	P6	
END SEMESTER EXAM			

Evaluation Scheme:

First internal exam – closed book exam – 25 marks

Second internal exam – open book exam – 25 marks

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Assignment/projects – 50 marks (iv) End semester exam – open book exam – 50 marks (2 hours duration – conducted by the University)

First Test: Marks: 25 Closed Book;

Questions may cover:-

Topics covered in the lectures.

How to arrive at the design details for a specific need gap given.

Sketching the design of a product that is to meet the given user requirements.

Second Test: Marks: 25 Open Book:

Students are permitted to bring in class notes, own notes, text books and other books (Maximum 3/4 books) for the test. Access to internet and mobile phones is NOT permitted.

Assignments: Marks: 20 Two assignments are to be given (10 marks each). These assignments are to cover specific design/s, sketching of the design, and a short but well written write-up on the design.

Projects: Marks: 30 Two mini projects are to be assigned. One is to be a group project and the other an individual one. A group of 3 or 4 students can take up the group project. Each project is to be evaluated for 15 marks.

The Group Project is to be done in the practical hours given for the course. Projects including the group projects are to be evaluated based on individual presentations and answers to the questions raised. These presentations could be done during the practical hours.

Question Paper Pattern for End Semester Examination (Open Book)

Part A – Eight questions of each 5 marks, out of which **six** questions are to be answered.

Part B – Three questions of each 10 marks, out of which **two** questions are to be answered.

Course No.	Course Name	L-T-P-Credits	Year of Introduction
CS100	Computer Programming	2-1-0	2016

Course Objectives

To understand the fundamental concept of C programming and use it in problem solving.

Syllabus

Introduction to C language; Operators and expressions; Sorting and searching; Pointers; Memory allocation; Stacks and Queues.

Course Outcomes

1. Identify appropriate C language constructs to solve problems.
2. Analyze problems, identify subtasks and implement them as functions/procedures.
3. Implement algorithms using efficient C-programming techniques.
4. Explain the concept of file system for handling data storage and apply it for solving problems
5. Apply sorting & searching techniques to solve application programs.

References

1. Rajaraman V., Computer Basics and Programming in C, PHI.
2. Anita Goel and Ajay Mittal, Computer fundamentals and Programming in C., Pearson.
3. Gottfried B.S., Programming with C, Schaum Series, Tata McGraw Hill.
4. Horowitz and Sahni, Fundamentals of data structures - Computer Science Press.
5. Gary J. Bronson, ANSI C Programming, CENGAGE Learning India.
6. Stewart Venit and Elizabeth Drake, Prelude to Programming – Concepts & Design, Pearson.
7. Dromy R.G., How to Solve it by Computer, Pearson.
8. Kernighan and Ritche D.M., The C. Programming Language, PHI.

COURSE PLAN

Module	Contents	Contact Hours	Sem.ExamMarks;%
1	Introduction to C Language: Preprocessor directives, header files, data types and qualifiers. Operators and expressions. Data input and output, control statements.	7	15%

II	Arrays and strings- example programs. Two dimensional arrays - matrix operations. Structure, union and enumerated data type.	8	15%
III	Pointers: Array of pointers, structures and pointers. Example programs using pointers and structures.	7	15%
FIRST INTERNAL EXAM			
IV	Functions – function definition and function prototype. Function call by value and call by reference. Pointer to a function –. Recursive functions.	7	15%
SECOND INTERNAL EXAM			
V	Sorting and Searching : Bubble sort, Selection sort, Linear Search and Binary search. Scope rules Storage classes. Bit-wise operations.	6	20%
VI	Data files – formatted, unformatted and text files. Command line arguments – examples.	7	20%
END SEMESTER EXAM			

Course code	Course Name	L-T-P Credits	Year of Introduction
CS201	**DISCRETE COMPUTATIONAL STRUCTURES**	**3-1-0-4**	**2016**

Pre-requisite: NIL

Course Objectives

1. To introduce mathematical notations and concepts in discrete mathematics that is essential for computing.
2. To train on mathematical reasoning and proof strategies.
3. To cultivate analytical thinking and creative problem solving skills.

Syllabus

Review of Set theory, Countable and uncountable Sets, Review of Permutations and combinations, Pigeon Hole Principle, Recurrence Relations and Solutions, Algebraic systems (semigroups, monoids, groups, rings, fields), Posets and Lattices, Prepositional and Predicate Calculus, Proof Techniques.

Expected Outcome:

Students will be able to

1. identify and apply operations on discrete structures such as sets, relations and functions in different areas of computing.
2. verify the validity of an argument using propositional and predicate logic.
3. construct proofs using direct proof, proof by contraposition, proof by contradiction and proof by cases, and by mathematical induction.
4. solve problems using algebraic structures.
5. solve problems using counting techniques and combinatorics.
6. apply recurrence relations to solve problems in different domains.

Text Books

1. Trembly J.P and Manohar R, "Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw–Hill Pub.Co.Ltd, New Delhi, 2003.
2. Ralph. P. Grimaldi, "Discrete and Combinatorial Mathematics: An Applied Introduction", 4/e, Pearson Education Asia, Delhi, 2002.

References:

1. Liu C. L., "Elements of Discrete Mathematics", 2/e, McGraw–Hill Int. editions, 1988.
2. Bernard Kolman, Robert C. Busby, Sharan Cutler Ross, "Discrete Mathematical Structures", Pearson Education Pvt Ltd., New Delhi, 2003
3. Kenneth H.Rosen, "Discrete Mathematics and its Applications", 5/e, Tata McGraw – Hill Pub. Co. Ltd., New Delhi, 2003.
4. Richard Johnsonbaugh, "Discrete Mathematics", 5/e, Pearson Education Asia, New Delhi, 2002.
5. Joe L Mott, Abraham Kandel, Theodore P Baker, "Discrete Mathematics for Computer Scientists and Mathematicians", 2/e, Prentice-Hall India, 2009.

Course Plan			
Module	**Contents**	**Hours (54)**	**End Sem Exam Marks**
I	**Review of elementary set theory** : Algebra of sets – Ordered pairs and Cartesian products – Countable and Uncountable sets **Relations** :- Relations on sets –Types of relations and their properties – Relational matrix and the graph of a relation – Partitions – Equivalence relations - Partial ordering- Posets – Hasse diagrams - Meet and Join – Infimum and Supremum ***Functions*** :- *Injective, Surjective and Bijective functions - Inverse of a function- Composition*	3 6 1	15 %
II	Review of Permutations and combinations, Principle of inclusion exclusion, Pigeon Hole Principle, **Recurrence Relations**: Introduction- Linear recurrence relations with constant coefficients– Homogeneous solutions – Particular solutions – Total solutions **Algebraic systems**:- Semigroups and monoids - Homomorphism, Subsemigroups and submonoids	3 4 2	15 %
FIRST INTERNAL EXAM			
III	**Algebraic systems (contd...)**:- Groups, definition and elementary properties, subgroups, Homomorphism and Isomorphism, Generators - Cyclic Groups, Cosets and Lagrange's Theorem Algebraic systems with two binary operations- rings, fields-sub rings, ring homomorphism	6 2	15 %
IV	**Lattices and Boolean algebra** :- Lattices –Sublattices – Complete lattices – Bounded Lattices - Complemented Lattices – Distributive Lattices – Lattice Homomorphisms. Boolean algebra – sub algebra, direct product and homomorphisms	7 3	15 %
SECOND INTERNAL EXAM			
V	**Propositional Logic**:- Propositions – Logical connectives – Truth tables Tautologies and contradictions – Contra positive – Logical	2 3	20 %

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	equivalences and implications Rules of inference: Validity of arguments.	3	
VI	**Predicate Logic**:- Predicates – Variables – Free and bound variables – Universal and Existential Quantifiers – Universe of discourse. Logical equivalences and implications for quantified statements – Theory of inference : Validity of arguments. **Proof techniques:** Mathematical induction and its variants – Proof by Contradiction – Proof by Counter Example – Proof by Contra positive.	3 3 3	20 %
END SEMESTER EXAM			

Question Paper Pattern:

1. There will be *five* parts in the question paper – A, B, C, D, E
2. Part A
   a. Total marks : 12
   b. *Four* questions each having *3* marks, uniformly covering module I and II; All *four* questions have to be answered.
3. Part B
   a. Total marks : 18
   b. *Three* questions each having *9* marks, uniformly covering module I and II; T*wo* questions have to be answered. Each question can have a maximum of three subparts
4. Part C
   a. Total marks : 12
   b. *Four* questions each having *3* marks, uniformly covering module III and IV; All *four* questions have to be answered.
5. Part D
   a. Total marks : 18
   b. *Three* questions each having *9* marks, uniformly covering module III and IV; T*wo* questions have to be answered. Each question can have a maximum of three subparts
6. Part E
   a. Total Marks: 40
   b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
   c. A question can have a maximum of three sub-parts.

7. There should be at least 60% analytical/numerical questions.

Course code	Course Name	L-T-P-Credits	Year of Introduction
CS205	Data Structures	3-1-0-4	2016

Pre-requisite: B101-05 Introduction to Computing and Problem Solving

Course Objectives

1. To impart a thorough understanding of linear data structures such as stacks, queues and their applications.
2. To impart a thorough understanding of non-linear data structures such as trees, graphs and their applications.
3. To impart familiarity with various sorting, searching and hashing techniques and their performance comparison.
4. To impart a basic understanding of memory management.

Syllabus

Introduction to various programming methodologies, terminologies and basics of algorithms analysis, Basic Abstract and Concrete Linear Data Structures, Non-linear Data Structures, Memory Management, Sorting Algorithms, Searching Algorithms, Hashing.

Expected Outcome:

Students will be able to

1. compare different programming methodologies and define asymptotic notations to analyze performance of algorithms.
2. use appropriate data structures like arrays, linked list, stacks and queues to solve real world problems efficiently.
3. represent and manipulate data using nonlinear data structures like trees and graphs to design algorithms for various applications.
4. illustrate and compare various techniques for searching and sorting.
5. appreciate different memory management techniques and their significance.
6. illustrate various hashing techniques.

Text Books:

1. Samanta D., Classic Data Structures, Prentice Hall India, 2/e, 2009.
2. Richard F. Gilberg, Behrouz A. Forouzan, Data Structures: A Pseudocode Approach with C, 2/e, Cengage Learning, 2005.

References

1. Horwitz E., S. Sahni and S. Anderson, Fundamentals of Data Structures in C, University Press (India), 2008.
2. Aho A. V., J. E. Hopcroft and J. D. Ullman, Data Structures and Algorithms, Pearson Publication,1983.
3. Tremblay J. P. and P. G. Sorenson, Introduction to Data Structures with Applications, Tata McGraw Hill, 1995.
4. Peter Brass, Advanced Data Structures, Cambridge University Press, 2008
5. Lipschuts S., Theory and Problems of Data Structures, Schaum's Series, 1986.
6. Wirth N., Algorithms + Data Structures = Programs, Prentice Hall, 2004.
7. Hugges J. K. and J. I. Michtm, A Structured Approach to Programming, PHI, 1987.
8. Martin Barrett, Clifford Wagner, And Unix: Tools For Software Design, John Wiley, 2008 reprint

COURSE PLAN			
Module	**Contents**	**Hours (56)**	**Sem. Exam Marks**
I	Introduction to programming methodologies – structured approach, stepwise refinement techniques, programming style, documentation – analysis of algorithms: frequency count, definition of Big O notation, asymptotic analysis of simple algorithms. Recursive and iterative algorithms.	**9**	**15%**
II	Abstract and Concrete Data Structures- Basic data structures – vectors and arrays. Applications, Linked lists:- singly linked list, doubly linked list, Circular linked list, operations on linked list, linked list with header nodes, applications of linked list: polynomials,.	**9**	**15%**
III	Applications of linked list (continued): Memory management, memory allocation and de-allocation. First-fit, best-fit and worst-fit allocation schemes Implementation of Stacks and Queues using arrays and linked list, DEQUEUE (double ended queue). Multiple Stacks and Queues, Applications.	**9**	**15%**
IV	String: - representation of strings, concatenation, substring searching and deletion. Trees: - m-ary Tree, Binary Trees – level and height of the tree, complete-binary tree representation using array, tree traversals (Recursive and non-recursive), applications. Binary search tree – creation, insertion and deletion and search operations, applications.	**10**	**15%**
V	Graphs – representation of graphs, BFS and DFS (analysis not required) applications. Sorting techniques – *Bubble sort, Selection Sort,* Insertion sort, Merge sort, Quick sort, Heaps and Heap sort. Searching algorithms (Performance comparison expected. Detailed analysis not required)	**09**	**20%**
VI	Linear and Binary search. (Performance comparison expected. Detailed analysis not required) Hash Tables – Hashing functions – Mid square, division, folding, digit analysis, collusion resolution and Overflow handling techniques.	**10**	**20%**

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Question Paper Pattern:

1. There will be *five* parts in the question paper – A, B, C, D, E
2. Part A
   a. Total marks : 12
   b. *Four* questions each having *3* marks, uniformly covering module I and II; All *four* questions have to be answered.
3. Part B
   a. Total marks : 18
   b. *Three* questions each having *9* marks, uniformly covering module I and II; T*wo* questions have to be answered. Each question can have a maximum of three subparts
4. Part C
   a. Total marks : 12
   b. *Four* questions each having *3* marks, uniformly covering module III and IV; All *four* questions have to be answered.
5. Part D
   a. Total marks : 18
   b. *Three* questions each having *9* marks, uniformly covering module III and IV; T*wo* questions have to be answered. Each question can have a maximum of three subparts

6. Part E
   a. Total Marks: 40
   b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
   c. A question can have a maximum of three sub-parts.

7. There should be at least 60% analytical/numerical/design questions.

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Course code	Course Name	L-T-P -Credits	Year of Introduction
CS207	ELECTRONIC DEVICES & CIRCUITS	3-0-0-3	2016

Pre-requisite: BE101-04 Introduction to Electronics Engg.

Course Objectives:

1. To introduce to the students the fundamental concepts of electronic devices and circuits for engineering applications
2. To develop the skill of analysis and design of various analog circuits using electronic devices
3. To provide comprehensive idea about working principle, operation and applications of electronic circuits
4. To equip the students with a sound understanding of fundamental concepts of operational amplifiers
5. To expose to the diversity of operations that operational amplifiers can perform in a wide range of applications
6. To expose to a variety of electronic circuits/systems using various analog ICs

Syllabus

RC Circuits, Diode Circuits, Regulated power supplies, **Field effect transistor,** DC analysis of BJT, RC Coupled amplifier, MOSFET amplifiers, Feedback amplifiers, Power amplifiers, Oscillators, Multivibrators, Operational Amplifier and its applications, Timer IC.

Expected Outcome:

Students will be able to

1. explain, illustrate, and design the different electronic circuits using electronic components
2. design circuits using operational amplifiers for various applications

Text Books:

1. David A Bell, Electronic Devices and Circuits, Oxford University Press, 2008
2. Salivahanan S. and V. S. K. Bhaaskaran, Linear Integrated Circuits, Tata McGraw Hill, 2008

References :

1. Neamen D., Electronic Circuits, Analysis and Design, 3/e, TMH, 2007
2. Robert Boylestad and L Nashelsky, Electronic Devices and Circuit Theory, Pearson.
3. Bogart T. F., Electronic Devices Circuits, 6/e, Pearson, 2012.
4. Maini A. K. and V. Agrawal, Electronic Devices and Circuits, Wiley India, 2011.
5. K.Gopakumar, Design and Analysis of Electronic Circuits, Phasor Books, Kollam, 2013
6. Millman J. and C. Halkias, Integrated Electronics, 2/e, McGraw-Hill, 2010.

Course Plan

Module	Contents	Hours (40)	Sem Exam Marks
1	**Wave shaping circuits:** Sinusoidal and non-sinusoidal wave shapes, Principle and working of RC differentiating and integrating circuits, Conversion of one non-sinusoidal wave shape into another. Clipping circuits - Positive, negative and biased clipper.	5	15%

	Clamping circuits - Positive, negative and biased clamper. Voltage multipliers- Voltage doubler and tripler. Simple sweep circuit using transistor as a switch.		
2	**Regulated power supplies:** Review of simple zener voltage regulator, Shunt and series voltage regulator using transistors, Current limiting and fold back protection, 3 pin regulators-78XX and 79XX, IC 723 and its use as low and high voltage regulators, DC to DC conversion, Circuit/block diagram and working of SMPS.	4	15 %
	Field effect transistors: JFET – Structure, principle of operation and characteristics, Comparison with BJT. MOSFET- Structure, Enhancement and Depletion types, principle of operation and characteristics.	3	
	FIRST INTERNAL EXAM		
3	**Amplifiers:** Introduction to transistor biasing, operating point, concept of load line, thermal stability, fixed bias, self bias, voltage divider bias. Classification of amplifiers, RC coupled amplifier - voltage gain and frequency response. Multistage amplifiers - effect of cascading on gain and bandwidth. Feedback in amplifiers - Effect of negative feedback on amplifiers. MOSFET Amplifier- Circuit diagram and working of common source MOSFET amplifier.	7	15 %
4	**Oscillators:** Classification, criterion for oscillation, analysis of Wien bridge oscillator, Hartley and Crystal oscillator. Non-sinusoidal oscillators: Astable, monostable and bi-stable multivibrators using transistors (Only design equations and working of circuit are required, Analysis not required).	5	15 %
	SECOND INTERNAL EXAM		
5	**Operational amplifiers:** Differential amplifier, characteristics of op-amps(gain, bandwidth, slew rate, CMRR, offset voltage, offset current), comparison of ideal and practical op-amp(IC741), applications of op-amps- scale changer, sign changer, adder/summing amplifier, subtractor, integrator, differentiator, Schmitt trigger, Wien bridge oscillator.	8	20 %

6	**Integrated circuits:** Active filters – Low pass and high pass (first and second order) active filters using op-amp with gain (No analysis required). D/A and A/D convertors – important specifications, Sample and hold circuit. Binary weighted resistor and R-2R ladder type D/A convertors. (concepts only). Flash, dual slope and successive approximation type A/D convertors. Circuit diagram and working of Timer IC555, astable and monostablemultivibrators using 555.	8	20 %
END SEMESTER EXAM			

Question Paper Pattern:

1. There will be *five* parts in the question paper – A, B, C, D, E
2. Part A
   a. Total marks : 12
   b. *Four* questions each having *3* marks, uniformly covering module I and II; All *four* questions have to be answered.
3. Part B
   a. Total marks : 18
   b. *Three* questions each having *9* marks, uniformly covering module I and II; T*wo* questions have to be answered. Each question can have a maximum of three subparts
4. Part C
   a. Total marks : 12
   b. *Four* questions each having *3* marks, uniformly covering module III and IV; All *four* questions have to be answered.
5. Part D
   a. Total marks : 18
   b. *Three* questions each having *9* marks, uniformly covering module III and IV; T*wo* questions have to be answered. Each question can have a maximum of three subparts

6. Part E
   a. Total Marks: 40
   b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
   c. A question can have a maximum of three sub-parts.

7. There should be at least 60% analytical/numerical/design questions.

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Course code	Course Name	L-T-P -Credits	Year of Introduction
CS202	Computer Organization and Architecture	3-1-0-4	2016

Pre-requisite: CS203 Switching theory and logic design

Course Objectives

1. To impart an understanding of the internal organization and operations of a computer.
2. To introduce the concepts of processor logic design and control logic design.

Syllabus

Fundamental building blocks and functional units of a computer. Execution phases of an instruction. Arithmetic Algorithms. Design of the processing unit – how arithmetic and logic operations are performed. Design of the control unit – hardwired and microprogrammed control. I/O organisation – interrupts, DMA, different interface standards. Memory Subsystem – different types.

Expected outcome

Students will be able to:

1. identify the basic structure and functional units of a digital computer.
2. analyze the effect of addressing modes on the execution time of a program.
3. design processing unit using the concepts of ALU and control logic design.
4. identify the pros and cons of different types of control logic design in processors.
5. select appropriate interfacing standards for I/O devices.
6. identify the roles of various functional units of a computer in instruction execution.

Text Books:

1. Hamacher C., Z. Vranesic and S. Zaky, *Computer Organization* ,5/e, McGraw Hill, 2011.
2. Mano M. M., Digital Logic & Computer Design, 4/e, Pearson Education, 2013.

References:

1. Mano M. M., Digital Logic & Computer Design, 4/e, Pearson Education, 2013.
2. Patterson D.A. and J. L. Hennessey, Computer Organization and Design, 5/e, Morgan Kauffmann Publishers, 2013.
3. William Stallings, Computer Organization and Architecture: Designing for Performance, Pearson, 9/e, 2013.
4. Chaudhuri P., Computer Organization and Design, 2/e, Prentice Hall, 2008.
5. Rajaraman V. and T. Radhakrishnan, Computer Organization and Architecture, Prentice Hall, 2011.
6. Messmer H. P., The Indispensable PC Hardware Book, 4/e, Addison-Wesley, 2001

Course Plan

Module	Contents	Hours (51)	Sem.ExamMarks
I	**Basic Structure of computers**–functional units – basic operational concepts –bus structures – software. Memory locations and addresses – memory operations – instructions and instruction sequencing – addressing modes – ARM Example (programs not required). Basic I/O operations – stacks subroutine calls.	6	15%

II	**Basic processing unit** – fundamental concepts – instruction cycle - execution of a complete instruction –multiple- bus organization – sequencing of control signals. **Arithmetic algorithms:** Algorithms for multiplication and division of binary and BCD numbers — array multiplier —Booth's multiplication algorithm — restoring and non-restoring division — algorithms for floating point, multiplication and division.	10	15%
FIRST INTERNAL EXAMINATION			
III	**I/O organization:** accessing of I/O devices – interrupts –direct memory access –buses –interface circuits –standard I/O interfaces (PCI, SCSI, USB)	8	15%
IV	**Memory system :** basic concepts –semiconductor RAMs –memory system considerations – semiconductor ROMs –flash memory –cache memory and mapping functions.	9	15%
SECOND INTERNAL EXAMINATION			
V	**Processor Logic Design:** Register transfer logic – inter register transfer – arithmetic, logic and shift micro operations –conditional control statements. **Processor organization:**–design of arithmetic unit, logic unit, arithmetic logic unit and shifter –status register –processor unit –design of accumulator.	9	20%
VI	**Control Logic Design:** Control organization – design of hardwired control –control of processor unit –PLA control. **Micro-programmed control:** Microinstructions –horizontal and vertical micro instructions – micro-program sequencer –micro programmed CPU organization.	9	20%
END SEMESTER EXAM			

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Question Paper Pattern:

1. There will be *five* parts in the question paper – A, B, C, D, E
2. Part A
   a. Total marks : 12
   b. *Four* questions each having *3* marks, uniformly covering module I and II; All *four* questions have to be answered.
3. Part B
   a. Total marks : 18
   b. *Three* questions each having *9* marks, uniformly covering module I and II; T*wo* questions have to be answered. Each question can have a maximum of three subparts
4. Part C
   a. Total marks : 12
   b. *Four* questions each having *3* marks, uniformly covering module III and IV; All *four* questions have to be answered.
5. Part D
   a. Total marks : 18
   b. *Three* questions each having *9* marks, uniformly covering module III and IV; T*wo* questions have to be answered. Each question can have a maximum of three subparts

6. Part E
   a. Total Marks: 40
   b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
   c. A question can have a maximum of three sub-parts.

7. There should be at least 60% analytical/numerical/design questions..

Course code	Course Name	L-T-P -Credits	Year of Introduction
CS204	**Operating Systems**	**3-1-0-4**	**2016**

Pre-requisite: CS205 Data structures

Course Objectives

1. To impart fundamental understanding of the purpose, structure, functions of operating system.
2. To impart the key design issues of an operating system

Syllabus

Basic concepts of Operating System, its structure, Process management, inter-process communication, process synchronization, CPU Scheduling, deadlocks, Memory Management, swapping, segmentation, paging, Storage Management - disk scheduling, RAID, File System Interface-implementation. Protection.

Expected outcome

Students will be able to:

1. identify the significance of operating system in computing devices.
2. exemplify the communication between application programs and hardware devices through system calls.
3. compare and illustrate various process scheduling algorithms.
4. apply appropriate memory and file management schemes.
5. illustrate various disk scheduling algorithms.
6. appreciate the need of access control and protection in an operating system.

Text Book:

1. Abraham Silberschatz, Peter B Galvin, Greg Gagne, Operating System Concepts, 9/e, Wiley India, 2015.

References:

1. Garry Nutt, Operating Systems: 3/e, Pearson Education, 2004
2. Bhatt P. C. P., An Introduction to Operating Systems: Concepts and Practice, 3/e, Prentice Hall of India, 2010.
3. William Stallings, Operating Systems: Internals and Design Principles, Pearson, Global Edition, 2015.
4. Andrew S Tanenbaum, Herbert Bos, Modern Operating Systems, Pearson, 4/e, 2015.
5. Madnick S. and J. Donovan, Operating Systems, McGraw Hill, 2001.
6. Hanson P. B., Operating System Principle, Prentice Hall of India, 2001.
7. Deitel H. M., An Introduction to Operating System Principles, Addison-Wesley, 1990.

Course Plan

Module	Contents	Hours (52)	Sem. Exam marks

I	**Introduction**: Functions of an operating system. Single processor, multiprocessor and clustered systems – overview. Kernel Data Structures – Operating Systems used in different computing environments. **Operating System Interfaces and implementation** - User Interfaces, System Calls – examples. Operating System implementation - approaches. Operating System Structure – Monolithic, Layered, Micro-kernel, Modular. System Boot process.	7	15%
II	**Process Management**: Process Concept – Processes-States – Process Control Block – Threads. Scheduling – Queues – Schedulers – Context Switching. Process Creation and Termination. **Inter Process Communication**: Shared Memory, Message Passing, Pipes.	9	15%
	FIRST INTERNAL EXAMINATION		
III	**Process Synchronization**: Critical Section- Peterson's solution. Synchronization – Locks, Semaphores, Monitors, Classical Problems – Producer Consumer, Dining Philosophers and Readers-Writers Problems	9	15%
IV	**CPU Scheduling** – Scheduling Criteria – Scheduling Algorithms. **Deadlocks** – Conditions, Modeling using graphs. Handling – Prevention – Avoidance – Detection- Recovery.	8	15%
	SECOND INTERNAL EXAMINATION		
V	**Memory Management**: Main Memory – Swapping – Contiguous Memory allocation – Segmentation – Paging – Demand paging	9	20%
VI	**Storage Management:** *Overview of mass storage structure- disks and tapes. Disk structure – accessing disks.* Disk scheduling and management. Swap Space. **File System Interface**: File Concepts – Attributes – operations – types – structure – access methods. File system mounting. Protection. File system implementation. Directory implementation – allocation methods. Free space Management. **Protection**– Goals, Principles, Domain. Access Matrix.	10	20%
	END SEMESTER EXAM		

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Question Paper Pattern:

1. There will be *five* parts in the question paper – A, B, C, D, E
2. Part A
   a. Total marks : 12
   b. *Four* questions each having *3* marks, uniformly covering module I and II; All *four* questions have to be answered.
3. Part B
   a. Total marks : 18
   b. *Three* questions each having *9* marks, uniformly covering module I and II; T*wo* questions have to be answered. Each question can have a maximum of three subparts
4. Part C
   a. Total marks : 12
   b. *Four* questions each having *3* marks, uniformly covering module III and IV; All *four* questions have to be answered.
5. Part D
   a. Total marks : 18
   b. *Three* questions each having *9* marks, uniformly covering module III and IV; T*wo* questions have to be answered. Each question can have a maximum of three subparts

6. Part E
   a. Total Marks: 40
   b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
   c. A question can have a maximum of three sub-parts.

7. There should be at least 60% analytical/numerical/design questions.

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Course code	Course Name	L-T-P - Credits	Year of Introduction
CS206	**Object Oriented Design and Programming**	**2-1-0-3**	**2016**

Pre-requisite: CS205 Data structures

Course Objectives

1. To introduce basic concepts of object oriented design techniques.
2. To give a thorough understanding of Java language.
3. To provide basic exposure to the basics of multithreading, database connectivity etc.
4. To impart the techniques of creating GUI based applications.

Syllabus

Object oriented concepts, Object oriented systems development life cycle, Unified Modeling Language, Java Overview, Classes and objects, Parameter passing, Overloading, Inheritance, Overriding, Packages, Exception Handling, Input/Output, Threads and multithreading, Applets, Event Handling mechanism, Working with frames and graphics, AWT Controls, Swings, Java database connectivity.

Expected outcome.

Students will be able to:

1. apply object oriented principles in software design process.
2. develop Java programs for real applications using java constructs and libraries.
3. understand and apply various object oriented features like inheritance, data abstraction, encapsulation and polymorphism to solve various computing problems using
   Java language.
4. implement Exception Handling in java.
5. use graphical user interface and Event Handling in java.
6. develop and deploy Applet in java.

Text Books:

1. Herbert Schildt, Java: The Complete Reference, 8/e, Tata McGraw Hill, 2011.
2. Bahrami A., Object Oriented Systems Development using the Unified Modeling Language, McGraw Hill, 1999.

References:

1. Y. Daniel Liang, Introduction to Java Programming, 7/e, Pearson, 2013.
2. Nageswararao R., Core Java: An Integrated Approach, Dreamtech Press, 2008.
3. Flanagan D., Java in A Nutshell, 5/e, O'Reilly, 2005.
4. Barclay K., J. Savage, Object Oriented Design with UML and Java, Elsevier, 2004.
5. Sierra K., Head First Java, 2/e, O'Reilly, 2005.
6. Balagurusamy E., Programming JAVA a Primer, 5/e, McGraw Hill, 2014.
7.

Course Plan

Module	Contents	Hours (42)	Sem. ExamMarks
I	Object oriented concepts, Object oriented systems development life cycle. Unified Modeling Language, UML class diagram, Use-case diagram. Java Overview: Java virtual machine, *data types, operators, control statements,* Introduction to Java programming.	08	15%

II	Classes fundamentals, objects, methods, constructors, parameter passing, overloading, access control keywords.	07	15%
	FIRST INTERNAL EXAMINATION		
III	Inheritance basics, method overriding, abstract classes, interface. Defining and importing packages. Exception handling fundamentals, multiple catch and nested try statements.	06	15%
IV	Input/Output: files, stream classes, reading console input. Threads: thread model, use of Thread class and Runnable interface, thread synchronization, multithreading.	06	15%
	SECOND INTERNAL EXAMINATION		
V	String class - basics. Applet basics and methods. Event Handling: delegation event model, event classes, sources, listeners.	07	20%
VI	Introduction to AWT: working with frames, graphics, color, font. AWT Control fundamentals. Swing overview. Java database connectivity: JDBC overview, creating and executing queries, dynamic queries.	08	20%
	END SEMESTER EXAM		

Question Paper Pattern:

1. There will be *five* parts in the question paper – A, B, C, D, E
2. Part A
    a. Total marks : 12
    b. *Four* questions each having *3* marks, uniformly covering module I and II; All *four* questions have to be answered.
3. Part B
    a. Total marks : 18
    b. *Three* questions each having *9* marks, uniformly covering module I and II; T*wo* questions have to be answered. Each question can have a maximum of three subparts
4. Part C
    a. Total marks : 12
    b. *Four* questions each having *3* marks, uniformly covering module III and IV; All *four* questions have to be answered.
5. Part D
    a. Total marks : 18
    b. *Three* questions each having *9* marks, uniformly covering module III and IV; T*wo* questions have to be answered. Each question can have a maximum of three subparts

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6. Part E
    a. Total Marks: 40
    b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
    c. A question can have a maximum of three sub-parts.

7. There should be at least 60% analytical/design questions.

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Course code	Course Name	L-T-P - Credits	Year of Introduction
CS208	Principles of Database Design	2-1-0-3	2016

Pre-requisite: CS205 Data structures

Course Objectives

- To impart the basic understanding of the theory and applications of database management systems.
- To give basic level understanding of internals of database systems.
- To expose to some of the recent trends in databases.

Syllabus:

Types of data, database and DBMS, Languages and users. Software Architecture, E-R and Extended E-R Modelling, Relational Model – concepts and languages, relational algebra and tuple relational calculus, SQL, views, assertions and triggers, relational db design, FDs and normal forms, Secondary storage organization, indexing and hashing, query optimization, concurrent transaction processing and recovery principles, recent topics.

Expected outcome.

Students will be able to:

1. define, explain and illustrate the fundamental concepts of databases.
2. construct an Entity-Relationship (E-R) model from specifications and to perform the transformation of the conceptual model into corresponding logical data structures.
3. model and design a relational database following the design principles.
4. develop queries for relational database in the context of practical applications
5. define, explain and illustrate fundamental principles of data organization, query optimization and concurrent transaction processing.
6. appreciate the latest trends in databases.

Text Books:

1. Elmasri R. and S. Navathe, *Database Systems: Models, Languages, Design andApplication Programming*, Pearson Education, 2013.
2. Sliberschatz A., H. F. Korth and S. Sudarshan, *Database System Concepts*, 6/e, McGraw Hill, 2011.

References:

1. Powers S., *Practical RDF*, O'Reilly Media, 2003.
2. Plunkett T., B. Macdonald, *et al.*, *Oracle Big Data Hand Book*, Oracle Press, 2013.

Course Plan

Module	Contents	Hours (42)	Sem. Exam Marks
I	**Introduction:** Data: structured, semi-structured and unstructured data, Concept & Overview of DBMS, Data Models, Database Languages, Database Administrator, Database Users, Three Schema architecture of DBMS. Database architectures and classification. (Reading: Elmasri Navathe, Ch. 1 and 2. Additional Reading: Silbershatz, Korth, Ch. 1) **Entity-Relationship Model:** Basic concepts, Design Issues, Mapping Constraints, Keys, Entity-	06	15%

	Relationship Diagram, Weak Entity Sets, Relationships of degree greater than 2 (Reading: Elmasri Navathe, Ch. 7.1-7.8)		
II	**Relational Model:** Structure of relational Databases, Integrity Constraints, synthesizing ER diagram to relational schema (Reading: Elmasri Navathe, Ch. 3 and 8.1, Additional Reading: Silbershatz, Korth, Ch. 2.1-2.4) **Database Languages:** Concept of DDL and DML relational algebra (Reading: Silbershatz, Korth, Ch 2.5-2.6 and 6.1-6.2, Elmasri Navathe, Ch. 6.1-6.5)	06	15%
FIRST INTERNAL EXAM			
III	**Structured Query Language (SQL)**: Basic SQL Structure, examples, Set operations, Aggregate Functions, nested sub-queries (Reading: Elmasri Navathe, Ch. 4 and 5.1) **Views, assertions and triggers** (Reading: Elmasri Navathe, Ch. 5.2-5.3, Optional reading: Silbershatz, Korth Ch. 5.3).	07	15%
IV	**Relational Database Design:** Different anomalies in designing a database, normalization, functional dependency (FD), Armstrong's Axioms, closures, Equivalence of FDs, minimal Cover (proofs not required). Normalization using functional dependencies, INF, 2NF, 3NF and BCNF, lossless and dependency preserving decompositions (Reading: Elmasri and Navathe, Ch. 14.1-14.5, 15.1-15.2. Additional Reading: Silbershatz, Korth Ch. 8.1-8.5)	07	15%
SECOND INTERNAL EXAM			
V	**Physical Data Organization**: index structures, primary, secondary and clustering indices, Single level and Multi-level indexing, B+-Trees (basic structure only, algorithms not needed), (Reading Elmasri and Navathe, Ch. 17.1-17.4) **Query Optimization**: heuristics-based query optimization, (Reading Elmasri and Navathe, Ch. 18.1, 18.7)	07	20%
VI	**Transaction Processing Concepts:** overview of concurrency control and recovery acid properties, serial and concurrent schedules, conflict serializability. Two-phase locking, failure classification, storage structure, stable storage, log based recovery, deferred database modification, check-pointing, (Reading Elmasri and Navathe, Ch. 20.1-20.5 (except 20.5.4-20.5.5) , Silbershatz, Korth Ch. 15.1 (except 15.1.4-15.1.5), Ch. 16.1 – 16.5) **Recent topics (preliminary ideas only):** Semantic Web and RDF(Reading: Powers Ch.1, 2), GIS, biological databases (Reading: Elmasri and Navathe Ch. 23.3-23.4) Big Data (Reading: Plunkett and Macdonald, Ch. 1, 2)	09	20%
END SEMESTER EXAM			

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Question Paper Pattern:

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    a. Total marks : 18
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    a. Total marks : 12
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5. Part D
    a. Total marks : 18
    b. *Three* questions each having *9* marks, uniformly covering module III and IV; T*wo* questions have to be answered. Each question can have a maximum of three subparts
6. Part E
    a. Total Marks: 40
    b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI, *four* questions have to be answered.
    c. A question can have a maximum of three sub-parts.
7. There should be at least 60% analytical/numerical/design questions.

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Course code	Course Name	L-T-P-Credits	Year of Introduction
CS232	Free and Open Source Software Lab	0-0-3-1	2016

Pre-requisite: CS204 Operating systems

Course Objectives: To expose students to FOSS environment and introduce them to use open source packages in open source platform.

List of Exercises/Experiments:

1. Getting started with Linux basic commands for directory operations, displaying directory structure in tree format etc.
2. Linux commands for operations such as redirection, pipes, filters, job control, changing ownership/permissions of files/links/directory.
3. Advanced linux commands curl, wget, ftp, ssh and grep
4. Shell Programming : Write shell script to show various system configuration like
   - Currently logged user and his login name
   - Your current shell
   - Your home directory
   - Your operating system type
   - Your current path setting
   - Your current working directory
   - Number of users currently logged in
5. Write shell script to show various system configurations like
   - your OS and version, release number, kernel version
   - all available shells
   - computer CPU information like processor type, speed etc
   - memory information
   - hard disk information like size of hard-disk, cache memory, model etc
   - File system (Mounted)
6. Write a shell script to implement a menu driven calculator with following functions
   1. Addition
   2. Subtraction
   3. Multiplication
   4. Division
   5. Modulus
7. Write a script called addnames that is to be called as follows
   ./addnames ulist username

   Here *ulist* is the name of the file that contains list of user names and *username* is a particular student's username. The script should
   - check that the correct number of arguments was received and print a message, in case the number of arguments is incorrect
   - check whether the ulist file exists and print an error message if it does not
   - check whether the username already exists in the file. If the username exists, print a message stating that the name already exists. Otherwise, add the username to the end of the list.

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8. Version Control System setup and usage using GIT. Try the following features.
    - Creating a repository
    - Checking out a repository
    - Adding content to the repository
    - Committing the data to a repository
    - Updating the local copy
    - Comparing different revisions
    - Revert
    - Conflicts and a conflict Resolution

9. Shell script which starts on system boot up and kills every process which uses more than a specified amount of memory or CPU.

10. Introduction to packet management system : Given a set of RPM or DEB, build and maintain, and serve packages over http or ftp. Configure client systems to access the package repository.

11. Perform simple text processing using Perl, Awk.

12. Running PHP : simple applications like login forms after setting up a LAMP stack

13. Virtualisation environment (e.g., xen, kqemu, virtualbox or lguest) to test applications, new kernels and isolate applications. It could also be used to expose students to other alternate OS such as freeBSD

14. Compiling from source : learn about the various build systems used like the auto* family, cmake, ant etc. instead of just running the commands. This could involve the full process like fetching from a cvs and also include autoconf, automake etc.,

15. Kernel configuration, compilation and installation : Download / access the latest kernel source code from *kernel.org*, compile the kernel and install it in the local system. Try to view the source code of the kernel

16. GUI Programming: Create scientific calculator – using any one of Gambas, GTK, QT

17. Installing various software packages. Either the package is yet to be installed or an older version is present. The student can practice installing the latest version. (Internet access is needed).
    - Install samba and share files to windows
    - Install Common Unix Printing System(CUPS)

18. Set up the complete network interface by configuring services such as gateway, DNS, IP tables etc. using *ifconfig*

Expected outcome:

The students will be able to:

1. Identify and apply various Linux commands
2. Develop shell scripts and GUI for specific needs
3. Use tools like GIT
4. Perform basic level application deployment, kernel configuration and installation, packet management and installation etc.

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Course code	Course Name	L-T-P Credits	Year of Introduction
CS301	**THEORY OF COMPUTATION**	**3-1-0-4**	**2016**

Prerequisite: Nil

Course Objectives

- To introduce the concept of formal languages.
- To discuss the Chomsky classification of formal languages with discussion on grammar and automata for regular, context-free, context sensitive and unrestricted languages.
- To discuss the notions of decidability and halting problem.

Syllabus

Introduction to Automata Theory, Structure of an automaton, classification of automata, grammar and automata for generating each class of formal languages in the Chomsky Hierarchy, decidability and Halting problem.

Expected Outcome

The Students will be able to

i. Classify formal languages into regular, context-free, context sensitive and unrestricted languages.
ii. Design finite state automata, regular grammar, regular expression and Myhill- Nerode relation representations for regular languages.
iii. Design push-down automata and context-free grammar representations for context-free languages.
iv. Design Turing Machines for accepting recursively enumerable languages.
v. Understand the notions of decidability and undecidability of problems, Halting problem.

Text Books

1. John E Hopcroft, Rajeev Motwani and Jeffrey D Ullman, Introduction to Automata Theory, Languages, and Computation, 3/e, Pearson Education, 2007
2. John C Martin, Introduction to Languages and the Theory of Computation, TMH, 2007
3. Michael Sipser, Introduction To Theory of Computation, Cengage Publishers, 2013

References

1. Dexter C. Kozen, Automata and Computability, Springer1999.

Course Plan

Module	Contents	Hours	End Sem. Exam Marks
I	Introduction to Automata Theory and its significance. **Type 3 Formalism:** Finite state automata – Properties of transition functions, Designing finite automata, NFA, Finite Automata with Epsilon Transitions, Equivalence of NFA and DFA, Conversion of NFA to DFA, Equivalence and Conversion of NFA with and without Epsilon Transitions.	10	15 %
II	Myhill-Nerode Theorem, Minimal State FA Computation. Finite State Machines with Output- Mealy and Moore machine (Design Only), Two- Way Finite Automata. Regular Grammar, Regular Expressions, Equivalence of regular expressions and NFA with epsilon transitions. Converting Regular Expressions to NFA with epsilon transitions Equivalence of DFA and regular expressions, converting DFA to Regular Expressions.	10	15 %

FIRST INTERNAL EXAM			
III	Pumping Lemma for Regular Languages, Applications of Pumping Lemma. Closure Properties of Regular sets (Proofs not required), Decision Problems related with Type 3 Formalism **Type 2 Formalism:-** Context-Free Languages (CFL), Context-Free Grammar (CFG), Derivation trees, Ambiguity, Simplification of CFG, Chomsky Normal Form, Greibach normal forms	**09**	**15 %**
IV	Non-Deterministic Pushdown Automata (NPDA), design. Equivalence of acceptance by final state and empty stack in PDA. Equivalence between NPDA and CFG, Deterministic Push Down Automata, Closure properties of CFLs (Proof not required), Decision Problems related with Type 3 Formalism.	**08**	**15 %**
SECOND INTERNAL EXAM			
V	Pumping Lemma for CFLs, Applications of Pumping Lemma. **Type 1 Formalism:** Context-sensitive Grammar. Linear Bounded Automata (Design not required) **Type 0 Formalism:** Turing Machine (TM) – Basics and formal definition, TMs as language acceptors, TMs as Transducers, Designing Turing Machines.	**09**	**20 %**
VI	Variants of TMs -Universal Turing Machine, Multi- tape TMs, Non Deterministic TMs, Enumeration Machine (Equivalence not required), Recursively Enumerable Languages, Recursive languages, Properties of Recursively Enumerable Languages and Recursive Languages, Decidability and Halting Problem. Chomsky Hierarchy	**08**	**20 %**
END SEMESTER EXAM			

Question Paper Pattern

1. There will be *five* parts in the question paper – A, B, C, D, E
2. Part A
   a. Total marks : 12 b. *Four* questions each having *3* marks, uniformly covering modules I and II; All *four* questions have to be answered.
3. Part B
   a. Total marks : 18 b. *Three* questions each having *9* marks, uniformly covering modules I and II; *Two* questions have to be answered. Each question can have a maximum of three subparts.
4. Part C
   a. Total marks : 12 b. *Four* questions each having *3* marks, uniformly covering modules III and IV; All *four* questions have to be answered.
5. Part D
   a. Total marks : 18 b. *Three* questions each having *9* marks, uniformly covering modules III and IV; *Two* questions have to be answered. Each question can have a maximum of three subparts
6. Part E
   a. Total Marks: 40 b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered. A question can have a maximum of three sub-parts.

There should be at least 60% analytical/numerical questions.

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Course code	Course Name	L-T-P Credits	Year of Introduction
CS303	SYSTEM SOFTWARE	2-1-0-3	2016

Prerequisite: Nil

Course Objectives

- To make students understand the design concepts of various system software like Assembler, Linker, Loader and Macro pre-processor, Utility Programs such as Text Editor and Debugger.

Syllabus

Different types of System Software, SIC & SIC/XE Architecture and Programming, Basic Functions of Assembler, Assembler Design, Single pass and 2 Pass Assemblers and their Design, Linkers and Loaders, Absolute Loader and Relocating loader, Design of Linking Loader, Macro Processor and its design, Fundamentals of Text Editor Design, Operational Features of Debuggers

Expected Outcome

The Students will be able to

i. distinguish different software into different categories..
ii. design, analyze and implement one pass, two pass or multi pass assembler.
iii. design, analyze and implement loader and linker.
iv. design, analyze and implement macro processors.
v. critique the features of modern editing /debugging tools.

Text book

1. Leland L. Beck, System Software: An Introduction to Systems Programming, 3/E, Pearson Education Asia, 1997.

References

1 D M. Dhamdhere, Systems Programming and Operating Systems, Second Revised Edition, Tata McGraw Hill.
2. http://gcc.gnu.org/onlinedocs/gcc-2.95.3/cpp_1.html - The C Preprocessor
3. J Nithyashri, System Software, Second Edition, Tata McGraw Hill.
4. John J. Donovan, Systems Programming, Tata McGraw Hill Edition 1991.
5. Jonathan Corbet, Alessandro Rubini, Greg Kroah-Hartman, Linux Device Drivers, Third Edition, O.Reilly Books
6. M. Beck, H. Bohme, M. Dziadzka, et al., Linux Kernel Internals, Second Edition, Addison Wesley Publications,
7. Peter Abel, IBM PC Assembly Language and Programming, Third Edition, Prentice Hall of India.
8. Writing UNIX device drivers - George Pajari – Addison Wesley Publications (Ebook : http://tocs.ulb.tu-darmstadt.de/197262074.pdf).

Course Plan

Module	Contents	Hours	End Sem Exam. Marks

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I	***Introduction :*** System Software Vs. Application Software, Different System Software– Assembler, Linker, Loader, Macro Processor, Text Editor, Debugger, Device Driver, Compiler, Interpreter, Operating System(Basic Concepts only) SIC & SIC/XE Architecture, Addressing modes, SIC & SIC/XE Instruction set, Assembler Directives and Programming.	2 6	15%
II	***Assemblers*** Basic Functions of Assembler. Assembler output format – Header, Text and End Records- Assembler data structures, Two pass assembler algorithm, Hand assembly of SIC/XE program, Machine dependent assembler features.	6	15 %
FIRST INTERNAL EXAM			
III	***Assembler design options:*** Machine Independent assembler features – program blocks, Control sections, Assembler design options- Algorithm for Single Pass assembler, Multi pass assembler, Implementation example of MASM Assembler	7	15 %
IV	***Linker and Loader*** Basic Loader functions - Design of absolute loader, Simple bootstrap Loader, Machine dependent loader features- Relocation, Program Linking, Algorithm and data structures of two pass Linking Loader, Machine dependent loader features, Loader Design Options.	7	15 %
SECOND INTERNAL EXAM			
V	***Macro Preprocessor:-*** Macro Instruction Definition and Expansion. One pass Macro processor Algorithm and data structures, Machine Independent Macro Processor Features, Macro processor design options	7	20 %
VI	***Device drivers:*** Anatomy of a device driver, Character and block device drivers, General design of device drivers ***Text Editors:*** Overview of Editing, User Interface, Editor Structure. ***Debuggers :-*** Debugging Functions and Capabilities, Relationship with other parts of the system, Debugging Methods- By Induction, Deduction and Backtracking.	2 2 4	20 %
END SEMESTER EXAM			

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Question Paper Pattern

1. There will be *five* parts in the question paper – A, B, C, D, E
2. Part A
   a. Total marks : 12
   b. *Four* questions each having *3* marks, uniformly covering modules I and II, All *four* questions have to be answered.
3. Part B
   a. Total marks : 18
   b. *Three* questionseach having *9* marks, uniformly covering modules I and II; T*wo* questions have to be answered. Each question can have a maximum of three subparts.
4. Part C
   a. Total marks : 12
   b. *Four* questions each having *3* marks, uniformly covering modules III and IV; All *four* questions have to be answered.
5. Part D
   a. Total marks : 18
   b. *Three* questions each having *9* marks, uniformly covering modules III and IV; *Two* questions have to be answered. Each question can have a maximum of three subparts
6. Part E
   a. Total Marks: 40
   b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
   c. A question can have a maximum of three sub-parts.

7. There should be at least 60% analytical/numerical questions.

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Course code.	Course Name	L-T-P-Credits	Year of Introduction
CS307	DATA COMMUNICATION	3-0-0-3	2016

Prerequisite: Nil

Course Objectives

- To introduce fundamental communication models.
- To discuss various time domain and frequency domain concepts of data communication.
- To introduce the concepts of encoding, multiplexing and spread spectrum.

Syllabus

Data Transmission, Transmission Impairments, Channel Capacity, Transmission media, Wireless propagation, Signal encoding Techniques, Multiplexing, Digital data transmission techniques, Sampling theorem, Error detection and correction, Spread spectrum, Basic principles of switching.

Expected Outcome

The Students will be able to

i. Identify and list the various issues present in the design of a data communication system.
ii. Apply the time domain and frequency domain concepts of signals in data communication.
iii. Compare and select transmission media based on transmission impairments and channel capacity.
iv. Select and use appropriate signal encoding techniques and multiplexing techniques for a given scenario.
v. Design suitable error detection and error correction algorithms to achieve error free data communication and explain different switching techniques.

Text Books

1. Curt M. White, Fundamentals of Networking and Communication 7/e, Cengage learning. [Chapter 3,4,9,10]
2. Forouzan B. A., Data Communications and Networking, 5/e, Tata McGraw Hill, 2013. [Chapters:3,4, 5, 6,7,8]
3. Schiller J., Mobile Communications, 2/e, Pearson Education, 2009. [Chapters:2,3]
4. William Stallings, Data and Computer Communication 9/e, Pearson Education, Inc. [Chapters: 4, 5, 6, 7, 8, 9].

References

1. Forouzan B. A., Data Communications and Networking, 4/e, Tata McGraw Hill, 2007.
2. Tanenbaum A. S. and D. Wetherall, Computer Networks, Pearson Education, 2013.

COURSE PLAN

Module	Contents	Hours	End Sem. Exam Marks

I	Data Transmission: Communication model Simplex, half duplex and full duplex transmission - Periodic Analog signals: Sine wave, phase, wavelength, time and frequency domain, bandwidth - Digital Signals; Digital data Transmission:- Analog & Digital data, Analog & Digital signals, Analog &Digital transmission – Transmission Impairments: Attenuation, Delay distortion, Noise - Channel capacity: Nyquist Bandwidth, Shannon's Capacity formula.	08	15%
II	Transmission media - Guided Transmission Media: Twisted pair, Coaxial cable, optical fiber, Wireless Transmission, Terrestrial microwave, Satellite microwave. Wireless Propagation: Ground wave propagation, Sky Wave propagation, LoS Propagation.	07	15%
FIRST INTERNAL EXAM			
III	Signal Encoding techniques - Digital Data Digital Signals: NRZ, Multilevel binary, Biphase - Digital Data Analog Signals : ASK, FSK, PSK - Analog Data Digital Signals: Sampling theorem, PCM, Delta Modulation - Analog Data Analog Signals: AM, FM, PM.	07	15%
IV	Multiplexing- Space Division Multiplexing-Frequency Division Multiplexing: Wave length Division Multiplexing - Time Division multiplexing: Characteristics, Digital Carrier system, SONET/SDH- Statistical time division multiplexing: Cable Modem - Code Division Multiplexing. Multiple Access– CDMA.	07	15%
SECOND INTERNAL EXAM			
V	Digital Data Communication Techniques - Asynchronous transmission, Synchronous transmission-Detecting and Correcting Errors-Types of Errors-Error Detection: Parity check, Cyclic Redundancy Check (CRC) - Error Control Error Correction: Forward Error Correction and Hamming Distance.	06	20%
VI	Spread Spectrum Techniques-Direct Sequence Spread Spectrum (DSSS), Frequency Hopping Spread Spectrum (FHSS). Basic principles of switching - Circuit Switched Networks, Structure of Circuit Switch - Packet Switching: Datagram Networks, Virtual Circuit Networks, Structure of packet switches.	07	20%
END SEMESTER EXAM			

Question Paper Pattern

1. There will be *five* parts in the question paper – A, B, C, D, E
2. Part A
   a. Total marks : 12
   b. *Four* questions each having *3* marks, uniformly covering modules I and II; All *four* questions have to be answered.
3. Part B

   a. Total marks : 18
   b. *Three*questions each having *9* marks, uniformly covering modules I and II; T*wo* questions have to be answered. Each question can have a maximum of three subparts.
4. Part C
   a. Total marks : 12
   b. *Four* questions each having *3* marks, uniformly covering modules III and IV;All*four* questions have to be answered.
5. Part D
   a. Total marks : 18
   b. *Three*questionseach having *9* marks, uniformly covering modules III and IV;*Two* questions have to be answered. Each question can have a maximum of three subparts
6. Part E
   a. Total Marks: 40
   b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
   c. A question can have a maximum of three sub-parts.
7. There should be at least 60% analytical/numerical questions.

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Course code	Course Name	L-T-P Credits	Year of Introduction
CS309	GRAPH THEORY AND COMBINATORICS	2-0-2-3	2016

Prerequisite: Nil

Course Objectives

- To introduce the fundamental concepts in graph theory, including properties and characterization of graphs/ trees and Graphs theoretic algorithms

Syllabus

Introductory concepts of graphs, Euler and Hamiltonian graphs, Planar Graphs, Trees, Vertex connectivity and edge connectivity, Cut set and Cut vertices, Matrix representation of graphs, Graphs theoretic algorithms.

Expected Outcome

The Students will be able to

i. Demonstrate the knowledge of fundamental concepts in graph theory, including properties and characterization of graphs and trees.
ii. Use graphs for solving real life problems.
iii. Distinguish between planar and non-planar graphs and solve problems.
iv. Develop efficient algorithms for graph related problems in different domains of engineering and science.

Text Books

1. Douglas B. West, Introduction to Graph Theory, Prentice Hall India Ltd., 2001
2. Narasingh Deo, Graph theory, PHI, 1979.
3. Robin J. Wilson, Introduction to Graph Theory, Longman Group Ltd., 2010

References

1. R. Diestel, *Graph Theory,* free online edition, 2016: diestel-graph-theory.com/basic.html.

Course Plan

Module	Contents	Hours	End Sem. Exam Marks
I	**Introductory concepts** - What is graph – Application of graphs – finite and infinite graphs – Incidence and Degree – Isolated vertex, pendent vertex and Null graph. Paths and circuits – Isomorphism, sub graphs, walks, paths and circuits, Connected graphs, disconnect graphs.	09	15 %
II	Euler graphs, Hamiltonian paths and circuits, Dirac's theorem for Hamiltonicity, Travelling salesman problem. Directed graphs – types of digraphs, Digraphs and binary relation	10	15 %
FIRST INTERNAL EXAM			
III	Trees – properties, pendent vertex, Distance and centres - Rooted and binary tree, counting trees, spanning trees.	07	15 %
IV	Vertex Connectivity, Edge Connectivity, Cut set and Cut Vertices, Fundamental circuits, Planar graphs, Different representation of planar graphs, Euler's theorem, Geometric dual, Combinatorial dual	09	15 %
SECOND INTERNAL EXAM			

V	Matrix representation of graphs- Adjacency matrix, Incidence Matrix, Circuit matrix, Fundamental Circuit matrix and Rank, Cut set matrix, Path matrix	**08**	**20 %**
VI	Graphs theoretic algorithms - Algorithm for computer representation of a graph, algorithm for connectedness and components, spanning tree, shortest path.	**07**	**20 %**
END SEMESTER EXAM			

Question Paper Pattern

1. There will be *five* parts in the question paper – A, B, C, D, E
2. Part A
    a. Total marks : 12
    b. *Four* questions each having *3* marks, uniformly covering modules I and II; All *four* questions have to be answered.
3. Part B
    a. Total marks : 18
    b. *Three* questions each having *9* marks, uniformly covering modules I and II; T*wo* questions have to be answered. Each question can have a maximum of three subparts.
4. Part C
    a. Total marks : 12
    b. *Four* questions each having *3* marks, uniformly covering modules III and IV; All *four* questions have to be answered.
5. Part D
    a. Total marks : 18
    b. *Three* questions each having *9* marks, uniformly covering modules III and IV; *Two* questions have to be answered. Each question can have a maximum of three subparts.
6. Part E
    a. Total Marks: 40
    b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
    c. A question can have a maximum of three sub-parts.
7. There should be at least 60% analytical/numerical questions.

Course code	Course Name	L-T-P Credits	Year of Introduction
CS361	**SOFT COMPUTING**	**3-0-0-3**	**2016**

Prerequisite: Nil

Course Objectives

- To introduce the concepts in Soft Computing such as Artificial Neural Networks, Fuzzy logic-based systems, genetic algorithm-based systems and their hybrids.

Syllabus

Introduction to Soft Computing, Artificial Neural Networks, Fuzzy Logic and Fuzzy systems, Genetic Algorithms, hybrid systems.

Expected Outcome

The Students will be able to

1. Learn soft computing techniques and their applications.
2. Analyze various neural network architectures.
3. Define the fuzzy systems.
4. Understand the genetic algorithm concepts and their applications.
5. Identify and select a suitable Soft Computing technology to solve the problem; construct a solution and implement a Soft Computing solution.

Text Books

1. S. N. Sivanandam and S. N.Deepa, Principles of soft computing – John Wiley & Sons, 2007.
2. Timothy J. Ross, Fuzzy Logic with engineering applications , John Wiley & Sons, 2016.

References

1. N. K. Sinha and M. M. Gupta, Soft Computing & Intelligent Systems: Theory & Applications-Academic Press /Elsevier. 2009.
2. Simon Haykin, Neural Network- A Comprehensive Foundation- Prentice Hall International, Inc.1998
3. R. Eberhart and Y. Shi, Computational Intelligence: Concepts to Implementation, Morgan Kaufman/Elsevier, 2007.
4. Driankov D., Hellendoorn H. and Reinfrank M., An Introduction to Fuzzy Control-Narosa Pub., 2001.
5. Bart Kosko, Neural Network and Fuzzy Systems- Prentice Hall, Inc., Englewood Cliffs, 1992
6. Goldberg D.E., Genetic Algorithms in Search, Optimization, and Machine Learning-Addison Wesley, 1989.

Course Plan

Module	Contents	Hours	End Sem. Exam Marks
I	Introduction to Soft Computing Artificial neural networks - biological neurons, Basic models of artificial neural networks – Connections, Learning, Activation Functions, McCulloch and Pitts Neuron, Hebb network.	**07**	**15%**
II	Perceptron networks – Learning rule – Training and testing algorithm, Adaptive Linear Neuron, Back propagation Network – Architecture, Training algorithm	**07**	**15%**
	FIRST INTERNAL EXAM		

III	Fuzzy logic - fuzzy sets - properties - operations on fuzzy sets, fuzzy relations - operations on fuzzy relations	**07**	**15%**
IV	Fuzzy membership functions, fuzzification, Methods of membership value assignments – intuition – inference – rank ordering, Lambda – cuts for fuzzy sets, Defuzzification methods	**07**	**15%**
SECOND INTERNAL EXAM			
V	Truth values and Tables in Fuzzy Logic, Fuzzy propositions, Formation of fuzzy rules - Decomposition of rules – Aggregation of rules, Fuzzy Inference Systems - Mamdani and Sugeno types, Neuro-fuzzy hybrid systems – characteristics - classification	**07**	**20%**
VI	Introduction to genetic algorithm, operators in genetic algorithm - coding - selection - cross over – mutation, Stopping condition for genetic algorithm flow, Genetic-neuro hybrid systems, Genetic-Fuzzy rule based system	**07**	**20%**
END SEMESTER EXAMINATION			

Question Paper Pattern

1. There will be *five* parts in the question paper – A, B, C, D, E
2. Part A
   a. Total marks : 12
   b. *Four* questions each having *3* marks, uniformly covering modules I and II; All *four* questions have to be answered.
3. Part B
   a. Total marks : 18
   b. *Three* questions each having *9* marks, uniformly covering modules I and II; *Two* questions have to be answered. Each question can have a maximum of three sub-parts
4. Part C
   a. Total marks : 12
   b. *Four* questions each having *3* marks, uniformly covering modules III and IV; All *four* questions have to be answered.
5. Part D
   a. Total marks : 18
   b. *Three* questions each having *9* marks, uniformly covering modules III and IV; *Two* questions have to be answered. Each question can have a maximum of three subparts
6. Part E
   a. Total Marks: 40
   b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
   c. A question can have a maximum of three sub-parts.
7. There should be at least 60% analytical/numerical/design questions.

Course code	Course Name	L-T-P-Credits	Year of Introduction
CS365	**OPTIMIZATION TECHNIQUES**	**3-0-0-3**	**2016**

Prerequisite: Nil

Course Objectives

- To build an understanding on the basics of optimization techniques.
- To introduce basics of linear programming and meta- heuristic search techniques.

Syllabus

Basics of Operations Research - Formulation of optimization problems - Linear Programming - Transportation Problem - Assignment Problem - Network flow Problem - Tabu Search - Genetic Algorithm - Simulated Annealing – Applications.

Expected Outcome

The Students will be able to

i. Formulate mathematical models for optimization problems.
ii. Analyze the complexity of solutions to an optimization problem.
iii. Design programs using meta-heuristic search concepts to solve optimization problems.
iv. Develop hybrid models to solve an optimization problem.

Text Books

1. G. Zapfel, R. Barune and M. Bogl, Meta heuristic search concepts: A tutorial with applications to production and logistics, Springer, 2010.
2. Hamdy A. Taha, Operations Research – An introduction, Pearson Education, 2010.
3. Rao S.S., Optimization Theory and Applications, Wiley Eastern, 1984.

References

1. Gass S. I., Introduction to Linear Programming, Tata McGraw Hill.
2. Goldberg, Genetic algorithms in Search, optimization and Machine Learning, Addison Wesley, 1989.
3. K. Deb, Optimization for engineering design – algorithms and examples, Prentice Hall of India, 2004.
4. Reeves C., Modern heuristic techniques for combinatorial problems, Orient Longman, 1993.

COURSE PLAN

Module	Contents	Hours	End Sem. Exam Marks
I	Decision-making procedure under certainty and under uncertainty - Operations Research-Probability and decision- making- Queuing or Waiting line theory-Simulation and Monte- Carlo Technique- Nature and organization of optimization problems- Scope and hierarchy of optimization- Typical applications of optimization.	**08**	**15%**
II	Essential features of optimization problems - Objective function- Continuous functions - Discrete functions - Unimodal functions - Convex and concave functions, Investment costs and operating costs in objective function - Optimizing profitably constraints-Internal and external constraints-Formulation of optimization problems. Continuous functions - Discrete functions - Unimodal functions - Convex and concave functions.	**07**	**15%**

FIRST INTERNAL EXAM			
III	Necessary and sufficient conditions for optimum of unconstrained functions-Numerical methods for unconstrained functions - One-dimensional search - Gradient-free search with fixed step size. Linear Programming - Basic concepts of linear programming - Graphical interpretation-Simplex method - Apparent difficulties in the Simplex method.	06	15%
IV	Transportation Problem, Loops in transportation table, Methods of finding initial basic feasible solution, Tests for optimality. Assignment Problem, Mathematical form of assignment problem, methods of solution.	06	15%
SECOND INTERNAL EXAM			
V	Network analysis by linear programming and shortest route, maximal flow problem. Introduction to Non-traditional optimization, Computational Complexity – NP-Hard, NP-Complete. Tabu Search-Basic Tabu search, Neighborhood, Candidate list, Short term and Long term memory	07	20%
VI	Genetic Algorithms- Basic concepts, Encoding, Selection, Crossover, Mutation. Simulated Annealing - Acceptance probability, Cooling, Neighborhoods, Cost function. Application of GA and Simulated Annealing in solving sequencing and scheduling problems and Travelling salesman problem.	08	20%
END SEMESTER EXAM			

Question Paper Pattern

1. There will be *five* parts in the question paper – A, B, C, D, E
2. Part A
   a. Total marks : 12
   b. *Four* questions each having *3* marks, uniformly covering modules I and II; All *four* questions have to be answered.
3. Part B
   a. Total marks : 18
   b. *Three* questions each having *9* marks, uniformly covering modules I and II; *Two* questions have to be answered. Each question can have a maximum of three subparts.
4. Part C
   a. Total marks : 12
   b. *Four* questions each having *3* marks, uniformly covering modules III and IV; All *four* questions have to be answered.
5. Part D
   a. Total marks : 18
   b. *Three* questions each having *9* marks, uniformly covering modules III and IV; *Two* questions have to be answered. Each question can have a maximum of three subparts

6. Part E
    a. Total Marks: 40
    b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
    c. A question can have a maximum of three sub-parts.

7. There should be at least 60% analytical/numerical questions.

Course code	Course Name	L-T-P - Credits	Year of Introduction
CS302	**Design and Analysis of Algorithms**	**3-1-0-4**	**2016**

Prerequisite: Nil

Course Objectives

- To introduce the concepts of Algorithm Analysis, Time Complexity, Space Complexity.
- To discuss various Algorithm Design Strategies with proper illustrative examples.
- To introduce Complexity Theory.

Syllabus

Introduction to Algorithm Analysis, Notions of Time and Space Complexity, Asymptotic Notations, Recurrence Equations and their solutions, Master's Theorem, Divide and Conquer and illustrative examples, AVL trees, Red-Black Trees, Union-find algorithms, Graph algorithms, Divide and Conquer, Dynamic Programming, Greedy Strategy, Back Tracking and Branch and Bound, Complexity classes

Expected outcome

The students will be able to

i. Analyze a given algorithm and express its time and space complexities in asymptotic notations.
ii. Solve recurrence equations using Iteration Method, Recurrence Tree Method and Master's Theorem.
iii. Design algorithms using Divide and Conquer Strategy.
iv. Compare Dynamic Programming and Divide and Conquer Strategies.
v. Solve Optimization problems using Greedy strategy.
vi. Design efficient algorithms using Back Tracking and Branch Bound Techniques for solving problems.
vii. Classify computational problems into P, NP, NP-Hard and NP-Complete.

Text Books

1. Ellis Horowitz, SartajSahni, SanguthevarRajasekaran, Computer Algorithms, Universities Press, 2007 [Modules 3,4,5]
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, Introduction to Algorithms, MIT Press, 2009 [Modules 1,2,6]

References

1. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, The Design and Analysis of Computer Algorithms, Pearson Education, 1999.
2. Anany Levitin, Introduction to the Design and Analysis of Algorithms, Pearson, 3rd Edition, 2011.
3. Gilles Brassard, Paul Bratley, Fundamentals of Algorithmics, Pearson Education, 1995.
4. Richard E. Neapolitan, Kumarss Naimipour, Foundations of Algorithms using C++ Psuedocode, Second Edition, 1997.

Course Plan

Module	Contents	Hours	End Sem. Exam Marks

I	*Introduction to Algorithm Analysis*Time and Space Complexity- Elementary operations and Computation of Time Complexity- Best, worst and Average Case Complexities- Complexity Calculation of simple algorithms *Recurrence Equations:*Solution of Recurrence Equations – Iteration Method and Recursion Tree Methods	04 04	15 %
II	*Master's Theorem*(Proof not required) – examples, Asymptotic Notations and their properties- Application of Asymptotic Notations in Algorithm Analysis- Common Complexity Functions *AVL Trees* – rotations, Red-Black Trees insertion and deletion (Techniques only; algorithms not expected). B-Trees – insertion and deletion operations. Sets- Union and find operations on disjoint sets.	05 05	15%
FIRST INTERNAL EXAM			
III	*Graphs* – DFS and BFS traversals, complexity, Spanning trees – Minimum Cost Spanning Trees, single source shortest path algorithms, Topological sorting, strongly connected components.	07	15%
IV	*Divide and Conquer:*The Control Abstraction, 2 way Merge sort, Strassen's Matrix Multiplication, Analysis *Dynamic Programming :* The control Abstraction- The Optimality Principle- Optimal matrix multiplication, Bellman-Ford Algorithm	04 05	15%
SECOND INTERNAL EXAM			
V	Analysis, Comparison of Divide and Conquer and Dynamic Programming strategies *Greedy Strategy:* - The Control Abstraction- the Fractional Knapsack Problem, Minimal Cost Spanning Tree Computation- Prim's Algorithm – Kruskal's Algorithm.	02 04 03	20%
VI	*Back Tracking:* -The Control Abstraction – The N Queen's Problem, 0/1 Knapsack Problem *Branch and Bound:*Travelling Salesman Problem. *Introduction to Complexity Theory :*-Tractable and Intractable Problems- The P and NP Classes- Polynomial Time Reductions - The NP- Hard and NP-Complete Classes	03 03 03	20%
END SEMESTER EXAM			

Question Paper Pattern

1. There will be *five* parts in the question paper – A, B, C, D, E
2. Part A
   a. Total marks : 12
   b. *Four* questions each having *3* marks, uniformly covering modules I and II; All *four* questions have to be answered.
3. Part B
   a. Total marks : 18
   b. *Three* questions each having *9* marks, uniformly covering modules I and II; *Two* questions have to be answered. Each question can have a maximum of three subparts.
4. Part C

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   a. Total marks : 12
   b. *Four* questions each having *3* marks, uniformly covering modules III and IV; All *four* questions have to be answered.
5. Part D
   a. Total marks : 18
   b. *Three* questions each having *9* marks, uniformly covering modules III and IV; *Two* questions have to be answered. Each question can have a maximum of three subparts
6. Part E
   a. Total Marks: 40
   b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
   c. A question can have a maximum of three sub-parts.

7. There should be at least 60% analytical/numerical questions.

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Course code	Course Name	L-T-P Credits	Year of Introduction
CS304	COMPILER DESIGN	3-0-0-3	2016

Prerequisite: Nil

Course Objectives

- To provide a thorough understanding of the internals of Compiler Design.

Syllabus

Phases of compilation, Lexical analysis, Token Recognition, Syntax analysis, Bottom Up and Top Down Parsers, Syntax directed translation schemes, Intermediate Code Generation, Triples and Quadruples, Code Optimization, Code Generation.

Expected Outcome

The students will be able to

i. Explain the concepts and different phases of compilation with compile time error handling.
ii. Represent language tokens using regular expressions, context free grammar and finite automata and design lexical analyzer for a language.
iii. Compare top down with bottom up parsers, and develop appropriate parser to produce parse tree representation of the input.
iv. Generate intermediate code for statements in high level language.
v. Design syntax directed translation schemes for a given context free grammar.
vi. Apply optimization techniques to intermediate code and generate machine code for high level language program.

Text Books

1. Aho A. Ravi Sethi and D Ullman. Compilers – Principles Techniques and Tools, Addison Wesley, 2006.
2. D. M.Dhamdhare, System Programming and Operating Systems,Tata McGraw Hill & Company, 1996.

References

1. Kenneth C. Louden, Compiler Construction – Principles and Practice, Cengage Learning Indian Edition, 2006.
2. Tremblay and Sorenson, The Theory and Practice of Compiler Writing, Tata McGraw Hill & Company,1984.

Course Plan

Module	Contents	Hours	End Sem. Exam Marks
I	Introduction to compilers – Analysis of the source program, Phases of a compiler, Grouping of phases, compiler writing tools – bootstrapping **Lexical Analysis**: The role of Lexical Analyzer, Input Buffering, Specification of Tokens using Regular Expressions, Review of Finite Automata, Recognition of Tokens.	07	15%
II	**Syntax Analysis:** Review of Context-Free Grammars – Derivation trees and Parse Trees, Ambiguity. **Top-Down Parsing**: Recursive Descent parsing, Predictive parsing, LL(1) Grammars.	06	15%

FIRST INTERNAL EXAM			
III	**Bottom-Up Parsing**: Shift Reduce parsing – Operator precedence parsing (Concepts only) LR parsing – Constructing SLR parsing tables, Constructing, Canonical LR parsing tables and Constructing LALR parsing tables.	**07**	**15%**
IV	**Syntax directed translation**: Syntax directed definitions, Bottom- up evaluation of S-attributed definitions, L- attributed definitions, Top-down translation, Bottom-up evaluation of inherited attributes. **Type Checking :** Type systems, Specification of a simple type checker.	**08**	**15%**
SECOND INTERNAL EXAM			
V	**Run-Time Environments:** Source Language issues, Storage organization, Storage-allocation strategies. **Intermediate Code Generation (ICG)**: Intermediate languages – Graphical representations, Three-Address code, Quadruples, Triples. Assignment statements, Boolean expressions.	**07**	**20%**
VI	**Code Optimization:**Principal sources of optimization, Optimization of Basic blocks **Code generation**: Issues in the design of a code generator. The target machine, A simple code generator.	**07**	**20%**
END SEMESTER EXAM			

Question Paper Pattern

1. There will be *five* parts in the question paper – A, B, C, D, E
2. Part A
   a. Total marks : 12 b.. *Four* questions each having *3* marks, uniformly covering modules I and II; All *four* questions have to be answered.
3. Part B
   a. Total marks : 18 b. *Three* questionseach having *9* marks, uniformly covering modules I and II; *Two* questions have to be answered. Each question can have a maximum of three subparts.
4. Part C
   a. Total marks : 12 b. *Four* questions each having *3* marks, uniformly covering modules III and IV; All *four* questions have to be answered.
5. Part D
   a. Total marks : 18 b. *Three* questions each having *9* marks, uniformly covering modules III and IV; *Two* questions have to be answered. Each question can have a maximum of three subparts
6. Part E
   b. Total Marks: 40 b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
   c. A question can have a maximum of three sub-parts.
7. There should be at least 60% analytical/numerical questions.

Course code	Course Name	L-T-P - Credits	Year of Introduction
CS306	Computer Networks	3-0-0-3	2016

Prerequisite: Nil

Course Objectives

- To build an understanding of the fundamental concepts of computer networking.
- To introduce the basic taxonomy and terminology of computer networking.
- To introduce advanced networking concepts.

Syllabus

Concept of layering, LAN technologies (Ethernet), Flow and error control techniques, switching, IPv4/IPv6, routers and routing algorithms (distance vector, link state), TCP/UDP and sockets, congestion control, Application layer protocols.

Expected Outcome

The students will be able to

i. Visualise the different aspects of networks, protocols and network design models.
ii. Examine various Data Link layer design issues and Data Link protocols.
iii. Analyse and compare different LAN protocols.
iv. Compare and select appropriate routing algorithms for a network.
v. Examine the important aspects and functions of network layer, transport layer and application layer in internetworking.

Text Books

1. Andrew S. Tanenbaum, Computer Networks, 4/e, PHI.
2. Behrouz A. Forouzan, Data Communications and Networking, 4/e, Tata McGraw Hill.
3. Larry L. Peterson & Bruce S. Dave, Computer Networks-A Systems Approach, 5/e, Morgan Kaufmann, 2011.

References

1. Fred Halsall, Computer Networking and the Internet, 5/e.
2. James F. Kurose, Keith W. Ross, Computer Networking: A Top-Down Approach, 6/e.
3. Keshav, An Engineering Approach to Computer Networks, Addison Wesley, 1998.
4. Request for Comments (RFC) Pages - IETF -https://www.ietf.org/rfc.html
5. W. Richard Stevens. TCP/IP Illustrated volume 1, Addison-Wesley, 2005.
6. William Stallings, Computer Networking with Internet Protocols, Prentice-Hall, 2004.

Course Plan

Module	Contents	Hours	End Sem. Exam Marks
I	Introduction – Uses – Network Hardware – LAN –MAN – WAN, Internetworks – Network Software – Protocol hierarchies – Design issues for the layers – Interface & Service – Service Primitives. Reference models – OSI – TCP/IP.	07	15%
II	Data Link layer Design Issues – Flow Control and ARQ techniques. Data link Protocols – HDLC. DLL in Internet. MAC Sub layer – IEEE 802 FOR LANs & MANs, IEEE 802.3, 802.4, 802.5. Bridges - Switches – High Speed LANs - Gigabit Ethernet. Wireless LANs - 802.11 a/b/g/n, 802.15.PPP	08	15%
FIRST INTERNAL EXAMINATION			

	engineering – historical aspects, economic aspects, maintenance aspects, specification and design aspects, team programming aspects. Software engineering a layered technology – processes, methods and tools. Software process models – prototyping models, incremental models, spiral model, waterfall model.		
II	Process Framework Models: Capability maturity model (CMM), ISO 9000. Phases in Software development – requirement analysis- requirements elicitation for software, analysis principles, software prototyping, specification.	**06**	**15%**
FIRST INTERNAL EXAM			
III	Planning phase – project planning objective, software scope, empirical estimation models- COCOMO, single variable model, staffing and personal planning. Design phase – design process, principles, concepts, effective modular design, top down, bottom up strategies, stepwise refinement.	**07**	**15%**
IV	Coding – programming practice, verification, size measures, complexity analysis, coding standards. Testing – fundamentals, white box testing, control structure testing, black box testing, basis path testing, code walk-throughs and inspection, testing strategies-Issues, Unit testing, integration testing, Validation testing, System testing.	**07**	**15%**
SECOND INTERNAL EXAM			
V	Maintenance-Overview of maintenance process, types of maintenance. Risk management: software risks - risk identification-risk monitoring and management. Project Management concept: People – Product-Process-Project.	**07**	**20%**
VI	Project scheduling and tracking: Basic concepts-relation between people and effort-defining task set for the software project-selecting software engineering task Software configuration management: Basics and standards User interface design - rules. Computer aided software engineering tools - CASE building blocks, taxonomy of CASE tools, integrated CASE environment.	**08**	**20%**
END SEMESTER EXAM			

Question Paper Pattern

1. There will be *five* parts in the question paper – A, B, C, D, E
2. Part A
   a. Total marks : 12
   b. *Four* questions each having 3 marks, uniformly covering modules I and II;

All *four* questions have to be answered.

3. Part B
    a. Total marks : 18
    b. *Three* questions each having *9* marks, uniformly covering modules I and II; *Two* questions have to be answered. Each question can have a maximum of three subparts.
4. Part C
    a. Total marks : 12
    b. *Four* questions each having *3* marks, uniformly covering modules III and IV; All *four* questions have to be answered.
5. Part D
    a. Total marks : 18
    b. *Three* questions each having *9* marks, uniformly covering modules III and IV; *Two* questions have to be answered. Each question can have a maximum of three subparts
6. Part E
    a. Total Marks: 40
    b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
    c. A question can have a maximum of three sub-parts.

7. There should be at least 60% analytical/numerical questions.

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Course code	Course Name	L-T-P-Credits	Year of Introduction
CS334	Network Programming Lab	0-0-3-1	2016

Pre-requisite: CS307 Data Communication

Course Objectives

- To introduce Network related commands and configuration files in Linux Operating System.
- To introduce tools for Network Traffic Analysis and Network Monitoring.
- To practice Network Programming using Linux System Calls.
- To design and deploy Computer Networks.

List of Exercises/ Experiments (12 Exercises/ Experiments are to be completed . Exercises/ Experiments marked with * are mandatory)

1. Getting started with Basics of Network configurations files and Networking Commands in Linux.
2. To familiarize and understand the use and functioning of System Calls used for Operating system and network programming in Linux.
3. Familiarization and implementation of programs related to Process and thread.
4. Implement the First Readers-Writers Problem.
5. Implement the Second Readers-Writers problem.
6. Implement programs for Inter Process Communication using PIPE, Message Queue and Shared Memory.
7. Implement Client-Server communication using Socket Programming and TCP as transport layer protocol.*
8. Implement Client-Server communication using Socket Programming and UDP as transport layer protocol.*
9. Implement a multi user chat server using TCP as transport layer protocol.*
10. Implement Concurrent Time Server application using UDP to execute the program at remoteserver. Client sends a time request to the server, server sends its system time back to the client. Client displays the result.*
11. Implement and simulate algorithm for Distance vector routing protocol.
12. Implement and simulate algorithm for Link state routing protocol.
13. Implement Simple Mail Transfer Protocol *
14. Develop concurrent file server which will provide the file requested by client if it exists. If not server sends appropriate message to the client. Server should also send its process ID (PID) to clients for display along with file or the message.*
15. Using Wireshark observe data transferred in client server communication using UDP and identify the UDP datagram.
16. Using Wireshark observe Three Way Handshaking Connection Establishment, Data Transfer and Three Way Handshaking Connection Termination in client server communication using TCP.
17. Develop a packet capturing and filtering application using raw sockets.
18. Design and configure a network with multiple subnets with wired and wireless LANs using required network devices. Configure the following services in the network- TELNET, SSH, FTP server, Web server, File server, DHCP server and DNS server *
19. Install network simulator NS-2 in any of the Linux operating system and simulate wired and wireless scenarios.

Expected Outcome

The students will be able to

1. Use network related commands and configuration files in Linux Operating System.
2. Develop operating system and network application programs.
3. Analyze network traffic using network monitoring tools.

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Course code	Course Name	L-T-P - Credits	Year of Introduction
CS364	**Mobile Computing**	**3-0-0-3**	**2016**

Pre-requisite: CS307 Data Communication

Course Objectives

- To impart basic understanding of the wireless communication systems.
- To expose students to various aspects of mobile and ad-hoc networks.

Syllabus

Mobile Computing Application and Services, Mobile Computing Architecture, Emerging Technologies, Intelligent Networks and Internet, Wireless LAN, MAC layer routing, Mobile transport layer Security Issues in mobile computing.

Expected Outcome

Student is able to

1. Explain various Mobile Computing application, services and architecture.
2. Understand various technology trends for next generation cellular wireless networks.
3. Describe protocol architecture of WLAN technology.
4. Understand Security Issues in mobile computing.

Text Books

1. Asoke K. Talukder, Hasan Ahmad, Mobile Computing Technology- Application and Service Creation, 2nd Edition, McGraw Hill Education.
2. Jochen Schiller, Mobile Communications, Pearson Education Asia, 2008.
3. Jonathan Rodriguez , Fundamentals of 5G Mobile Networks, ,Wiley Publishers, 2015
4. Theodore S. Rappaport, Wireless Communications Principles and Practice, 2/e, PHI, New Delhi, 2004.

References

1. Andrew S. Tanenbaum, Computer Networks, PHI, Third edition, 2003.

Course Plan

Module	Contents	Hours	End Sem. Exam Marks
I	Introduction to mobile computing, Middleware and Gateways, Application and services, Internet-Ubiquitous networks, Architecture and three-tier architecture for Mobile Computing, Design consideration for Mobile Computing.	06	15%
II	Spread spectrum – Direct sequence, Frequency hoping. Medium Access Control - SDMA, FDMA, TDMA, CDMA, Cellular concepts- channel assignment strategy- hand off strategy interface and system capacity- improving coverage and capacity in cellular system, Satellite Systems-GEO, LEO, MEO. Wireless Communication Systems- Telecommunication Systems- GSM-GSM services & features, architecture -DECT features & characteristics, architecture.	06	15%
FIRST INTERNAL EXAM			
III	Wireless LANS: Wireless LAN Standards – IEEE 802 Protocol Architecture, IEEE 802.11 System Architecture, Protocol Architecture & Services, Cellular Networks: Channel allocation, multiple access, location management, Handoffs. MAC Layer & Management, Routing - Classification of Routing	07	15%

	Algorithms, Algorithms such as DSR, AODV, DSDV, Mobile Agents, Service Discovery.		
IV	Mobile internet-mobile network layer-mobile IP-dynamic host configuration protocol-, mobile transport layer-implications of TCP on mobility-indirect TCP-snooping TCP- mobile TCP transmission-selective retransmission, Transaction oriented TCP- Support for mobility-file systems-WAP.	**07**	**15%**
SECOND INTERNAL EXAM			
V	Mobile Transport Layer - Conventional TCP/IP Protocols, Indirect TCP, Snooping TCP, Mobile TCP, Other Transport Layer Protocols for Mobile Networks. Protocols and Platforms for Mobile Computing - WAP, Bluetooth, XML, J2ME, JavaCard, PalmOS, Linux for Mobile Devices, Android.	**08**	**20%**
VI	Security issues in mobile computing, Information Security, Components of Information Security, Next Generation Networks-LTE – Architecture & Interface – LTE radio planning and tools, 5G architecture, MIMO, Super core concept, Features and Application Case Study – Setting up anadhoc network system, LiFi.	**08**	**20%**
END SEMESTER EXAM			

Question Paper Pattern

1. There will be *five* parts in the question paper – A, B, C, D, E
2. Part A
   a. Total marks : 12
   b. *Four* questions each having *3* marks, uniformly covering modules I and II; All*four* questions have to be answered.
3. Part B
   a. Total marks : 18
   b. *Three*questions each having *9* marks, uniformly covering modules I and II; *Two* questions have to be answered. Each question can have a maximum of three subparts.
4. Part C
   a. Total marks : 12
   b. *Four*questions each having *3* marks, uniformly covering modules III and IV; All*four* questions have to be answered.
5. Part D
   a. Total marks : 18
   b. *Three* questions each having *9* marks, uniformly covering modules III and IV; *Two* questions have to be answered. Each question can have a maximum of three subparts
6. Part E
   a. Total Marks: 40
   b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
   c. A question can have a maximum of three sub-parts.

I	**Introduction to the Internet:** The World Wide Web, Web Browsers, Web Servers, Uniform Resource Locators, Multipurpose Internet Mail Extensions, The Hypertext Transfer Protocol. Common Gateway Interface(CGI), Content Management System – Basics *Case Study:* Apache Server, WordPress.	06	15%
II	**Introduction to HTML/XHTML :** Origins and Evolution of HTML and XHTML, Basic Syntax of HTML, Standard HTML Document Structure, Basic Text Markup, Images, Hypertext Links, Lists, Tables, Forms, HTML5, Syntactic Differences between HTML and XHTML.	07	15%
FIRST INTERNAL EXAM			
III	**Introduction to Styles sheets and Frameworks** **Cascading Style Sheets:** Levels of Style Sheets - Style Specification Formats, Selector Forms, Property-Value Forms, Font Properties, List Properties, Alignment of Text, Color, The Box Model, Background Images, The span and div Tags. **Frameworks:** Overview and Basics of Responsive CSS Frameworks - Bootstrap.	06	15%
IV	**Introduction to JavaScript and jQuery** **The Basics of JavaScript:** Overview of JavaScript, Object Orientation and JavaScript, General Syntactic Characteristics-Primitives, Operations, and Expressions, Screen Output and Keyboard Input, Control Statements, Object Creation and Modification,Arrays, Functions. Callback Functions, Java Script HTML DOM. **Introduction to jQuery:** Overview and Basics.	07	15%
SECOND INTERNAL EXAMINATION			
V	**Introduction to Data Interchange Formats** **XML:** The Syntax of XML, XML Document Structure, Namespaces, XML Schemas, Displaying Raw XML Documents, Displaying XML Documents with CSS, XSLT Style Sheets, XML Applications. **JSON**(Basics Only): Overview, Syntax, Datatypes, Objects, Schema, Comparison with XML.	08	20%
VI	**Introduction to PHP**: Origins and Uses of PHP, Overview of PHP - General Syntactic Characteristics - Primitives, Operations, and Expressions - Control Statements, Arrays, Functions, Pattern Matching, Form Handling, Cookies, Session Tracking.	08	20%
END SEMESTER EXAM			

Assignment:
It is highly recommended to give assignment based on:

1. JavaScript Frameworks (like AngularJS or/and NodeJS)
2. Any PHP web app based on frameworks(like Laravel, CodeIgniter, CakePHP, Zend etc.)

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Question Paper Pattern

1. There will be *five* parts in the question paper – A, B, C, D, E
2. Part A
   a. Total marks : 12
   b. *Four* questions each having *3* marks, uniformly covering modules I and II; All *four* questions have to be answered.
3. Part B
   a. Total marks : 18
   b. *Three* questions each having *9* marks, uniformly covering modules I and II; *Two* questions have to be answered. Each question can have a maximum of three subparts.
4. Part C
   a. Total marks : 12
   b. *Four* questions each having *3* marks, uniformly covering modules III and IV; All *four* questions have to be answered.
5. Part D
   a. Total marks : 18
   b. *Three* questions each having *9* marks, uniformly covering modules III and IV; *Two* questions have to be answered. Each question can have a maximum of three subparts
6. Part E
   a. Total Marks: 40
   b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
   c. A question can have a maximum of three sub-parts.

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Course code	Course Name	L-T-P Credits	Year of Introduction
CS401	COMPUTER GRAPHICS	4-0-0-4	2016

Course Objectives :

- To introduce concepts of graphics input and display devices.
- To discuss line and circle drawing algorithms.
- To introduce 2D and 3D transformations and projections.
- To introduce fundamentals of image processing.

Syllabus:

Basic Concepts in Computer Graphics. Input devices. Display devices. Line and circle drawing Algorithms. Solid area scan-conversion. Polygon filling. Two dimensional transformations. Windowing, clipping. 3D Graphics, 3D transformations. Projections – Parallel, Perspective. Hidden Line Elimination Algorithms. Image processing – digital image representation – edge detection – Robert, Sobel, Canny edge detectors. Scene segmentation and labeling – region-labeling algorithm – perimeter measurement.

Expected Outcome:

The Students will be able to :

i. compare various graphics devices
ii. analyze and implement algorithms for line drawing, circle drawing and polygon filling
iii. apply geometrical transformation on 2D and 3D objects
iv. analyze and implement algorithms for clipping
v. apply various projection techniques on 3D objects
vi. summarize visible surface detection methods
vii. interpret various concepts and basic operations of image processing

Text Books:

1. Donald Hearn and M. Pauline Baker, Computer Graphics, PHI, 2e, 1996
2. E. Gose, R. Johnsonbaugh and S. Jost., Pattern Recognition and Image Analysis, PHI PTR, 1996 (Module VI – Image Processing part)
3. William M. Newman and Robert F. Sproull , Principles of Interactive Computer Graphics. McGraw Hill, 2e, 1979
4. Zhigang Xiang and Roy Plastock, Computer Graphics (Schaum's outline Series), McGraw Hill, 1986.

References:

1. David F. Rogers , Procedural Elements for Computer Graphics, Tata McGraw Hill, 2001.
2. M. Sonka, V. Hlavac, and R. Boyle, Image Processing, Analysis, and Machine Vision, Thomson India Edition, 2007.
3. Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing. Pearson, 2017

Course Plan

Module	Contents	Hours	End Sem. Exam Marks
I	Basic concepts in Computer Graphics – Types of Graphic Devices – Interactive Graphic inputs – Raster Scan and Random Scan Displays.	7	15%
II	Line Drawing Algorithm- DDA, Bresenham's algorithm – Circle Generation Algorithms –Mid point circle algorithm, Bresenham's algorithm- Scan Conversion-frame buffers – solid area scan conversion – polygon filling algorithms	8	15%
	FIRST INTERNAL EXAM		
III	Two dimensional transformations. Homogeneous coordinate systems – matrix formulation and concatenation of transformations. Windowing concepts –Window to Viewport Transformation- Two dimensional clipping-Line clipping – Cohen Sutherland, Midpoint Subdivision algorithm	8	15%
IV	Polygon clipping-Sutherland Hodgeman algorithm, Weiler-Atherton algorithm, Three dimensional object representation-Polygon surfaces, Quadric surfaces – Basic 3D transformations	8	15%
	SECOND INTERNAL EXAM		
V	Projections – Parallel and perspective projections – vanishing points. Visible surface detection methods– Back face removal- Z-Buffer algorithm, A-buffer algorithm, Depth-sorting method, Scan line algorithm.	9	20%
VI	Image processing – Introduction - Fundamental steps in image processing – digital image representations – relationship between pixels – gray level histogram –spatial convolution and correlation – edge detection – Robert, Prewitt, Sobel.	8	20%
	END SEMESTER EXAM		

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Question Paper Pattern (End semester exam)

1. There will be ***FOUR*** parts in the question paper – **A, B, C, D**
2. **Part A**
   a. **Total marks : 40**
   b. *TEN* questions, each have **4 marks**, covering **all the SIX modules** (***THREE*** questions from **modules I & II**; ***THREE*** questions from **modules III & IV**; ***FOUR*** questions from **modules V & VI**).
   All the TEN questions have to be answered.
3. **Part B**
   a. **Total marks : 18**
   b. *THREE* questions, each having **9 marks**. One question is from **module I**; one question is from **module II**; one question ***uniformly*** covers **modules I & II**.
   c. *Any TWO* questions have to be answered.
   d. Each question can have ***maximum THREE*** subparts.
4. **Part C**
   a. **Total marks : 18**
   b. *THREE* questions, each having **9 marks**. One question is from **module III**; one question is from **module IV**; one question ***uniformly*** covers **modules III & IV**.
   c. *Any TWO* questions have to be answered.
   d. Each question can have ***maximum THREE*** subparts.
5. **Part D**
   a. **Total marks : 24**
   b. *THREE* questions, each having **12 marks**. One question is from **module V**; one question is from **module VI**; one question ***uniformly*** covers **modules V & VI**.
   c. *Any TWO* questions have to be answered.
   d. Each question can have ***maximum THREE*** subparts.
6. There will be ***AT LEAST* 50%** analytical/numerical questions in all possible combinations of question choices.

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Course code	Course Name	L-T-P -Credits	Year of Introduction
CS405	COMPUTER SYSTEM ARCHITECTURE	3-0-0-3	2016

Course Objectives:

- To impart a basic understanding of the parallel architecture and its operations
- To introduce the key features of high performance computers

Syllabus:

Basic concepts of parallel computer models, SIMD computers, Multiprocessors and multi-computers, Cache Coherence Protocols, Multicomputers, Pipelining computers and Multithreading.

Expected outcome :

The Students will be able to :

i. summarize different parallel computer models
ii. analyze the advanced processor technologies
iii. interpret memory hierarchy
iv. compare different multiprocessor system interconnecting mechanisms
v. interpret the mechanisms for enforcing cache coherence
vi. analyze different message passing mechanisms
vii. analyze different pipe lining techniques
viii. appraise concepts of multithreaded and data flow architectures

Text Book:

- K. Hwang and Naresh Jotwani, Advanced Computer Architecture, Parallelism, Scalability, Programmability, TMH, 2010.

References:

1. H P Hayes, Computer Architecture and Organization, McGraw Hill, 1978.
2. K. Hwang & Briggs , Computer Architecture and Parallel Processing, McGraw Hill International, 1986
3. M J Flynn, Computer Architecture: Pipelined and Parallel Processor Design, Narosa Publishing House, 2012.
4. M Sasikumar, D Shikkare and P Raviprakash, Introduction to Parallel Processing, PHI, 2014.
5. P M Kogge, The Architecture of Pipelined Computer, McGraw Hill, 1981.
6. P V S Rao , Computer System Architecture, PHI, 2009.
7. Patterson D. A. and Hennessy J. L., Morgan Kaufmann , Computer Organization and Design: The Hardware/Software Interface, Morgan Kaufmann Pub, 4/e, 2010.

Course Plan			
Module	**Contents**	**Hours**	**End Sem. Exam Marks**
I	Parallel computer models – Evolution of Computer Architecture, System Attributes to performance, Amdahl's law for a fixed workload. Multiprocessors and Multicomputers, Multivector and SIMD computers, Architectural development tracks, Conditions of parallelism.	6	15%
II	Processors and memory hierarchy – Advanced processor technology- Design Space of processors, Instruction Set Architectures, CISC Scalar Processors, RISC Scalar Processors, Superscalar and vector processors, Memory hierarchy technology.	8	15%
FIRST INTERNAL EXAM			
III	Multiprocessors system interconnects - Hierarchical bus systems, Cross bar switch and multiport memory, Multistage and combining networks. Cache Coherence and Synchronization Mechanisms, Cache Coherence Problem, Snoopy Bus Protocol, Directory Based Protocol, Hardware Synchronization Problem	7	15%
IV	Message Passing Mechanisms-Message Routing schemes, Flow control Strategies, Multicast Routing Algorithms. Pipelining and Superscalar techniques – Linear Pipeline processors and Nonlinear pipeline processors	8	15%
SECOND INTERNAL EXAM			
V	Instruction pipeline design, Arithmetic pipeline deign - Super Scalar Pipeline Design	8	20%
VI	Multithreaded and data flow architectures - Latency hiding techniques, Principles of multithreading - Multithreading Issues and Solutions, Multiple context Processors, Fine-grain Multicomputer- Fine-grain Parallelism. Dataflow and hybrid architecture	8	20%
END SEMESTER EXAM			

Question Paper Pattern (End semester exam)

1. There will be *FOUR* parts in the question paper – **A, B, C, D**
2. **Part A**
    a. **Total marks : 40**
    b. *TEN* questions, each have **4 marks,** covering **all the SIX modules** (*THREE* questions from **modules I & II**; *THREE* questions from **modules III & IV**; *FOUR* questions from **modules V & VI**).
    All the TEN questions have to be answered.
3. **Part B**
    a. **Total marks : 18**
    b. *THREE* questions, each having **9 marks**. One question is from **module I**; one question is from **module II**; one question ***uniformly*** covers **modules I & II**.
    c. *Any TWO* questions have to be answered.
    d. Each question can have ***maximum*** *THREE* subparts.
4. **Part C**
    a. **Total marks : 18**
    b. *THREE* questions, each having **9 marks**. One question is from **module III**; one question is from **module IV**; one question ***uniformly*** covers **modules III & IV**.
    c. *Any TWO* questions have to be answered.
    d. Each question can have ***maximum*** *THREE* subparts.
5. **Part D**
    a. **Total marks : 24**
    b. *THREE* questions, each having **12 marks**. One question is from **module V**; one question is from **module VI**; one question ***uniformly*** covers **modules V & VI**.
    c. *Any TWO* questions have to be answered.
    d. Each question can have ***maximum*** *THREE* subparts.
6. There will be *AT LEAST* 60% analytical/numerical questions in all possible combinations of question choices.

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Course code	Course Name	L-T-P - Credits	Year of Introduction
CS407	DISTRIBUTED COMPUTING	3-0-0-3	2016

Course Objectives:

- To introduce fundamental principles of distributed systems, technical challenges and key design issues.
- To impart knowledge of the distributed computing models, algorithms and the design of distributed system.

Syllabus:

Introduction to distributed computing, Design issues, Distributed Computing Models, System models, Inter-process communication, Distributed file system, Name Service , Distributed mutual exclusion , Distributed system design.

Expected Outcome

The Students will be able to :

i. distinguish distributed computing paradigm from other computing paradigms
ii. identify the core concepts of distributed systems
iii. illustrate the mechanisms of inter process communication in distributed system
iv. apply appropriate distributed system principles in ensuring transparency, consistency and fault-tolerance in distributed file system
v. compare the concurrency control mechanisms in distributed transactional environment
vi. outline the need for mutual exclusion and election algorithms in distributed systems

Text Books:

1. George Coulouris, Jean Dollimore and Tim Kindberg , Distributed Systems: Concepts and Design, Fifth Edition , Pearson Education, 2011
2. Pradeep K Sinha, Distributed Operating Systems : Concepts and Design, Prentice Hall of India

References:

1. A S Tanenbaum and M V Steen , Distributed Systems: Principles and paradigms, Pearson Education, 2007
2. M Solomon and J Krammer, Distributed Systems and Computer Networks, PHI

Course Plan

Module	Contents	Hours	End Sem. Exam Marks
I	Evolution of Distributed Computing -Issues in designing a distributed system- Challenges- Minicomputer model – Workstation model - Workstation-Server model– Processor - pool model - Trends in distributed systems	7	15%
II	System models: Physical models - Architectural models - Fundamental models	6	15%

FIRST INTERNAL EXAM			
III	Interprocess communication: characteristics – group communication - Multicast Communication –Remote Procedure call - Network virtualization. Case study : Skype	7	15%
IV	Distributed file system: File service architecture - Network file system- Andrew file system- Name Service	7	15%
SECOND INTERNAL EXAM			
V	Transactional concurrency control:- Transactions, Nested transactions-Locks-Optimistic concurrency control	7	20%
VI	Distributed mutual exclusion – central server algorithm – ring based algorithm- Maekawa's voting algorithm – Election: Ring -based election algorithm – Bully algorithm	7	20%
END SEMESTER EXAM			

Question Paper Pattern

1. There will be *FOUR* parts in the question paper – **A, B, C, D**
2. **Part A**
   a. **Total marks : 40**
   b. *TEN* questions, each have **4 marks**, covering **all the SIX modules** (*THREE* questions from **modules I & II**; *THREE* questions from **modules III & IV**; *FOUR* questions from **modules V & VI**).
   All the TEN questions have to be answered.
3. **Part B**
   a. **Total marks : 18**
   b. *THREE* questions, each having **9 marks**. One question is from **module I**; one question is from **module II**; one question *uniformly* covers **modules I & II**.
   c. *Any TWO* questions have to be answered.
   d. Each question can have *maximum THREE* subparts.
4. **Part C**
   a. **Total marks : 18**
   b. *THREE* questions, each having **9 marks**. One question is from **module III**; one question is from **module IV**; one question *uniformly* covers **modules III & IV**.
   c. *Any TWO* questions have to be answered.
   d. Each question can have *maximum THREE* subparts.
5. **Part D**
   a. **Total marks : 24**
   b. *THREE* questions, each having **12 marks**. One question is from **module V**; one question is from **module VI**; one question *uniformly* covers **modules V & VI**.
   c. *Any TWO* questions have to be answered.
   d. Each question can have *maximum THREE* subparts.
6. There will be *AT LEAST* 50% analytical/numerical questions in all possible combinations of question choices.

Course code	Course Name	L-T-P Credits	Year of Introduction
CS409	CRYPTOGRAPHY AND NETWORK SECURITY	3-0-0-3	2016

Course Objectives:

- To introduce fundamental concepts of symmetric and asymmetric cipher models.
- To introduce fundamental concepts of authentication.
- To introduce network security and web security protocols.

Syllabus:

Symmetric Cipher Models - Differential and linear Cryptanalysis- Block Cipher Design principles- Primitive operations- Key expansions- Inverse Cipher- Principles of Public key Cryptography Systems - Authentication functions- Message authentication codes- Hash functions- Digital signatures- Authentication protocols- Network security - Web Security - secure Socket Layer and Transport layer Security- Secure electronic transaction –Firewalls.

Expected Outcome:

The Students will be able to :

i. summarize different classical encryption techniques
ii. identify mathematical concepts for different cryptographic algorithms
iii. demonstrate cryptographic algorithms for encryption/key exchange
iv. summarize different authentication and digital signature schemes
v. identify security issues in network, transport and application layers and outline appropriate security protocols

Text Books:

1. Behrouz A. Forouzan, Cryptography and Network Security, Tata McGraw-Hill. 2010
2. William Stallings, Cryptography and Network Security, Pearson Education, 2014

References:

1. B. Schneier , Applied Cryptography, Protocols, Algorithms, and Source Code in C, 2 nd Edn, Wiley, 1995.
2. Charlie Kaufman, Radia Perlman, Mike Speciner, Network Security, PHI, 2002

Course Plan

Module	Contents	Hours	End Sem. Exam Marks
I	Symmetric Cipher Models- Substitution techniques- Transposition techniques- Rotor machines-Steganography. Simplified DES- Block Cipher principles- The Data Encryption Standard, Strength of DES- Differential and linear Cryptanalysis. Block Cipher Design principles- Block Cipher modes of operations.	7	15 %
II	IDEA: Primitive operations- Key expansions- One round, Odd round, Even Round- Inverse keys for decryption. AES: Basic Structure- Primitive operation- Inverse Cipher- Key Expansion, Rounds, Inverse Rounds. Stream Cipher –RC4.	7	15 %
	FIRST INTERNAL EXAM		

III	Public key Cryptography: - Principles of Public key Cryptography Systems, Number theory- Fundamental Theorem of arithmetic, Fermat's Theorem, Euler's Theorem, Euler's Totient Function, Extended Euclid's Algorithm, Modular arithmetic. RSA algorithm- Key Management - Diffie-Hellman Key Exchange, Elliptic curve cryptography	7	15 %
IV	Authentication requirements- Authentication functions- Message authentication codes- Hash functions- SHA -1, MD5, Security of Hash functions and MACs- Authentication protocols-Digital signatures-Digital signature standards.	7	15 %
SECOND INTERNAL EXAM			
V	Network security: Electronic Mail Security: Pretty good privacy- S/MIME. IP Security: Architecture- authentication Header- Encapsulating Security payload- Combining Security associations- Key management.	7	20 %
VI	Web Security: Web Security considerations- secure Socket Layer and Transport layer Security- Secure electronic transaction. Firewalls-Packet filters- Application Level Gateway- Encrypted tunnels.	7	20 %
END SEMESTER EXAM			

Question Paper Pattern (End semester exam)

1. There will be ***FOUR*** parts in the question paper – **A, B, C, D**
2. **Part A**
   a. **Total marks : 40**
   b. *TEN* questions, each have **4 marks**, covering **all the SIX modules** (*THREE* questions from **modules I & II**; *THREE* questions from **modules III & IV**; *FOUR* questions from **modules V & VI**). *All* questions have to be answered.
3. **Part B**
   a. **Total marks : 18**
   b. *THREE* questions, each having **9 marks**. One question is from **module I**; one question is from **module II**; one question ***uniformly*** covers **modules I & II**.
   c. *Any TWO* questions have to be answered.
   d. Each question can have ***maximum THREE*** subparts.
4. **Part C**
   a. **Total marks : 18**
   b. *THREE* questions, each having **9 marks**. One question is from **module III**; one question is from **module IV**; one question ***uniformly*** covers **modules III & IV**.
   c. *Any TWO* questions have to be answered.
   d. Each question can have ***maximum THREE*** subparts.
5. **Part D**
   a. **Total marks : 24**
   b. *THREE* questions, each having **12 marks**. One question is from **module V**; one question is from **module VI**; one question ***uniformly*** covers **modules V & VI**.
   c. *Any TWO* questions have to be answered.
   d. Each question can have ***maximum THREE*** subparts.
6. There will be ***AT LEAST* 60%** analytical/numerical questions in all possible combinations of question choices.

II	Image transforms and its properties – Unitary transform; Discrete Fourier Transform; Discrete Cosine Transform; Walsh Transform; Hadamard Transform;	7	15%
FIRST INTERNAL EXAM			
III	Image Enhancement in spatial domain Basic Gray Level Transformation functions – Image Negatives; Log Transformations; Power-Law Transformations. Piecewise-Linear Transformation Functions: Contrast Stretching; Gray Level Slicing; Bit Plane Slicing; Histogram Processing–Equalization; Specification. Basics of Spatial Filtering – Smoothing: Smoothing	8	15%
IV	Image Enhancement in Frequency Domain Basics of Filtering in Frequency Domain, Filters - Smoothing Frequency Domain Filters : Ideal Low Pass Filter; Gaussian Low Pass Filter; Butterworth Low Pass Filter; Sharpening Frequency Domain Filters: Ideal High Pass Filter; Gaussian High Pass Filter; Butterworth High Pass Filter; Homomorphic Filtering	6	15%
SECOND INTERNAL EXAM			
V	Image Segmentation: Pixel-Based Approach- Multi-Level Thresholding, Local Thresholding, Threshold Detection Method; Region-Based Approach- Region Growing Based Segmentation, Region Splitting, Region Merging, Split and Merge, Edge Detection -	8	20%
VI	Morphological Operations Basics of Set Theory; Dilation and Erosion - Dilation, Erosion; Structuring Element; Opening and Closing; Hit or Miss Transformation. Representation and Description Representation - Boundary, Chain codes, Polygonal approximation approaches, Boundary segments.	7	20%
END SEMESTER EXAM			

Question Paper Pattern (End semester exam)

1. There will be ***FOUR*** parts in the question paper – **A, B, C, D**
2. **Part A**
   a. **Total marks : 40**
   b. *TEN* questions, each have **4 marks**, covering **all the SIX modules** (***THREE*** questions from **modules I & II**; ***THREE*** questions from **modules III & IV**; ***FOUR*** questions from **modules V & VI**).
   All the TEN questions have to be answered.

3. **Part B**
    a. **Total marks : 18**
    b. ***THREE*** questions, each having **9 marks**. One question is from **module I**; one question is from **module II**; one question ***uniformly*** covers **modules I & II**.
    c. ***Any TWO*** questions have to be answered.
    d. Each question can have ***maximum THREE*** subparts.
4. **Part C**
    a. **Total marks : 18**
    b. ***THREE*** questions, each having **9 marks**. One question is from **module III**; one question is from **module IV**; one question ***uniformly*** covers **modules III & IV**.
    c. ***Any TWO*** questions have to be answered.
    d. Each question can have ***maximum THREE*** subparts.
5. **Part D**
    a. **Total marks : 24**
    b. ***THREE*** questions, each having **12 marks**. One question is from **module V**; one question is from **module VI**; one question ***uniformly*** covers **modules V & VI**.
    c. ***Any TWO*** questions have to be answered.
    d. Each question can have ***maximum THREE*** subparts.
6. There will be ***AT LEAST 60%*** analytical/numerical questions in all possible combinations of question choices.

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Course code	Course Name	L-T-P Credits	Year of Introduction
CS467	MACHINE LEARNING	3-0-0-3	2016

Course Objectives:

- To introduce the prominent methods for machine learning
- To study the basics of supervised and unsupervised learning
- To study the basics of connectionist and other architectures

Syllabus:
Introduction to Machine Learning, Learning in Artificial Neural Networks, Decision trees, HMM, SVM, and other Supervised and Unsupervised learning methods.

Expected Outcome:
The Students will be able to :

i. differentiate various learning approaches, and to interpret the concepts of supervised learning
ii. compare the different dimensionality reduction techniques
iii. apply theoretical foundations of decision trees to identify best split and Bayesian classifier to label data points
iv. illustrate the working of classifier models like SVM, Neural Networks and identify classifier model for typical machine learning applications
v. identify the state sequence and evaluate a sequence emission probability from a given HMM
vi. illustrate and apply clustering algorithms and identify its applicability in real life problems

References:

1. Christopher M. Bishop, *Pattern Recognition and Machine Learning*, Springer, 2006.
2. Ethem Alpaydın, *Introduction to Machine Learning* (Adaptive Computation and Machine Learning), MIT Press, 2004.
3. Margaret H. Dunham. Data Mining: introductory and Advanced Topics, Pearson, 2006
4. Mitchell. T, *Machine Learning*, McGraw Hill.
5. Ryszard S. Michalski, Jaime G. Carbonell, and Tom M. Mitchell, *Machine Learning : An Artificial Intelligence Approach*, Tioga Publishing Company.

Course Plan

Module	Contents	Hours	End Sem. Exam Marks %
I	Introduction to Machine Learning, Examples of Machine Learning applications - Learning associations, Classification, Regression, Unsupervised Learning, Reinforcement Learning. Supervised learning- Input representation, Hypothesis class, Version space, Vapnik-Chervonenkis (VC) Dimension	6	15

II	Probably Approximately Learning (PAC), Noise, Learning Multiple classes, Model Selection and Generalization. Dimensionality reduction- Subset selection, Principle Component Analysis	8	15
FIRST INTERNAL EXAM			
III	Classification- Cross validation and re-sampling methods- K-fold cross validation, Boot strapping, Measuring classifier performance- Precision, recall, ROC curves. Bayes Theorem, Bayesian classifier, Maximum Likelihood estimation, Density functions, Regression	8	20
IV	Decision Trees- Entropy, Information Gain, Tree construction, ID3, Issues in Decision Tree learning- Avoiding Over-fitting, Reduced Error Pruning, The problem of Missing Attributes, Gain Ratio, Classification by Regression (CART), Neural Networks- The Perceptron, Activation Functions, Training Feed Forward Network by Back Propagation.	6	15
SECOND INTERNAL EXAM			
V	Kernel Machines- Support Vector Machine- Optimal Separating hyper plane, Soft-margin hyperplane, Kernel trick, Kernel functions. Discrete Markov Processes, Hidden Markov models, Three basic problems of HMMs- Evaluation problem, finding state sequence, Learning model parameters. Combining multiple learners, Ways to achieve diversity, Model combination schemes, Voting, Bagging, Booting	8	20
VI	Unsupervised Learning - Clustering Methods - K-means, Expectation-Maximization Algorithm, Hierarchical Clustering Methods , Density based clustering	6	15
END SEMESTER EXAM			

Question Paper Pattern

1. There will be ***FOUR*** parts in the question paper – **A, B, C, D**
2. **Part A**
   a. **Total marks : 40**
   b. *TEN* questions, each have **4 marks**, covering **all the SIX modules** (***THREE*** questions from **modules I & II**; ***THREE*** questions from **modules III & IV**; ***FOUR*** questions from **modules V & VI**).
   All the TEN questions have to be answered.
3. **Part B**
   a. **Total marks : 18**
   b. *THREE* questions, each having **9 marks**. One question is from **module I**; one question is from **module II**; one question ***uniformly*** covers **modules I & II.**
   c. *Any TWO* questions have to be answered.
   d. Each question can have ***maximum THREE*** subparts.

4. **Part C**
    a. **Total marks : 18**
    b. *THREE* questions, each having **9 marks**. One question is from **module III**; one question is from **module IV**; one question ***uniformly*** covers **modules III & IV**.
    c. ***Any TWO*** questions have to be answered.
    d. Each question can have ***maximum THREE*** subparts.
5. **Part D**
    a. **Total marks : 24**
    b. *THREE* questions, each having **12 marks**. One question is from **module V**; one question is from **module VI**; one question ***uniformly*** covers **modules V & VI**.
    c. ***Any TWO*** questions have to be answered.
    d. Each question can have ***maximum THREE*** subparts.
6. There will be ***AT LEAST* 60%** analytical/numerical questions in all possible combinations of question choices.

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Course code	Course Name	L-T-P Credits	Year of Introduction
CS402	DATA MINING AND WAREHOUSING	3-0-0-3	2016

Course Objectives:

- To introduce the concepts of data Mining and its applications
- To understand investigation ofe data using practical data mining tools.
- To introduce Association Rules Mining
- To introduce advanced Data Mining techniques

Syllabus:

Data Mining, Applications, Data Mining Models, Data Warehousing and OLAP, Challenges, Tools, Data Mining Principles, Data Preprocessing: Data Preprocessing Concepts, Data Visualization, Data Sets and Their Significance, Classification Models, Multi Resolution Spatial Data Mining, Classifiers, Association Rules Mining, Cluster Analysis, Practical Data Mining Tools, Advanced Data Mining Techniques, Web Mining, Text Mining, CRM Applications and Data Mining, Data warehousing.

Expected Outcome:

The Student will be able to :

i. identify the key process of Data mining and Warehousing
ii. apply appropriate techniques to convert raw data into suitable format for practical data mining tasks
iii. analyze and compare various classification algorithms and apply in appropriate domain
iv. evaluate the performance of various classification methods using performance metrics
v. make use of the concept of association rule mining in real world scenario
vi. select appropriate clustering and algorithms for various applications
vii. extend data mining methods to the new domains of data

Text Books:

1. Dunham M H, "Data Mining: Introductory and Advanced Topics", Pearson Education, New Delhi, 2003.
2. Jaiwei Han and Micheline Kamber, "Data Mining Concepts and Techniques", Elsevier, 2006.

References:

1. M Sudeep Elayidom, "Data Mining and Warehousing", 1st Edition, 2015, Cengage Learning India Pvt. Ltd.
2. Mehmed Kantardzic, "Data Mining Concepts, Methods and Algorithms", John Wiley and Sons, USA, 2003.
3. Pang-Ning Tan and Michael Steinbach, "Introduction to Data Mining", Addison Wesley, 2006.

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Course Plan			
Module	**Contents**	**Hours**	**End Sem Exam . Marks**
I	Data Mining:- Concepts and Applications, Data Mining Stages, Data Mining Models, Data Warehousing (DWH) and On-Line Analytical Processing (OLAP), Need for Data Warehousing, Challenges, Application of Data Mining Principles, OLTP Vs DWH, Applications of DWH	6	15%
II	Data Preprocessing: Data Preprocessing Concepts, Data Cleaning, Data integration and transformation, Data Reduction, Discretization and concept hierarchy.	6	15%
FIRST INTERNAL EXAM			
III	Classification Models: Introduction to Classification and Prediction, Issues regarding classification and prediction, Decision Tree- ID3, C4.5, Naive Bayes Classifier.	6	15%
IV	Rule based classification- 1R. Neural Networks-Back propagation. Support Vector Machines, Lazy Learners-K Nearest Neighbor Classifier. Accuracy and error Measures-evaluation. Prediction:-Linear Regression and Non-Linear Regression.	6	15%
SECOND INTERNAL EXAM			
V	Association Rules Mining: Concepts, Apriori and FP-Growth Algorithm. Cluster Analysis: Introduction, Concepts, Types of data in cluster analysis, Categorization of clustering methods. Partitioning method: K-Means and K-Medoid Clustering.	8	20
VI	Hierarchical Clustering method: BIRCH. Density-Based Clustering –DBSCAN and OPTICS. Advanced Data Mining Techniques: Introduction, Web Mining- Web Content Mining, Web Structure Mining, Web Usage Mining. Text Mining. Graph mining:- Apriori based approach for mining frequent subgraphs. Social Network Analysis:- characteristics of social networks. Link mining:- Tasks and challenges.	8	20
END SEMESTER EXAMINATION			

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Question Paper Pattern

1. There will be ***FOUR*** parts in the question paper – **A, B, C, D**
2. **Part A**
   a. **Total marks : 40**
   b. *TEN* questions, each have **4 marks,** covering **all the SIX modules** (*THREE* questions from **modules I & II**; *THREE* questions from **modules III & IV**; *FOUR* questions from **modules V & VI**).
   All the TEN questions have to be answered.
3. **Part B**
   a. **Total marks : 18**
   b. *THREE* questions, each having **9 marks**. One question is from **module I**; one question is from **module II**; one question ***uniformly*** covers **modules I & II**.
   c. ***Any TWO*** questions have to be answered.
   d. Each question can have ***maximum THREE*** subparts.
4. **Part C**
   a. **Total marks : 18**
   b. *THREE* questions, each having **9 marks.** One question is from **module III**; one question is from **module IV**; one question ***uniformly*** covers **modules III & IV**.
   c. ***Any TWO*** questions have to be answered.
   d. Each question can have ***maximum THREE*** subparts.
5. **Part D**
   a. **Total marks : 24**
   b. *THREE* questions, each having **12 marks**. One question is from **module V**; one question is from **module VI**; one question ***uniformly*** covers **modules V & VI**.
   c. ***Any TWO*** questions have to be answered.
   d. Each question can have ***maximum THREE*** subparts.
6. There will be ***AT LEAST* 60%** analytical/numerical questions in all possible combinations of question choices.

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Course code	Course Name	L-T-P -Credits	Year of Introduction
CS404	Embedded Systems	3-0-0-3	2016

Course Objectives:

- To introduce the technologies behind embedded computing systems.
- To introduce and discuss various software components involved in embedded system design and development.
- To expose students to the recent trends in embedded system design.

Syllabus:

Introduction to embedded systems, basic components, its characteristics. Modelling embedded systems, firmware development. Integration and testing of embedded systems, development environment. Characteristics of RTOS, interrupt handling, creating tasks in a typical RTOS. Embedded product development life cycle.

Expected Outcome:

The Student will be able to :

i. demonstrate the role of individual components involved in a typical embedded system
ii. analyze the characteristics of different computing elements and select the most appropriate one for an embedded system
iii. model the operation of a given embedded system
iv. substantiate the role of different software modules in the development of an embedded system
v. develop simple tasks to run on an RTOS
vi. examine the latest trends prevalent in embedded system design

References:

1. J Staunstrup and Wayne Wolf, Hardware / Software Co-Design: Principles and Practice, Prentice Hall.
2. Jean J. Labrose, Micro C/OS II: The Real Time Kernel, 2e, CRC Press, 2002.
3. Raj Kamal, Embedded Systems: Architecture, Programming and Design, Third Edition. McGraw Hill Education (India), 2014.
4. Shibu K.V., Introduction to Embedded Systems, McGraw Hill Education (India), 2009.
5. Steave Heath, Embedded System Design, Second Edition, Elsevier.
6. Wayne Wolf , Computers as Components-Principles of Embedded Computer System Design, Morgan Kaufmann publishers, Third edition, 2012.

Course Plan

Module	Contents	Hours	End Sem. Exam Marks
I	Fundamentals of Embedded Systems- complex systems and microprocessors- Embedded system design process .Specifications- architecture design of embedded system- design of hardware and software components- structural and behavioural description.	6	15%
II	Hardware Software Co-Design and Program Modelling – Fundamental Issues, Computational Models- Data Flow Graph, Control Data Flow Graph, State Machine,. Sequential Model, Concurrent Model, Object oriented model, UML	9	15%

FIRST INTERNAL EXAMINATION			
III	Design and Development of Embedded Product – Firmware Design and Development – Design Approaches, Firmware Development Languages.	6	15%
IV	Integration and Testing of Embedded Hardware and Firmware- Integration of Hardware and Firmware. Embedded System Development Environment – IDEs, Cross Compilers, Disassemblers, Decompilers, Simulators, Emulators and Debuggers.	6	15%
SECOND INTERNAL EXAMINATION			
V	RTOS based Design – Basic operating system services. Interrupt handling in RTOS environment. Design Principles. Task scheduling models. How to Choose an RTOS. Case Study – MicroC/OS-II.	9	20%
VI	Networks – Distributed Embedded Architectures, Networks for embedded systems, Network based design, Internet enabled systems. Embedded Product Development Life Cycle – Description – Objectives -Phases – Approaches1. Recent Trends in Embedded Computing.	6	20%
END SEMESTER EXAM			

Question Paper Pattern

1. There will be ***FOUR*** parts in the question paper – **A, B, C, D**
2. **Part A**
   a. **Total marks : 40**
   b. *TEN* questions, each have **4 marks**, covering **all the SIX modules** (***THREE*** questions from **modules I & II**; ***THREE*** questions from **modules III & IV**; *FOUR* questions from **modules V & VI**). *All* questions have to be answered.
3. **Part B**
   a. **Total marks : 18**
   b. *THREE* questions, each having **9 marks**. One question is from **module I**; one question is from **module II**; one question ***uniformly*** covers **modules I & II**.
   c. *Any TWO* questions have to be answered.
   d. Each question can have ***maximum THREE*** subparts.
4. **Part C**
   a. **Total marks : 18**
   b. *THREE* questions, each having **9 marks**. One question is from **module III**; one question is from **module IV**; one question ***uniformly*** covers **modules III & IV**.
   c. *Any TWO* questions have to be answered.
   d. Each question can have ***maximum THREE*** subparts.
5. **Part D**
   a. **Total marks : 24**
   b. *THREE* questions, each having **12 marks**. One question is from **module V**; one question is from **module VI**; one question ***uniformly*** covers **modules V & VI**.
   c. *Any TWO* questions have to be answered.
   d. Each question can have ***maximum THREE*** subparts.
6. There will be ***AT LEAST*** **50%** analytical/numerical questions in all possible combinations of question choices.

Course code	Course Name	L-T-P - Credits	Year of Introduction
CS464	**ARTIFICIAL INTELLIGENCE**	**3-0-0-3**	**2016**

Course Objectives:

- To introduce basic principles that drive complex real world intelligence applications.
- To introduce and discuss the basic concepts of AI Techniques and Learning

Syllabus:

Introduction to AI, Solving Problems by Searching-uninformed, informed, heuristic, constraint Satisfaction problems -AI Representational Schemes-Learning-Advanced searches-Alpha beta pruning, Expert Systems-Natural Language Processing Concepts.

Expected Outcome:

The Student will be able to :

i. appreciate the scope and limits of the artificial intelligence (AI) field
ii. assess the applicability, strengths, and weaknesses of the basic knowledge representation
iii. interpret the role of knowledge representation, problem solving, and learning
iv. explain various search algorithms (uninformed, informed, and heuristic) for problem solving
v. comprehend the fundamentals of Natural Language Processing

Text Books:

1. E Rich. K Knight, Artificial Intelligence, 3/e, Tata McGraw Hil, 2009.
2. George.F.Luger, Artificial Intelligence- Structures and Strategies for Complex Problem Solving, 4/e, Pearson Education. 2002.

References:

1. D. Poole and A. Mackworth. Artificial Intelligence: Foundations of Computational Agents, Cambridge University Press, 2010 Available online: *http://artint.info/*
2. Dan W Patterson, Introduction to Artificial Intelligence,Pearson,2009
3. Deepak Khemeni,A First course in Artificial Intelligence,Tata McGraw Hill,2013
4. Maja J. Mataric .Robotics Primer,MIT press,2007
5. Patrick Henry Winston,Artificial intelligence,Addisson wessley,1992
6. Stefan Edelkamp, Stefan Schroedl, Heuristic Search: Theory and Applications, Morgan Kaufman, 2011.
7. Stuart Jonathan Russell, Peter Norvig, Artificial intelligence, A modern approach,3rd edition, pearson,2010

Course Plan			
Module	**Contents**	**Hours**	**End Sem. Exam Marks**
I	**Introduction**: What is AI, The foundations of AI, History and applications, Production systems. Structures and strategies for state space search. Informed and Uninformed searches.	5	15%
II	**Search Methods:** data driven and goal driven search. Depth first and breadth first search, DFS with iterative deepening. Heuristic search-best first search, A * algorithm.AO* algorithm, Constraint Satisfaction. Crypt Arithmetic Problems	8	15%
FIRST INTERNAL EXAMINATION			
III	**AI representational schemes-** Semantic nets, conceptual dependency, scripts, frames, introduction to agent based problem solving, Machine learning-symbol based-a frame work for symbol based learning.	6	15%
IV	**Advanced Search:** Heuristics in Games, Design of good heuristic-an example. Min-Max Search Procedure, Alpha Beta pruning,	6	15%
SECOND INTERNAL EXAMINATION			
V	**Learning Concepts:** Version space search. Back propagation learning. Social and emergent models of learning-genetic algorithm, classifier systems and genetic programming.	9	20%
VI	**Expert Systems:** rule based expert systems. Natural language processing-natural language understanding problem, deconstructing language. Syntax stochastic tools for language analysis, natural language applications	9	20%
END SEMESTER EXAM			

Question Paper Pattern (End semester exam)

1. There will be ***FOUR*** parts in the question paper – **A, B, C, D**
2. **Part A**
   a. **Total marks : 40**
   b. ***TEN*** questions, each have **4 marks**, covering **all the SIX modules** (***THREE*** questions from **modules I & II**; ***THREE*** questions from **modules III & IV**; ***FOUR*** questions from **modules V & VI**).
   All the TEN questions have to be answered.

3. **Part B**
    a. **Total marks : 18**
    b. *THREE* questions, each having **9 marks**. One question is from **module I**; one question is from **module II**; one question ***uniformly*** covers **modules I & II**.
    c. *Any TWO* questions have to be answered.
    d. Each question can have ***maximum THREE*** subparts.
4. **Part C**
    a. **Total marks : 18**
    b. *THREE* questions, each having **9 marks**. One question is from **module III**; one question is from **module IV**; one question ***uniformly*** covers **modules III & IV**.
    c. *Any TWO* questions have to be answered.
    d. Each question can have ***maximum THREE*** subparts.
5. **Part D**
    a. **Total marks : 24**
    b. *THREE* questions, each having **12 marks**. One question is from **module V**; one question is from **module VI**; one question ***uniformly*** covers **modules V & VI**.
    c. *Any TWO* questions have to be answered.
    d. Each question can have ***maximum THREE*** subparts.
6. There will be ***AT LEAST 60%*** analytical/numerical questions in all possible combinations of question choices.

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Course code	Course Name	L-T-P -Credits	Year of Introduction
CS468	CLOUD COMPUTING	3-0-0-3	2016

Course Objectives:

- To impart the fundamentals of virtualization techniques.
- To introduce concepts and security issues of cloud paradigm.
- To introduce cloud computing based programming techniques and cloud services.

Syllabus:

Introduction to Virtualization – Introduction to Cloud Computing , Cloud Architecture and Resource Management ,Cloud Programming ,Security in the Cloud , Using Cloud Services.

Expected Outcome:

The Student will be able to :

i. identify the significance of implementing virtualization techniques.
ii. interpret the various cloud computing models and services
iii. compare the various public cloud platforms and software environments.
iv. apply appropriate cloud programming methods to solve big data problems.
v. appreciate the need of security mechanisms in cloud
vi. illustrate the use of various cloud services available online.

Text Book:

- Kai Hwang , Geoffrey C Fox, Jack J Dongarra : "Distributed and Cloud Computing – From Parallel Processing to the Internet of Things" , Morgan Kaufmann Publishers – 2012.

References:

1. Alex Amies, Harm Sluiman, Qiang Guo Tong and Guo Ning Liu: Developing and Hosting Applications on the cloud, IBM Press, 2012.
2. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud (Theory in Practice)", O'Reilly Publications, 2009.
3. Haley Beard, "Cloud Computing Best Practices for Managing and Measuring Processes for On-demand Computing – applications and Data Centers in the Cloud with SLAs", Emereo Pty Limited, July 2008
4. James E. Smith and Ravi Nair: Virtual Machines: Versatile Platforms for Systems and Processes, Morgan Kaufmann, ELSEVIER Publication, 2006.
5. John W Rittinghouse and James F Ransome , "Cloud Computing: Implementation – Management – and Security", CRC Press, 2010.
6. Michael Miller, "Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online", Pearson Education, 2009.
7. Richard N. Katz, "The Tower and The Cloud", Higher Education in the Age of Cloud Computing, 2008.
8. Toby Velte, Anthony Velte and Robert Elsenpeter: "Cloud Computing – A Practical Approach", TMH, 2009.

Course Plan			
Module	**Contents**	**Hours**	**End Sem. Exam Marks**
I	**INTRODUCTION TO VIRTUALIZATION** Virtual Machines and Virtualization Middleware – Data Center Virtualization for Cloud Computing – Implementation Levels of Virtualization – Virtualization Structures/Tools and Mechanisms – Virtualization of CPU – Memory – I/O Devices	7	15%
II	**INTRODUCTION TO CLOUD COMPUTING** System Models for Distributed and Cloud Computing – Software Environments for Distributed Systems and Clouds – Cloud Computing and Service Models – Public – Private – Hybrid Clouds – Infrastructure-as-a-Service (IaaS) – Platform-as-a-Service (PaaS) - Software-as-a-Service (SaaS)-Different Service Providers	8	15%
FIRST INTERNAL EXAMINATION			
III	**CLOUD ARCHITECTURE AND RESOURCE MANAGEMENT** Architectural Design of Compute and Storage Clouds – Public Cloud Platforms: GAE – AWS – Azure- Emerging Cloud Software Environments – Eucalyptus- Nimbus – Open Stack – Extended Cloud Computing Services – Resource Provisioning and Platform Deployment – Virtual Machine Creation and Management.	8	15%
IV	**CLOUD PROGRAMMING** Parallel Computing and Programming Paradigms – Map Reduce – Twister – Iterative Map Reduce – Hadoop Library from Apache – Pig Latin High Level Languages- Mapping Applications to Parallel and Distributed Systems – Programming the Google App Engine – Google File System (GFS) – Big Table – Google's NOSQL System	7	15%
SECOND INTERNAL EXAMINATION			
V	**SECURITY IN THE CLOUD** Security Overview – Cloud Security Challenges – Security -as-a-Service – Security Governance – Risk Management – Security Monitoring – Security Architecture Design – Data Security – Application Security – Virtual Machine Security.	6	20%
VI	**USING CLOUD SERVICES :** Email Communications – Collaborating on To-Do Lists –Contact Lists – Cloud Computing for the Community- Collaborating on Calendars – Schedules and Task Management – Exploring Online Scheduling Applications – Exploring Online Planning and Task Management – Collaborating on Event Management – Project Management -Word Processing – Databases .	6	20%
END SEMESTER EXAM			

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Question Paper Pattern

1. There will be ***FOUR*** parts in the question paper – **A, B, C, D**
2. **Part A**
    a. **Total marks : 40**
    b. *TEN* questions, each have **4 marks**, covering **all the SIX modules** (***THREE*** questions from **modules I & II**; ***THREE*** questions from **modules III & IV**; ***FOUR*** questions from **modules V & VI**).
    All the TEN questions have to be answered.
3. **Part B**
    a. **Total marks : 18**
    b. ***THREE*** questions, each having **9 marks**. One question is from **module I**; one question is from **module II**; one question ***uniformly*** covers **modules I & II**.
    c. *Any TWO* questions have to be answered.
    d. Each question can have ***maximum THREE*** subparts.
4. **Part C**
    a. **Total marks : 18**
    b. ***THREE*** questions, each having **9 marks**. One question is from **module III**; one question is from **module IV**; one question ***uniformly*** covers **modules III & IV**.
    c. *Any TWO* questions have to be answered.
    d. Each question can have ***maximum THREE*** subparts.
5. **Part D**
    a. **Total marks : 24**
    b. ***THREE*** questions, each having **12 marks**. One question is from **module V**; one question is from **module VI**; one question ***uniformly*** covers **modules V & VI**.
    c. *Any TWO* questions have to be answered.
    d. Each question can have ***maximum THREE*** subparts.
6. There will be ***AT LEAST* 50%** analytical/numerical questions in all possible combinations of question choices.

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Course code	Course Name	L-T-P - Credits	Year of Introduction
CS472	PRINCIPLES OF INFORMATION SECURITY	3-0-0-3	2016

Course Objectives

- To introduce fundamental concepts of security.
- To introduce and discuss the relevance of security in operating system, web services etc.
- To introduce fundamental concepts of secure electronic transactions.

Syllabus

Overview of computer security, Security concepts, Need of Security, Access Control, Access control matrix, Security policies, Software vulnerabilities, Security in current domains - Wireless LAN security, Cell phone security, Secure Electronic transactions, Web Services security

Expected Outcome:

The Student will be able to :

i. appreciate the common threats faced today
ii. interpret the foundational theory behind information security
iii. design a secure system
iv. identify the potential vulnerabilities in software
v. appreciate the relevance of security in various domains
vi. develop secure web services and perform secure e-transactions

Text Books:

1. Bernard Menezes, Network security and Cryptography, Cengage Learning India, 2010.
2. M Bishop, Computer Security: Art and Science, Pearson Education, 2003.

References:

1. E Whiteman and J Mattord, Principles of information security 4th edn, Cengage Learning
2. V K Pachghare, Cryptography and information security, PHI
3. Behrousz A Forouzan, D Mukhopadhyay, Cryptography and network Security, McGraw Hill
4. W Mao, Modern Cryptography: Theory & Practice, Pearson Education, 2004.
5. C P. Fleeger and S L Fleeger, Security in Computing, 3/e, Pearson Education, 2003.

Course Plan

Module	Contents	Hours	End Sem. Exam Marks
I	**Introduction**: Overview of computer security, Security concepts, Need of Security- Threats- Deliberate software attacks, Deviation in quality of service, Attacks- malicious code, brute force, Timing attack, sniffers **Access Control Mechanisms** - Access Control, Access control matrix, Access control in OS-Discretionary and Mandatory access control, Role-based access control, case study SELinux	7	15%

II	**Security policies and models:** confidentiality policies, Bell-LaPadula model, Integrity policies, Biba model, Clark-Wilson models, Chinese wall model, waterfall model	7	15%
FIRST INTERNAL EXAMINATION			
III	**Software vulnerabilities**: Buffer and stack overflow, Cross-site scripting(XSS) , and vulnerabilities, SQL injection and vulnerabilities , Phishing.	6	15%
IV	**Malware:** Viruses, Worms and Trojans. Topological worms. Internet propagation models for worms.	6	15%
SECOND INTERNAL EXAMINATION			
V	**Security in current domains:** Wireless LAN security - WEP details. wireless LAN vulnerabilities – frame spoofing. Cellphone security - GSM and UMTS security. Mobile malware - bluetooth security issues.	8	20%
VI	**Secure Electronics transactions:** Framework, strength and weakness. Security in current applications : Online banking , Credit Card Payment Systems. **Web Services security**: XML, SOAP, SAML, RFID	8	20%
END SEMESTER EXAM			

Question Paper Pattern (End semester exam)

1. There will be ***FOUR*** parts in the question paper – **A, B, C, D**
2. **Part A**
   a. **Total marks : 40**
   b. *TEN* questions, each have **4 marks**, covering **all the SIX modules** (***THREE*** questions from **modules I & II**; ***THREE*** questions from **modules III & IV**; *FOUR* questions from **modules V & VI**). ***All*** questions are to be answered.
3. **Part B**
   a. **Total marks : 18**
   b. *THREE* questions, each having **9 marks.** One question is from **module I;** one question is from **module II**; one question ***uniformly*** covers **modules I & II**.
   c. *Any TWO* questions have to be answered.
   d. Each question can have ***maximum THREE*** subparts.
4. **Part C**
   a. **Total marks : 18**
   b. *THREE* questions, each having **9 marks**. One question is from **module III;** one question is from **module IV**; one question ***uniformly*** covers **modules III & IV**.
   c. *Any TWO* questions have to be answered.
   d. Each question can have ***maximum THREE*** subparts.
5. **Part D**
   a. **Total marks : 24**
   b. *THREE* questions, each having **12 marks**. One question is from **module V;** one question is from **module VI**; one question ***uniformly*** covers **modules V & VI**.
   c. *Any TWO* questions have to be answered.
   d. Each question can have ***maximum THREE*** subparts.
6. There will be ***AT LEAST 60%*** analytical/numerical questions in all possible combinations of question choices.

Electronics and Communication Engineering

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COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC307	Power Electronics & Instrumentation	3-0-0-3	2015

Prerequisite: EC205 Electronic Circuits

Course objectives:
The purpose of this course is:
1. To provide an insight on the concepts of Power Electronics and Electronic instruments.
2. To study the applications of Power electronics such as Switched mode regulators and inverters.
3. To develop understanding of the concept ofTransducers and Digital instruments.

Syllabus:
Power semiconductor switches and its static and dynamic characteristics. Switched mode regulators, SMPS, Switched mode inverters, UPS.
Performance characteristics of instruments, Measurement of passive components, Different Transducers, Digital Instruments.

Expected outcome:
The student should able:
1. To understand the concepts of Power Electronics and the various applications.
2. To get an insight on various electronic instruments, their configuration and measurements using them.
3. To understand the principle of operation of Transducers

Text Books:
1. Umanand L., Power Electronics Essentials and Applications, Wiley India, 2015.
2. Rashid M. H., "Power Electronics Circuits, Devices and Applications", Prentice Hall India, Third Edition, New Delhi.
3. Bell D. A., Electronic Instrumentation and Measurements, Oxford University Press, 2003.

References:
1. Mohan N. and T. M. Undeland, Power Electronics: Converters, Applications and Design, John Wiley, 2007.
2. Mandal, Power Electronics 1e, McGraw Hill Education India, 2014
3. Nakra, Instrumentation, Measurement and Analysis,4e, Mc Graw –Hill Education New Delhi,2016
4. Daniel W. Hart, Power Electronics, McGraw Hill, 2011.
5. Doeblin E., Measurement Systems, 5/e, McGraw Hill, 2003.
6. Helfrick A. D. and W. D. Cooper: Modern Electronic Instrumentation and Measurement Techniques, 5/e, PHI, 2003.
7. Patranabis D., Principles of Electronic Instrumentation, PHI, 2008.

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Course Plan			
Module	**Course content**	**Hours**	**Sem. Exam Marks**
I	Linear Electronics versus Power Electronics - Power semiconductor switches.	1	15
	Power diodes-structure, static and dynamic characteristics	2	
	Power transistors - Power BJT, Power MOSFET, GTO and IGBT	3	
	Steady state and switching characteristics of Power BJT, Power MOSFET and IGBT.	2	
II	Introduction to Switched mode regulators	1	15
	Buck, Boost and Buck-Boost DC-DC converters	2	
	Waveforms and expression of DC-DC converters for output voltage, voltage and current ripple under continuous conduction mode. (Derivation not required)	1	
	Isolated converters - Flyback, Forward, Push Pull, Half Bridge and Full Bridge Converters - waveforms and governing equations. (Derivation not required)	3	
FIRST INTERNAL EXAM			
III	Overview of SMPS, Switched mode inverters- Principles of PWM switching schemes.	2	15
	Single phase inverters - half bridge, full bridge and push pull.	2	
	UPS - on line and off line.	1	
	Three phase inverters - PWM and Space vector modulation in three phase inverters.	3	
IV	Generalized configurations of instruments - Functional elements. Classification of instruments	1	15
	Generalized performance characteristics of instruments - Static characteristics and Dynamic characteristics.	2	
	Measurement of: resistance using Wheastone's bridge, inductance using Maxwell-Wien bridge, and capacitance using Schering's bridge.	2	
SECOND INTERNAL EXAM			
V	Transducers - Classification, Selection of transducers.	1	20
	Resistance transducers - Principle of operation, strain gauge.	2	
	Inductive Transducers: LVDT.	2	
	Capacitive transducers - different types, capacitor microphone, Hall Effect transducer, proximity transducers.	2	
VI	Electronic Multimeter, Audio Power Meter, RF power meter	2	20
	Digital Instruments - Basics, digital measurement of time, phase, frequency and digital voltmeter.	2	

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	Frequency synthesizer, Spectrum analyzers, Logic State analyzers (block diagram only).	1	
	Digital storage oscilloscope – Working Principle, controls and applications.	2	
END SEMESTER EXAM			

Question Paper Pattern

The question paper consists of three parts. Part A covers modules I and II, Part B covers modules III and IV and Part C covers modules V and VI. Each part has three questions. Each question can have a maximum of four subparts. Among the three questions one will be a compulsory question covering both the modules and the remaining two questions will be as one question from each module, of which one is to be answered. Mark pattern is according to the syllabus with 100 % for theory.

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COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC401	INFORMATION THEORY & CODING	4-0-0-4	2016

Prerequisite: EC302 Digital Communication

Course objectives:

- To introduce the concept of information
- To understand the limits of error free representation of information signals and the transmission of such signals over a noisy channel
- To design and analyze data compression techniques with varying efficiencies as per requirements
- To understand the concept of various theorems proposed by Shannon for efficient data compression and reliable transmission
- To give idea on different coding techniques for reliable data transmission
- To design an optimum decoder for various coding schemes used.

Syllabus: Concept of amount of information, Entropy, Source coding, Channel Capacity, Shannon's Limit, Rate Distortion Theory, Channel Coding, Linear Block Codes, Cyclic codes, Cryptography, Convolutional Codes, Viterbi Algorithm

Expected outcome:

The students will be able to

i. Apply the knowledge of Shannon's source coding theorem and Channel coding theorem for designing an efficient and error free communication link.
ii. Analyze various coding schemes
iii. Design an optimum decoder for various coding schemes used.

Text Books:

1. K S Sathya Narayana, Concepts of Information Theory & Coding, Dynaram Publications, 2005
2. Simon Haykin: Digital Communication Systems, Wiley India, 2013.

References:

1. Bose, Information theory coding and cryptography, 3/e McGraw Hill Education India , 2016
2. D.E.R. Denning, Cryptography and Data Security, Addison Wesley, 1983.
3. J S Chitode, Information Theory and Coding, Technical Publications, Pune, 2009
4. Kelbert & Suhov, Information theory and coding by examples, Cambridge University Press, 2013
5. Shu Lin & Daniel J. Costello. Jr., Error Control Coding : Fundamentals and Applications, 2/e, Prentice Hall Inc., Englewood Cliffs, NJ,2004

Course Plan

Module	Course contents	Hours	End Sem. Exam Marks
I	Introduction to Information Theory. Concept of information, units, entropy, marginal, conditional and joint entropies, relation among entropies, mutual information, information rate. Source coding: Instantaneous codes, construction of instantaneous codes, Kraft's inequality, coding efficiency and redundancy	9	15%
II	Noiseless coding theorem , construction of basic source codes, Shannon – Fano Algorithm, Huffman coding, Chan[illegible]ry	9	15%

	symmetric channel (BSC), Binary erasure channel (BEC) – capacity of band limited Gaussian channels		
	FIRST INTERNAL EXAM		
III	Continuous Sources and Channels: Differential Entropy, Mutual information, Waveform channels, Gaussian channels, Shannon – Hartley theorem, bandwidth, SNR trade off, capacity of a channel of infinite bandwidth, Shannon's limit	9	**15%**
IV	Introduction to rings, fields, and Galois fields. Codes for error detection and correction – parity check coding – linear block codes – error detecting and correcting capabilities – generator and parity check matrices – Standard array and syndrome decoding	9	**15%**
	SECOND INTERNAL EXAM		
V	Perfect codes, Hamming codes, encoding and decoding Cyclic codes, polynomial and matrix descriptions, generation of cyclic codes, decoding of cyclic codes BCH codes, Construction and decoding, Reed Solomon codes	9	**20%**
VI	Convolutional Codes – encoding – time and frequency domain approaches, State Tree & Trellis diagrams – transfer function and minimum free distance – Maximum likelihood decoding of convolutional codes – The Viterbi Algorithm. Sequential decoding.	9	**20%**
	END SEMESTER EXAM		

Question Paper

The question paper shall consist of three parts. Part A covers modules I and II. Part B covers modules III and IV, and Part C covers modules V and VI. Each part has three questions uniformly covering the two modules and each question can have maximum four subdivisions. In each part, any two questions are to be answered. Mark patterns are as per the syllabus with 50% for theory and 50% for logical/numerical problems, derivation and proof.

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COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC402	NANOELECTRONICS	3-0-0 -3	2016

Prerequisite: EC203 Solid State Devices, EC304 VLSI

Course objectives:

- To introduce the concepts of nanoelectronics.

Syllabus:

Introduction to nanotechnology, Mesoscopic physics, trends in microelectronics and optoelectronics, characteristic lengths in mesoscopic systems, Quantum mechanical coherence, Schrodinger's Equation, wave function, Low dimensional structures Quantum wells, Basic properties of two dimensional semiconductor nanostructures, Quantum wires and quantum dots, carbon nano tube, grapheme, Introduction to methods of fabrication of nano-layers, Introduction to characterization of nanostructures, Principle of operation of Scanning Tunnelling Microscope, X-Ray Diffraction analysis, MOSFET structures, Quantum wells, modulation doped quantum wells, multiple quantum wells, The concept of super lattices, Transport of charge in Nanostructures under Electric field, Transport of charge in magnetic field, Nanoelectonic devices, principle of NEMS

Expected outcome:

- The students will be able to understand basic concepts of nanoelectronic devices and nano technology.

Text Books:

1. J.M. Martinez-Duart, R.J. Martin Palma, F. Agulle Rueda, Nanotechnology for Microelectronics and optoelectronics, Elsevier, 2006
2. W.R. Fahrner, Nanotechnology and Nanoelctronics, Springer, 2005

References:

1. Chattopadhyay, Banerjee, Introduction to Nanoscience & Technology, PHI, 2012
2. George W. Hanson, Fundamentals of Nanoelectronics, Pearson Education, 2009.
3. K. Goser, P. Glosekotter, J. Dienstuhl, Nanoelectronics and nanosystems, Springer 2004.
4. Murty, Shankar, Text book of Nanoscience and Nanotechnology, Universities Press, 2012.
5. Poole, Introduction to Nanotechnology, John Wiley, 2006.
6. Supriyo Dutta, Quantum Transport- Atom to transistor, Cambridge, 2013.

Course Plan

Module	Course contents	Hours	End Sem. Exam Marks
I	Introduction to nanotechnology, Impacts, Limitations of conventional microelectronics, Trends in microelectronics and optoelectronics	1	15%
	Mesoscopic physics, trends in microelectronics and optoelectronics, characteristic lengths in mesoscopic systems, Quantum mechanical coherence	2	
	Classification of Nano structures, Low dimensional structures Quantum wells, wires and dots, Density of states and dimensionality	1	

	Basic properties of two dimensional semiconductor nanostructures, square quantum wells of finite depth, parabolic and triangular quantum wells,	2	
	Quantum wires and quantum dots, carbon nano tube, graphene	1	
II	Introduction to methods of fabrication of nano-layers, different approaches, physical vapour deposition, chemical vapour deposition	2	15%
	Molecular Beam Epitaxy, Ion Implantation, Formation of Silicon Dioxide- dry and wet oxidation methods.	2	
	Fabrication of nano particle- grinding with iron balls, laser ablation, reduction methods, sol gel, self assembly, precipitation of quantum dots.	2	
FIRST INTERNAL EXAM			
III	Introduction to characterization of nanostructures, tools used for of nano materials characterization, microscope-optical, electron, and electron microscope.	2	15%
	Principle of operation of Scanning Tunnelling Microscope, Atomic Force Microscope, Scanning Electron microscope, Specimen interaction. Transmission Electron Microscope	2	
	X-Ray Diffraction analysis, PL & UV Spectroscopy, Particle size analyser.	2	
IV	Two dimensional electronic system, two dimensional behaviour, MOSFET structures, Heterojunctions	2	15%
	Quantum wells, modulation doped quantum wells, multiple quantum wells	2	
	The concept of super lattices Kronig - Penney model of super lattice.	[illegible]	
[illegible]			
V	Transport of charge in Nanostructures under Electric field - parallel transport, hot electrons, perpendicular transport.	2	20%
	Quantum transport in nanostructures, Coulomb blockade	2	
	Transport of charge in magnetic field - Effect of magnetic field on a crystal. Aharonov-Bohm effect, the Shubnikov-de Hass effect, the quantum Hall effect.	3	
VI	Nanoelectonic devices- MODFETS, heterojunction bipolar transistors	1	20%
	Resonant tunnel effect, RTD, RTT, Hot electron transistors	2	
	Coulomb blockade effect and single electron transistor, CNT transistors	2	
	Heterostructure semiconductor laser	1	
	Quantum well laser, quantum dot LED, quantum dot laser	2	
	Quantum well optical modulator, quantum well sub band photo detectors, principle of NEMS.	2	
END SEMESTER EXAM			

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Question Paper Pattern

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COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC403	MICROWAVE & RADAR ENGINEERING	3-0-0-3	2016

Prerequisite: EC303 Applied Electromagnetic Theory, EC306 Antenna & Wave Propagation

Course objectives:

- To introduce the various microwave sources, their principle of operation and measurement of various parameters
- To study the various microwave hybrid circuits and formulate their S matrices.
- To understand the basic concepts, types, working of radar and introduce to radar transmitters and receivers.

Syllabus:

Microwaves: introduction, advantages, Cavity Resonators, Microwave vacuum type amplifiers and sources, Klystron Amplifiers, Reflex Klystron Oscillators, Magnetron oscillators, Travelling Wave Tube, Microwave measurements, Microwave hybrid circuits, Directional couplers, Solid state microwave devices, Gunn diodes, Radar, MTI Radar, Radar Transmitters, Radar receivers.

Expected outcome:

The students will be able to understand the basics of microwave engineering and radar systems.

Text Books:

1. Merrill I. Skolnik, Introduction to Radar Systems, 3/e, Tata McGraw Hill, 2008.
2. Samuel Y. Liao, Microwave Devices and Circuits, 3/e, Pearson Education, 2003.

References:

1. Das, Microwave Engineering, 3/e, McGraw Hill Education India Education , 2014
2. David M. Pozar, Microwave [illegible] 4/e, Wiley India, 2012
3. Kulkarni M, Microwave and Radar Engineering, [illegible]/e, Umesh Publications, 2012
4. Rao, Microwave Engineering, [illegible]/e, PHI, 201[illegible]
5. [illegible]rt E. Collin, Foundat[illegible] Mic[illegible]ve [illegible], 2/e, [illegible], 2012.

Course Plan

Module	Course contents	Hours	End Sem. Exam Marks
I	**Microwaves:** introduction, advantages, Cavity Resonators - Rectangular and Circular wave guide resonators- Derivation of resonance frequency of Rectangular cavity.	4	15%
	Microwave vacuum type amplifiers and sources: Klystron Amplifiers - Re-entrant cavities, Velocity modulation, Bunching (including analysis), Output power and beam	4	
II	**Reflex Klystron Oscillators**: Derivation of Power output, efficiency and admittance	2	15%
	Magnetron oscillators: Cylindrical magnetron, Cyclotron angular frequency, Power output and efficiency.	3	
	FIRST INTERNAL EXAM		
III	**Travelling Wave Tube**: Slow wave structures, Helix TWT, Amplification process, Derivation of convection current, axial electric field, wave modes and gain.	4	15%
	Microwave measurements: Measurement of impedance, frequency and power	2	

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IV	**Microwave hybrid circuits**: Scattering parameters, Waveguide tees- Magic tees, Hybrid rings, Corners, Bends, and Twists. Formulation of S-matrix.	5	15%
	Directional couplers: Two hole directional couplers, S-matrix of a directional coupler. Circulators and isolators.	4	
	SECOND INTERNAL EXAM		
V	**Solid state microwave devices**: Microwave bipolar transistors, Physical structures, Power frequency limitations equivalent circuit. Principle of **Tunnel diodes** and tunnel	4	20%
	Gunn diodes: Different modes, Principle of operation Gunn Diode Oscillators.	2	
VI	**Radar**: The simple Radar equation. Pulse Radar, CW Radar, CW Radar with non zero IF, Equation for doppler frequency FM-CW Radar using sideband super heterodyne receiver. **MTI Radar**-Delay line canceller, MTI Radar with power amplifier & power oscillator, Non coherent MTI Radar, Pulse	5	20%
	Radar Transmitters: Radar Modulator-Block diagram, **Radar receivers**- noise figure, low noise front ends, Mixers, Radar Displays	3	
	END SEMESTER EXAM		

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COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC404	ADVANCED COMMUNICATION SYSTEMS	3-0-0 -3	2016

Prerequisite: EC302 Digital Communication, EC403 Microwave & Radar Engineering

Course objectives:

- To impart the basic concepts of various communication system.

Syllabus:

Microwave Radio Communications, Diversity, protection switching arrangements, Digital TV, Satellite communication systems, Satellite sub systems, Evolution of mobile radio communications, Introduction to Modern Wireless Communication Systems, wireless networks, Over view of WIMAX technologies, Cellular concept, Wireless propagation mechanism, Introduction to Multiple Access GSM system architecture, Introduction to new data services

Expected outcome:

- The students will be able to understand the basics and technology of advanced communication system

Text Books:

1. Dennis Roody, Satellite communication, 4/e, McGraw Hill, 2006.
2. Herve Benoit, Digital Television Satellite, Cable, Terrestrial, IPTV, Mobile TV in the DVB Framework, 3/e, Focal Press, Elsevier, 2008
3. Simon Haykin, Michael Mohar, Modern wireless communication, Pearson Education, 2008
4. Theodore S. Rappaport: Wireless communication principles and practice,2/e, Pearson Education, 1990

References:

1. Jochen Schiller, Mobile Communications, Pearson, 2008.
2. Mishra, Wireless communications and Networks, McGraw Hill, 2/e, 2013.
3. Nathan, Wirelesscommunications,PHI, 2012.
4. Singal, Wireless communications, Mc Graw Hill, 2010.
5. Tomasi, Advanced Electronic Communication Systems, 6/e, Pearson, 2015.
6. W.C.Y.Lee, Mobile Cellular Telecommunication, McGraw Hill, 2010.

Course Plan

Module	Course content (42hrs)	Hours	End Sem. Exam Marks
I	Microwave Radio Communications : Introduction, Advantages and Disadvantages, Analog vs digital microwave, frequency vs amplitude modulation	1	15%
	Frequency modulated microwave radio system, FM microwave radio repeaters	1	
	Diversity, protection switching arrangements, FM microwave radio stations, microwave repeater station, line of sight path characteristics	2	
II	Digital TV: Digitized Video, Source coding of Digitized Video, Compression of Frames, DCT based (JPED), Compression of Moving Pictures (MPEG). Basic blocks of MPEG2 and MPE4,Digital Video Broadcasting (DVB)	4	15%
	Modulation: QAM (DVB-S, DVB-C), OFDM for Terrestrial Digital TV (DVB -T), Reception of Digital TV Signals (Cable, Satellite and	4	

	terrestrial). Digital TV over IP, Digital terrestrial TV for mobile		
	Display Technologies: basic working of Plasma, LCD and LED Displays	2	
	FIRST INTERNAL EXAM		
III	Satellite Communication systems, introduction, Kepler's laws, orbits, orbital effects, orbital perturbations	2	15%
	Satellite sub systems, Antennas, Transponders, earth station technology, Link calculation,	2	
	Satellite systems- GEO systems, non-GEO communication systems, Satellite Applications- Global Positioning System, Very Small Aperture Terminal system, Direct to Home Satellite Systems	3	
IV	Evolution of mobile radio communications, paging systems, Cordless telephone systems, comparison of various wireless systems	2	15%
	Introduction to Modern Wireless Communication Systems, Second generation cellular networks, third generation wireless networks, fourth generation wireless technologies	1	
	Wireless in local loop, wireless local area networks, Blue tooth and Personal Area networks, Over view of WIMAX Technologies, architecture, spectrum allocation	2	
	SECOND INTERNAL EXAM		
	Cellular concept, hand off strategies, Interference and system capacity: Cell splitting, Sectoring, Repeaters, and Microcells. Cellular System Design Fundamentals: Frequency Reuse, channel assignment strategies, handoff Strategies, Interference and system capacity, tracking and grade off service, improving coverage and capacity	3	
	Wireless propagation mechanism, free space propagation model, ground reflection model, knife edge diffraction model, path loss prediction in hilly terrain, introduction to fading and diversity techniques, Introduction to MIMO system	3	
VI	Introduction to Multiple Access, FDMA, TDMA, Spread Spectrum multiple Access, space division multiple access, CDMA, OFDM	2	20%
	Wireless Networking, Difference between wireless and fixed telephone networks, development of wireless networks, fixed network transmission hierarchy, traffic routing in wireless networks, wireless data services, Wireless standards,	2	
	GSM system architecture, radio link aspects, network aspects	1	
	Introduction to new data services like High Speed Circuit Switched Data (HSCSD), General Packet Radio Service (GPRS), Digital Enhanced Cordless Telecommunications (DECT) , Enhanced Data Rate for Global Evolution (EDGE), Ultra wideband systems (UWB), Push To Talk (PTT) technology, Mobile IP	5	
	END SEMESTER EXAM		

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COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC405	OPTICAL COMMUNICATION	3-0-0-3	2016

Prerequisite: EC203 Solid State Devices, EC205 Electronic Circuits

Course objectives:

- To introduce the concepts of light transmission through optical fibers, optical sources and detectors.
- To compare the performance of various optical transmission schemes.
- To impart the working of optical components and the principle of operation of optical amplifiers.
- To give idea on WDM technique.

Syllabus: General light wave system, advantages, classification of light wave systems, fibre types, linear and non linear effects in fibres, Fibre materials, fabrication of fibres, Optical sources, LEDs and LDs Optical detectors, Optical receivers, Digital transmission systems, Optical Amplifiers, WDM concept, Introduction to free space optics, Optical Time Domain Reflectometer (OTDR).

Expected outcome:

The students will be able to:-

i. Know the working of optical source and detectors.
ii. Compare the performance of various optical modulation schemes.
iii. Apply the knowledge of optical amplifiers in the design of optical link.
iv. Analyse the performance of optical amplifiers.
v. Know the concept of WDM
vi. Describe the principle of FSO and LiFi.

Text Books:

1. Gerd Keiser, Optical Fiber Communications, 5/e, McGraw Hill, 2013.
2. Mishra and Ugale, Fibre optic Communication, Wiley, 2014.

References:

1. Chakrabarthi, Optical Fibre Communication, McGraw Hill, 2015.
2. Hebbar, Optical fibre communication, Elsevier, 2014
3. John M Senior- Optical communications, 3/e, Pearson, 2009.
4. Joseph C. Palais, Fibre Optic Communications, 5/e Pearson, 2013.
5. Keiser, Optical Communication Essentials (SIE), 1/e McGraw Hill Education New Delhi, 2008.

Course Plan

Module	Course contents	Hours	End Sem. Exam Marks
I	General light wave system, advantages, classification of light wave systems. Fibres: types and refractive index profiles, mode theory of fibres: modes in SI and GI fibres, linear and non linear effects in fibres, dispersion, Group Velocity Dispersion, modal, wave guide and Polarization, Modes, Dispersion, attenuation- absorption, bending and scattering losses.	8	15%
II	Fibre materials, fabrication of fibres, photonic crystal fibre, index guiding PCF, photonic bandgap fibre, fibre cables. Optical sources, LEDs and LDs structures, characteristics	7	15%

	modulators using LEDs and LDs. coupling with fibres, noise in Laser diodes, Amplified Spontaneous Emission noise, effects of Laser diode noise in fibre communications		
FIRST INTERNAL EXAM			
III	Optical detectors, types and characteristics, structure and working of PIN and AP, noise in detectors, comparison of performance. Optical receivers, Ideal photo receiver and quantum limit of detection.	6	**15%**
IV	Digital transmission systems, design of IMDD links- power and rise time budgets, coherent Systems, sensitivity of a coherent receiver, comparison with IMDD systems. Introduction to soliton transmission, soliton links using optical amplifiers, GH effect, soliton-soliton interaction, amplifier gain fluctuations, and design guide lines of soliton based links.	8	**15%**
SECOND INTERNAL EXAM			
V	Optical Amplifiers ,basic concept, applications, types, doped fibre amplifiers, EDFA, basic theory, structure and working, Semiconductor laser amplifier, Raman amplifiers, TDFA, amplifier configurations, performance comparison.	6	**20%**
VI	The WDM concept, WDM standards, WDM components, couplers, splitters, Add/ Drop multiplexers, gratings, tunable filters, system performance parameters. Introduction to optical networks. Introduction to free space optics, LiFi technology and VLC. Optical Time Domain Reflectometer (OTDR) – fault detection, length and refractive index measurements.	7	**20%**
END SEMESTER EXAM			

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COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC407	COMPUTER COMMUNICATION	3-0-0-3	2016

Prerequisite: NIL

Course objectives:

- To give the basic concepts of computer network and working of layers, protocols and interfaces in a computer network.
- To introduce the fundamental techniques used in implementing secure network communications and give them an understanding of common threats and its defences.

Syllabus: Introduction to computer communication, Transmission modes, Networks, Interconnection of Networks: Internetwork, Network models: OSI model, TCP/IP protocol suite. Physical Layer, Data Link Layer, Media access control, Ethernet(802.3), Logical link control, Logical addressing: IPV4, IPV6, Subnetting, CIDR, ICMP, IGMP, DHCP, Routing, Transport Layer, Congestion Control & Quality of Service, Application Layer, Introduction to system and network security, security attacks, Firewalls, Intrusion detection systems.

Expected outcome:

The students will have a thorough understanding of:

i. Different types of network topologies and protocols.
ii. The layers of the OSI model and TCP/IP with their functions.
iii. The concept of subnetting and routing mechanisms.
iv. The basic protocols of computer networks, and how they can be used to assist in network design and implementation.
v. Security aspects in designing a trusted computer communication system.

Text Books:

1. Behrouz A. Forouzan, Cryptography & Network Security, IV Edition, Tata McGraw-Hill, 2008
2. J F Kurose and K W Ross, Computer Network A Top-down Approach Featuring the Internet, 3/e, Pearson Education, 2010

References:

1. Behrouz A Forouzan, Data Communications and Networking, 4/e, Tata McGraw-Hill, 2006.
2. Larry Peterson and Bruce S Davie: Computer Network- A System Approach, 4/e, Elsevier India, 2011.
3. S. Keshav, An Engineering Approach to Computer Networking, Pearson Education, 2005.
4. Achyut S.Godbole, Data Communication and Networking, 2e, McGraw Hill Education New Delhi, 2011

Course Plan

Module	Course content (42 hrs)	Hours	End Sem. Exam Marks
I	Introduction to computer communication: Transmission modes - serial and parallel transmission, asynchronous, synchronous, simplex, half duplex, full duplex communication. Switching: circuit switching and packet switching	2	15%

	Networks: Network criteria, physical structures, network models, categories of networks, Interconnection of Networks: Internetwork	2	
	Network models: Layered tasks, OSI model, Layers in OSI model, TCP/IP protocol suite.	2	
II	Physical Layer: Guided and unguided transmission media (Co-axial cable, UTP,STP, Fiber optic cable)	2	15%
	Data Link Layer: Framing, Flow control (stop and wait , sliding window flow control)	2	
	Error control, Error detection(check sum, CRC), Bit stuffing, HDLC	2	
	Media access control: Ethernet (802.3), CSMA/CD, Logical link control, Wireless LAN (802.11), CSMA/CA	2	
FIRST INTERNAL EXAM			
	Network Layer Logical addressing : IPv4 & IPV6	2	15%
	Address Resolution protocols (ARP, RARP)	2	
	Subnetting, Classless Routing(CIDR), ICMP, IGMP, DHCP	3	
III	Virtual LAN, Networking devices (Hubs, Bridges & Switches)	1	
IV	Routing: Routing and Forwarding, Static routing and Dynamic routing	1	15%
	Routing Algorithms: Distance vector routing algorithm, Link state routing (Dijkstra's algorithm)	2	
	Routing Protocols: Routing Information protocol (RIP), Open Shortest Path First (OSPF), Border Gateway Protocol (BGP), MPLS	3	
SECOND INTERNAL EXAM			
V	Transport Layer –UDP, TCP	1	20%
	Congestion Control & Quality of Service – Data traffic, Congestion, Congestion Control, QoS and Flow Characteristics	4	
	Application Layer – DNS, Remote Logging (Telnet), SMTP, FTP, WWW, HTTP, POP3, MIME, SNMP	3	
VI	Introduction to information system security, common attacks	1	20%
	Security at Application Layer (E-MAIL, PGP and S/MIME). Security at Transport Layer (SSL and TLS). Security at Network Layer (IPSec).	3	
	Defence and counter measures: Firewalls and their types. DMZ, Limitations of firewalls, Intrusion Detection Systems -Host based, Network based, and Hybrid IDSs	2	
END SEMESTER EXAM			

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COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC409	CONTROL SYSTEMS	3-0-0-3	2016

Prerequisite: EC202 Signals & Systems

Course objectives:

- To introduce the elements of control system and its modelling
- To introduce methods for analyzing the time response, the frequency response and the stability of systems.
- To design control systems with compensating techniques.
- To introduce the state variable analysis method.
- To introduce basic concepts of digital control systems.

Syllabus:

Control system, types and application, feedback system, mathematically modelling of control systems, block diagram representation, signal flow graph, Mason's formula, test signals, time response analysis, frequency analysis, stability concepts and analysis, state variable analysis, Observability and controllability, digital control systems , state space analysis, Jury's test

Expected outcome:

The Students will be able to

i. Represent mathematically a systems and deriving their transfer function model.
ii. Analyse the time response and frequency response of the systems for any input
iii. Find the stability of system
iv. Design a control system with suitable compensation techniques
v. Analyse a digital control system.

Text Books

1. Farid Golnaraghi, Benjamin C. Kuo, Automatic Control Systems, 9/e, Wiley India.
2. Gopal, Control Systems, 4/e, McGraw Hill Education India Education , 2012.
3. Ogata K., Discrete-time Control Systems, 2/e, Pearson Education.

References

1. Gopal, Digital Control and State Variable Method, 4/e, McGraw Hill Education India 2012.
2. Norman S. Nise, Control System Engineering, 5/e, Wiley India
3. Ogata K., Modern Control Engineering, Prentice Hall of India, 4/e, Pearson Education, 2002.
4. Richard C Dorf and Robert H. Bishop, Modern Control Systems, 9/e, Pearson Education, 2001.

Course Plan

Module	Course contents	Hours	End Sem Exam Marks
I	Basic Components of a Control System, Applications, Open-Loop Control Systems and Closed-Loop Control Systems, Examples of control system	1	15%
	Effects of Feedback on Overall Gain, Stability, External, disturbance	1	

	Types of Feedback Control Systems, Linear versus Nonlinear Control Systems, Time-Invariant versus Time-Varying Systems.	1	
	Overview of solving differential equations using Laplace transforms	1	
	Mathematical modelling of control systems - Electrical Systems and Mechanical systems.	2	
	Block diagram representation and reduction methods	2	
	Signal flow graph and Mason's rule formula.	2	
II	Standard test signals. Time response specifications.	1	15%
	Time response of first and second order systems to unit step input, ramp inputs, time domain specifications	2	
	Steady state error and static error coefficients.	1	
	Dynamic error coefficient.	1	
FIRST INTERNAL EXAM			
III	Stability of linear control systems: methods of determining stability, Routh's Hurwitz Criterion.	2	15%
	Root Locus Technique: Introduction, properties and its construction.	2	
	Frequency domain analysis: Frequency domain specifications, correlation between time and frequency responses.	1	
IV	Nyquist stability criterion: fundamentals and analysis	2	[illegible]
	Relative stability: gain margin and phase margin. Stability analysis with Bode plot.	2	
	Design of Control Systems: PI,PD and PID controllers	2	
	Design with phase-lead and phase-lag controllers (frequency domain approach), Lag-lead	[illegible]	
SECOND INTERNAL EXAM			
V	State variable analysis: state equation, state space representation of Continuous Time systems	2	20%
	Transfer function from State Variable Representation, Solutions of the state equations, state transition matrix	2	
	Concepts of Controllability and Observability, Kalman's Test, Gilbert's test	2	
VI	Discrete Control systems fundamentals: Overview of Z transforms. State space representation for Discrete time systems.	2	20%
	Sampled Data control systems, Sampling Theorem, Sample & Hold, Open loop & Closed loop sampled data systems.	2	
	State space analysis : Solving discrete time state space equations, pulse transfer function, Discretization of continuous time state space equations	3	
	Stability analysis of discrete time systems Jury's test	1	
END SEMESTER EXAM			

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COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC461	MICROWAVE DEVICES AND CIRCUITS	3-0-0-3	2016

Prerequisite: EC403 Microwave & Radar Engineering

Course objectives:

- To study microwave semiconductor devices & applications.
- To study microwave sources and amplifiers.
- To analyse microwave networks.
- To introduce microwave integrated circuits.

Syllabus:

Limitation of conventional solid state devices at Microwave, Gunn – effect diodes, Microwave generation and amplification, IMPATT and TRAPATT diodes, Bipolar transistors, MESFET, Microwave amplifiers and oscillators, Microwave Network Analysis, Signal flow graphs, Microwave filters, Filter design by image parameter method, Filter transformation and implementation, Introduction to MICs, Distributed and lumped elements of integrated circuits, Diode control devices

Expected outcome:

The Students will be able to understand with active & passive microwave devices & components used in microwave communication systems and analyse microwave networks.

Text Books:

1. David M. Pozar, Microwave Engineering, 4/e, Wiley India, 2012
2. Robert E. Collin, Foundation of Microwave Engineering, 2/e, Wiley India, 2012.
3. Samuel Y. Liao, Microwave Devices and Circuits, 3/e, Pearson Education, 2003.

References:

1. Bharathi Bhat and Shiban K. Koul: Stripline-like Transmission Lines for MIC, New Age International (P) Ltd, 1989.
2. I Kneppo, J. Fabian, et al., Microwave Integrated Circuits, BSP, India, 2006.
3. Leo Maloratsky, Passive RF and Microwave Integrated Circuits, Elsevier, 2006.

Course Plan

Module	Course contents	Hours	End Sem. Exam Marks
I	Introduction, Characteristic, features of microwaves, Limitation of conventional solid state devices at Microwave.	1	15%
	Gunn – effect diodes – Gunn effect, Ridley – Watkins-Hilsum theory, Modes of operation, Limited space – Charge accumulation (LSA) mode of Gunn diode.	2	
	Microwave generation and amplification. Structure, Operation, Power output and efficiency of IMPATT and TRAPATT diodes	2	
II	Bipolar transistors – biasing, FET – biasing, MESFET – Structure, Operation.	4	15%
	Microwave amplifiers and oscillators – Amplifiers – Gain and stability, Single stage transistor amplifier design.	4	
	Oscillator design – One port negative resistance oscillators.	2	
FIRST INTERNAL EXAM			

COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC462	MIXED SIGNAL CIRCUIT DESIGN	3-0-0 -3	2016

Prerequisite: EC 304 VLSI, EC308 Embedded Systems

Course objectives:
- To give the knowledge about various analog and digital CMOS circuits
- To impart the skill in analysis and design of analog and digital CMOS circuits.

Syllabus:
CMOS Amplifiers: CS,CG,CD stages, Cascoded stages, Folded cascode Amplifier, MOS Current Mirror, MOSFET cascode current mirror, Differential Amplifiers, MOS telescopic cascode amplifier,CMOS OP AMPS, Design of classical Two Stage OP AMP, Comparator, Band gap References, Phase Locked Loop, Dynamic analog circuits, Data Converters, Switched Capacitor Circuits, Data Converters- Specifications, DAC, ADC Architecture

Expected outcome:
The students will be able to design and analyse various analog and digital CMOS circuits.

Text Books:
1. Phillip E. Allen, Douglas R. Holbery, CMOS Analog Circuit Design, Oxford, 2004.
2. Razavi B., Fundamentals of Microelectronics, Wiley student Edition2014.

References:
1. Baker, Li, Boyce, CMOS: Circuits Design, Layout and Simulation, Prentice Hall India

2. Razavi B., Design of Analog CMOS Integrated Circuits, Mc Graw Hill, 2001.

Course Plan

Module	Course contents	Hours	End Sem. Exam Marks
I	**CMOS Amplifiers-** Common Source with diode connected loads and current source load, CS stage with source degeneration, CG stage and Source Follower (Only Voltage Gain and Output impedance of circuits)	4	15%
	Cascoded stages - Cascoded amplifier, Cascoded amplifier with cascoded loads , Folded cascode Amplifier	4	
II	**MOS Current Mirror-** Basic circuit, PMOS and NMOS current mirrors Current mirror copying circuits, MOSFET cascode current mirror circuits	3	15%
	Differential Amplifiers-Differential Amplifier with MOS current source Load, with cascaded load and with current mirror load, MOS telescopic cascode amplifier. (Only Voltage Gain and Output impedance of circuits)	4	
	FIRST INTERNAL EXAM		
III	**CMOS OP AMPS-** Two Stage Operational Amplifiers - Frequency compensation of OPAMPS, miller compensation,	3	15%

	Design of classical Two Stage OP AMP		
	Comparator- Characterization of a comparator-static and dynamic, A Two stage open loop comparator (analysis not required)	3	
IV	**Band gap References-** Supply Independent Biasing, Temperature independent references –band gap reference	5	15%
	Phase Locked Loop – Simple PLL ,Basic PLL Topology, Charge Pump PLL, Basic Charge Pump PLL	3	
	SECOND INTERNAL EXAM		
V	**Dynamic analog circuits –** charge injection and capacitive feed through in MOS switch, Reduction technique	3	20%
	Switched Capacitor Circuits- sample and hold circuits, Switched Capacitor Integrator, Ladder filters	3	
VI	**Data Converters-** DAC Specifications-DNL, INL, latency, SNR, Dynamic Range ADC Specifications-Quantization error, Aliasing, SNR, Aperture error	4	20%
	DAC Architecture - Resistor String, Charge Scaling and Pipeline types. **ADC Architecture-** Flash and Pipe line types	3	
	END SEMESTER EXAM		

Question Paper Pattern

The question paper shall consist of three parts. Part A covers modules I and II, Part B covers modules III and IV, and Part C covers modules V and VI. Each part has three questions uniformly covering the two modules and each question can have maximum four subdivisions. In each part, any two questions are to be answered. Mark patterns are as per the syllabus with 60% for theory and 40% for logical/numerical problems, derivation and proof.

Estd.
2014

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Since 1968

COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC463	SPEECH AND AUDIO SIGNAL PROCESSING	3-0-0-3	2016

Prerequisite: EC301 Digital Signal Processing

Course objectives:

- To familiarize the basic mechanism of speech production and the basic concepts of methods for speech analysis and parametric representation of speech.
- To give an overall picture about various applications of speech processing
- To impart ideas of Perception of Sound, Psycho-acoustic analysis, Spatial Audio Perception and rendering.
- To introduce Audio Compression Schemes.

Syllabus: Speech production, Time domain analysis, Frequency domain analysis, Cepstral analysis, LPC analysis, Speech coding, Speech recognition, Speech enhancement, Text to speech conversion. Signal Processing Models of Audio Perception, Psycho-acoustic analysis, Spatial Audio Perception and rendering, Audio compression methods, Parametric Coding of Multi-channel audio, Transform coding of digital audio, audio quality analysis.

Expected outcome:

The students will be able to

i. Understand basic concepts of speech production, speech analysis, speech coding and parametric representation of speech and apply it in practical applications
ii. Develop systems for various applications of speech processing
iii. Learn Signal processing models of sound perception and application of perception models in audio signal processing.
iv. Implement audio compression algorithms and standards.

Text Books:

1. Douglas O'Shaughnessy, Speech Communications: Human and Machine, IEEE Press, Hardcover 2/e, 1999; ISBN: 0780334493.
2. Nelson Morgan and Ben Gold, Speech and Audio Signal Processing: Processing and Perception Speech and Music, July 1999, John Wiley & Sons, ISBN: 0471351547

References:

1. Donald G. Childers, Speech Processing and Synthesis Toolboxes, John Wiley & Sons, September 1999; ISBN: 0471349593
2. Rabiner and Juang, Fundamentals of Speech Recognition, Prentice Hall, 1994.
3. Rabiner and Schafer, Digital Processing of Speech Signals, Prentice Hall, 1978.
4. Thomas F. Quatieri, Discrete-Time Speech Signal Processing: Principles and Practice, Prentice Hall; ISBN: 013242942X; 1/e

Course Plan

Module	Course contents	Hours	End Sem. Exam Marks
I	Speech Production: Acoustic theory of speech production. Speech Analysis: Short-Time Speech Analysis, Time domain analysis (Short time energy, short time zero crossing Rate, ACF). Parametric representation of speech: AR Model, ARMA model. LPC Analysis (LPC model, Auto correlation method).	5	15%

II	Frequency domain analysis (Filter Banks, STFT, Spectrogram), Cepstral Analysis, MFCC. Fundamentals of Speech recognition and Text-to-speech conversion	8	15%
FIRST INTERNAL EXAM			
III	Speech coding, speech enhancement, Speaker Verification, Language Identification	7	15%
IV	Signal Processing Models of Audio Perception: Basic anatomy of hearing System. Auditory Filter Banks, Psycho-acoustic analysis: Critical Band Structure, Absolute Threshold of Hearing, Simultaneous Masking, Temporal Masking, Quantization Noise Shaping, MPEG psycho-acoustic model.	6	15%
SECOND INTERNAL EXAM			
V	Audio compression methods: Sampling rate and bandwidth requirement for digital audio, Redundancy removal and perceptual irrelevancy removal, Transform coding of digital audio: MPEG2-AAC coding standard, MDCT and its properties, Pre-echo and pre-echo suppression, Loss less coding methods.	7	20%
VI	Spatial Audio Perception and rendering: The physical and psycho-acoustical basis of sound localization and space perception. Spatial audio standards. Audio quality analysis: Objective analysis methods- PEAQ, Subjective analysis methods- [illegible]	6	20%
END SEMESTER EXAM			

Question Paper Pattern

The question paper shall consist of three parts. Part A covers modules I and II, Part B covers modules III and IV, and Part C covers modules V and VI. Each part has three questions uniformly covering the two modules and each question can have maximum four subdivisions. In each part, any two questions are to be answered. Mark patterns are as per the syllabus with 50% for theory and 50% for logical/numerical problems, derivation and proof.

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COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC464	LOW POWER VLSI	3-0-0 -3	2016

Prerequisite: EC 304 VLSI, EC308 Embedded Systems

Course objectives:

- To identify the power dissipation mechanisms in various MOS logic styles
- To familiarize suitable techniques to reduce power dissipation

Syllabus:
Physics of Power dissipation in MOSFET devices, Sources of power dissipation in CMOS, Circuit techniques for leakage power reduction, Design and test of low voltage CMOS, Non clocked circuit design style, Adiabatic switching.

Expected outcome:
The students will be able to:

i. Identify the sources of power dissipation in digital IC systems.
ii. Understand the impact of power on system performance and reliability
iii. Understand leakage sources and reduction techniques
iv. Recognise advanced issues in VLSI systems, specific to the deep-submicron silicon technologies
v. Identify the mechanisms of power dissipation in CMOS integrated circuits

Text Books:

1. Gray Yeap, Practical low power digital VLSI design, Springer, 1998
2. Kaushik Roy, Sharat C Prasad, Low power CMOS VLSI circuit design, Wiley India, 2000

References:

1. Abdellatif Bellaouar, Mohamed I Elmasry, Low power digital VLSI design, Kluwer Academic, 1995
2. Anatha P Chandrakasan, Robert W Brodersen, Low power digital CMOS Design, Kluwer Academic, 1995
3. Christian Piguet, Low power CMOS circuits, Taylor & Francis, 2006
4. Kiat Seng Yeo, Kaushik Roy, Low voltage, low power VLSI sub systems, Tata McGraw Hill, 2004

Course Plan

Module	Course contents	Hours	End Sem. Exam Marks
I	**Physics of Power dissipation in MOSFET devices** MIS structure, Need for low power circuit design	2	15%
	Threshold voltage, body effects,	1	
	Short channel effects-surface scattering, punch through, velocity saturation, impact ionization	2	
	Hot electron effects, drain induced barrier lowering, narrow width effects	2	
II	**Sources of power dissipation in CMOS**-Switching power dissipation,	2	15%
	Short circuit power dissipation, glitching power dissipation	2	
	Leakage power dissipation [illegible]	3	

	deep submicron transistors		
	FIRST INTERNAL EXAM		
III	**Circuit techniques for leakage power reduction** – standby leakage control using transistor stacks	2	15%
	multiple V_{th} techniques, Dynamic V_{th} techniques	2	
	supply voltage scaling techniques, Deep submicron devices design issues	2	
	Minimizing short channel effect	2	
IV	**Design and test of low voltage CMOS** – Circuit design style- clocked design style- Basic concept	2	15%
	Domino logic (domino NAND gate)	1	
	Differential Current Switch Logic.	2	
	SECOND INTERNAL EXAM		
V	**Non clocked circuit design style**-fully complementary logic	2	20%
	NMOS and pseudo –NMOS logic	2	
	differential cascade voltage switch logic(DCVS),	2	
	pass transistor logic	2	
VI	**Adiabatic switching** – Adiabatic charging, adiabatic amplification	2	20%
	One stage and two stage adiabatic buffer	2	
	fully adiabatic system	1	
	Adiabatic logic gates, pulsed power supplies	2	
	END SEMESTER EXAM		

Question Paper Pattern

The question paper shall consist of three parts. Part A covers modules I and II, Part B covers modules III and IV, and Part C covers modules V and VI. Each part has three questions uniformly covering the two modules and each question can have maximum four subdivisions. In each part, any two questions are to be answered. Mark patterns are as per the syllabus with 60% for theory and 40% for logical/numerical problems, derivation and proof.

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COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC465	MEMS	3-0-0 -3	2016

Prerequisite : NIL

Course objectives:
- To understand the operation of major classes of MEMS devices/systems
- To give the fundamentals of standard micro fabrication techniques and processes
- To understand the unique demands, environments and applications of MEMS devices

Syllabus:

MEMS and Microsystems applications, Review of Mechanical concepts, Actuation and Sensing techniques, Scaling laws in miniaturization, Materials for MEMS, Micro System fabrication techniques, Micro manufacturing, Micro system Packaging, Bonding techniques for MEMS, Overview of MEMS areas.

Expected outcome:
The student will be able to:
i. Understand the working principles of micro sensors and actuators
ii. Understand the application of scaling laws in the design of micro systems
iii. Understand the typical materials used for fabrication of micro systems
iv. Understand the principles of standard micro fabrication techniques
v. Appreciate the challenges in the design and fabrication of Micro systems

Text Books:
1. Chang Liu, Foundations of MEMS, Pearson 2012
2. Tai-Ran Hsu, MEMS and Microsystems Design and Manufacture, TMH, 2002

References:
1. Chang C Y and Sze S. M., VLSI Technology, McGraw-Hill, New York, 2000
2. Julian W Gardner, Microsensors: Principles and Applications, John Wiley & Sons, 1994
3. Mark Madou, Fundamentals of Micro fabrication, CRC Press, New York, 1997
4. Stephen D. Senturia, Microsystem design, Springer (India), 2006.
5. Thomas B. Jones, Electromechanics and MEMS, Cambridge University Press, 2001

Course Plan

Module	Course content (42hrs)	Hours	End Sem. Exam Marks
I	MEMS and Microsystems: Applications – Multidisciplinary nature of MEMS – principles and examples of Micro sensors and micro actuators – micro accelerometer –comb drives - Micro grippers – micro motors, micro valves, micro pumps, Shape Memory Alloys.	4	15%
	Review of Mechanical concepts: Stress, Strain, Modulus of Elasticity, yield strength, ultimate strength – General stress strain relations – compliance matrix. Overview of commonly used mechanical structures in MEMS - Beams, Cantilevers, Plates, Diaphragms – Typical applications	3	

II	Flexural beams: Types of Beams, longitudinal strain under pure bending – Deflection of beams – Spring constant of cantilever – Intrinsic stresses	3	15%
	Actuation and Sensing techniques : Thermal sensors and actuators, Electrostatic sensors and actuators , Piezoelectric sensors and actuators, magnetic actuators	4	
FIRST INTERNAL EXAM			
III	Scaling laws in miniaturization - scaling in geometry, scaling in rigid body dynamics, Trimmer force scaling vector, scaling in electrostatic and electromagnetic forces, scaling in electricity and fluidic dynamics, scaling in heat conducting and heat convection.	5	15%
IV	Materials for MEMS – Silicon – Silicon compounds – Silicon Nitride, Silicon Dioxide, Silicon carbide, Poly Silicon, GaAs , Silicon Piezo resistors,	4	
	Polymers in MEMS – SU-8, PMMA, PDMS, Langmuir – Blodgett Films, Micro System fabrication – Photolithography – Ion implantation- Diffusion – Oxidation – Chemicalvapour deposition – Etching	5	15%
SECOND INTERNAL EXAM			
V	Overview of Micro manufacturing – Bulk micro manufacturing, Surface micro machining , LIGA process –Microstereo lithography	6	20%
	Micro system Packaging: general considerations in packaging design – Levels of Micro system packaging	3	
VI	Bonding techniques – MEMS : Surface bonding , Anodic bonding , Silicon - on Insulator, wire bonding, Sealing – Assembly of micro systems	3	20%
	Overview of MEMS areas : RF MEMS, BioMEMS, MOEMS, NEMS	2	
END SEMESTER EXAM			

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COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC467	PATTERN RECOGNITION	3-0-0-3	2016

Prerequisite: NIL

Course objectives:

- To introduce the fundamental algorithms for pattern recognition
- To instigate the various classification and clustering techniques

Syllabus: Review of Probability Theory and Probability distributions, Introduction to Pattern Recognition and its applications, Bayesian decision theory, Bayesian estimation: Gaussian distribution, ML estimation, EM algorithm, Supervised and unsupervised learning, Feature selection, Linear Discriminant Functions, Non-parametric methods, Hidden Markov models for sequential data classification, Linear models for regression and classification, Clustering

Expected outcome:

The students will be able to

i. Design and construct a pattern recognition system
ii. Know the major approaches in statistical and syntactic pattern recognition.
iii. Become aware of the theoretical issues involved in pattern recognition system design such as the curse of dimensionality.
iv. Implement pattern recognition techniques

Text Books

1. C M Bishop, Pattern Recognition and Machine Learning, Springer
2. R O Duda, P.E. Hart and D.G. Stork, Pattern Classification and scene analysis, John Wiley

References

1. Morton Nadier and Eric Smith P., Pattern Recognition Engineering, John Wiley & Sons, New York, 1993.
2. Robert J. Schalkoff, Pattern Recognition : Statistical, Structural and Neural Approaches, John Wiley & Sons Inc., New York, 2007.
3. S.Theodoridis and K. Koutroumbas, Pattern Recognition, 4/e, Academic Press, 2009.
4. Tom Mitchell, Machine Learning, McGraw-Hill
5. Tou and Gonzales, Pattern Recognition Principles, Wesley Publication Company, London, 1974.

Course Plan

Module	Course content	Hours	End Sem Exam Marks
I	**Introduction:** Basics of pattern recognition system, various applications, Machine Perception, classification of pattern recognition systems	3	15%
	Design of Pattern recognition system, Pattern recognition Life Cycle	2	

	Statistical Pattern Recognition: Review of probability theory, Gaussian distribution, Bayes decision theory and Classifiers, Optimal solutions for minimum error and minimum risk criteria, Normal density and discriminant functions, Decision surfaces	4	
II	Parameter estimation methods: Maximum-Likelihood estimation, Expectation-maximization method, Bayesian parameter estimation	2	15%
	Concept of feature extraction and dimensionality, Curse of dimensionality, Dimension reduction methods - Fisher discriminant analysis, Principal component analysis Hidden Markov Models (HMM) basic concepts, Gaussian mixture models.	6	
FIRST INTERNAL EXAM			
III	Non-Parameter methods: Non-parametric techniques for density estimation - Parzen-window method, K-Nearest Neighbour method.	3	15%
	Non-metric methods for pattern classification: Non-numeric data or nominal data Decision trees: Concept of construction, splitting of nodes, choosing of attributes, overfitting, pruning	3	
IV	Linear Discriminant based algorithm: Perceptron, Support Vector Machines	5	15%
SECOND INTERNAL EXAM			
[illegible]	Multilayer perceptrons, Back Propagation algorithm, Artificial Neural networks Classifier Ensembles: Bagging, Boosting / AdaBoost	[illegible]	20%
VI	Unsupervised learning: Clustering - Criterion functions for clustering, Algorithms for clustering: K-means and Hierarchical methods, Cluster validation	5	20%
END SEMESTER EXAM			

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COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC468	**SECURE COMMUNICATION**	**3-0-0 -3**	**2016**

Prerequisite: EC407 COMPUTER COMMUNICATION

Course objectives:

- To impart the students about the theory and technology behind the secure communication.

Syllabus:

Introduction on Security, Security Goals, Types of Attacks, Modular arithmetic: Groups, Ring, Fields. The Euclidean algorithm, Finite fields of the form GF(p), Polynomial arithmetic, Symmetric Ciphers, Symmetric Cipher Model, Substitution Techniques, Transposition techniques, Block Ciphers, Data encryption Standards, Differential and Linear Crypt analysis Advanced Encryption standard, The AES Cipher, Public key cryptosystem, RSA algorithm, Intruders, Password management

Expected outcome:

The student will be

i. Exposed to the different approaches that handle security and the algorithms in use for maintaining data integrity and authenticity.
ii. Enabled student to appreciate the practical aspects of security features design and their implementation

Text Books:

1. Behrouz A. Forouzan , Cryptography and Network security Tata McGraw-Hill, 2008
2. William Stallings, Cryptography and Network security: principles and practice", 2nd Edition, Prentice Hall of India, New Delhi, 2002

References:

1. David S. Dummit & Richard M Foote, Abstract Algebra, 2nd Edition, Wiley India Pvt Ltd, 2008
2. Douglas A. Stinson, Cryptography, Theory and Practice, 2/e, Chapman & Hall, CRC Press Company, Washington, 2005.
3. Lawrence C. Washington, Elliptic Curves: Theory and Cryptography, Chapman & Hall, CRC Press Company, Washington, 2008.
4. N. Koeblitz: A course in Number theory and Cryptography, 2008
5. Thomas Koshy: Elementary Number Theory with Applications, 2/e, Academic Press, 2007
6. Tyagi and Yadav , Cryptography and network security, Dhanpatrai, 2012

Course Plan

Module	Course contents	Hours	End Sem. Exam Marks
I	Introduction on security, security goals and types of attacks: Passive attack, active attack, attacks on confidentiality, attacks on integrity and availability, Security services and mechanisms.	5	15%
II	Modular arithmetic: Groups, Ring, Fields. The Euclidean algorithm, Finite fields of the form GF(p)	4	15%
	Polynomial arithmetic: Finite fields of the form GF (2n).	4	
	FIRST INTERNAL EXAM		
III	Symmetric Ciphers, Symmetric Cipher Model	3	15%

COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC365	Biomedical Engineering	3-0-0-3	2015

Prerequisite: Nil

Course objectives:

The purpose of this course is:

1. To introduce student to basic biomedical engineering technology
2. To understand the anatomy & physiology of major systems of the body in designing equipment for medical treatments.
3. To impart knowledge about the principle and working of different types of bio-medical electronic equipment/devices.

Syllabus:

Human body-overview, Physiological systems of body, Measurement of physiological parameters, Assisting and therapeutic devices, Medical laboratory equipments, Telemetry in patient care, Patient safety, Medical imaging system

Expected outcome:

On completion of this course, the students will be able:

1. To understand diagnosis and therapy related equipments.
2. To understand the problem and identify the necessity of equipment for diagnosis and therapy.
3. To understand the importance of electronics engineering in medical field.
4. To understand the importance of telemetry in patient care

1. K S Kandpur, "Hand book of Biomedical instrumentation", Tata McGraw Hill 2nd e/d.
2. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, Biomedical Instrumentation and Measurements, PHI, 2nd Edition, 2004

References:

1. J. J. Carr, "Introduction to Biomedical Equipment Technology", Pearson Education 4th e/d.
2. John G Webster, "Medical Instrumentation application and design", John Wiley 3rd e/d.
3. Richard Aston, "Principle of Biomedical Instrumentation and Measurement". Merrill Education/Prentice Hall.
4. Barbara Christe, Introduction to Biomedical Instrumentation, Cambridge University Press, 2008.

Course Plan

Module	Course content	Hours	Sem. Exam Marks
I	Introduction to bio-medical instrumentation system, overview of anatomy and physiological systems of the body.	1	15
	Sources of bio-electric potential: Resting and action potential, propagation of action potentials. Bioelectric potentials examples (ECG, EEG, EMG, ERG, EOG, EGG, etc introduction only.)	2	
	Electrode theory: Nernst relation Bio potential electrodes: Microelectrodes, skin surface electrodes, needle electrodes.	1	

	Instrumentation for clinical laboratory: Bio potential amplifiers-instrumentation amplifiers, carrier amplifiers, isolation amplifiers, chopper amplifiers	2	
II	Heart and cardiovascular system (brief discussion), electro conduction system of the heart. Electrocardiography, ECG machine block diagram, ECG lead configurations, ECG recording system, Einthoven triangle, analysis of ECG signals.	3	15
	Measurement of blood pressure: Direct, indirect and relative methods of blood pressure measurement, auscultatory method, oscillometric and ultrasonic non-invasive pressure measurements.	2	
	Measurement of blood flow: Electromagnetic blood flow meters and ultrasonic blood flow meters.	2	
FIRST INTERNAL EXAM			
III	The human nervous system. Neuron, action potential of brain, brain waves, types of electrodes, placement of electrodes, evoked potential, EEG recording, analysis of EEG.	2	15
	Electromyography: Nerve conduction velocity, instrumentation system for EMG.	1	
	Physiology of respiratory system (brief discussion), Respiratory parameters, spirometer, body plethysmographs, gas exchange and distribution.	2	
	Instruments for clinical laboratory: Oxymeters, pH meter, blood cell counter, flame photometer, spectrophotometer	3	
IV	Therapeutic Equipments: Principle, block schematic diagram, working and applications of : pacemakers, cardiac defibrillators, heart–lung machine, dialyzers, surgical diathermy equipment, ventilators	6	15
SECOND INTERNAL EXAM			
V	Medical Imaging systems (Basic Principle only): X-ray imaging - Properties and production of X-rays, X-ray machine, applications of X-rays in medicine.	2	20
	Computed Tomograpy: Principle, image reconstruction, scanning system and applications.	2	
	Ultrasonic imaging systems: Basic pulse echo system, propagation of ultrasonic through tissues and reflections, display types, A-Scan, B-Scan, M-Scan, applications, real-time ultrasonic imaging systems and probes.	3	
VI	Magnetic Resonance Imaging – Basic NMR components, Biological effects and advantages of NMR imaging	3	20
	Biomedical Telemetry system: Components of biotelemetry system, application of telemetry in medicine, single channel telemetry system for ECG and temperature	2	

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	Patient Safety: Electric shock hazards, leakage current, safety codes for electro medical equipments	1	
END SEMESTER EXAM			

Question Paper

The question paper shall consist of three parts. Part A covers I and II module, Part B covers III and IV module, Part C covers V and VI module. Each part has three questions which may have maximum four subdivisions. Among the three questions one will be a compulsory question covering both modules and the remaining from each module, of which one to be answered. Mark patterns are as per the syllabus with 100 % for theory.

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FIRST INTERNAL EXAM			
III	Hazards – static and dynamic hazards – essential	1	15
	Design of Hazard free circuits – Data synchronizers	1	
	Mixed operating mode asynchronous circuits	1	
	Practical issues- clock skew and jitter	1	
	Synchronous and asynchronous inputs – switch bouncing	2	
IV	Fault table method – path sensitization method – Boolean difference method	2	15
	Kohavi algorithm	2	
	Automatic test pattern generation – Built in Self Test(BIST)	3	
SECOND INTERNAL EXAM			
V	PLA Minimization - PLA folding	2	20
	Foldable compatibility Matrix- Practical PLA	2	
	Fault model in PLA	1	
	Test generation and Testable PLA Design.	3	
VI	CPLDs and FPGAs - Xilinx XC 9500 CPLD family, functional block diagram– input output block architecture - switch matrix	3	20
	FPGAs – Xilinx XC 4000 FPGA family – configurable logic block - input output block, Programmable interconnect	3	
END SEMESTER EXAM			

Question Paper Pattern

The question paper consists of three parts. Part A covers modules I and II, Part B covers modules III and IV and Part C covers modules V and VI. Each part has three questions. Each question has a maximum of four subparts. Among the three questions one will be a compulsory question covering both the modules and the remaining two questions will be as one question from each module, of which one is to be answered. Mark pattern is according to the syllabus with 50 % for theory, derivation, proof and 50% for logical/numerical problems.

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COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC 361	DIGITAL SYSTEM DESIGN	3-0-0-3	2015

Prerequisite: EC207 Logic Circuit Design

Course objectives:
The purpose of this course is:
5. To study synthesis and design of CSSN
6. To study synthesis and design of ASC
7. To study hazards and design hazard free circuits
8. To study PLA folding
9. To study architecture of one CPLDs and FPGA family

Syllabus:
Clocked synchronous networks, asynchronous sequential circuits, Hazards, Faults, PLA, CPLDs and FPGA

Expected outcome:
The student should able:
1. To analyze and design clocked synchronous sequential circuits
2. To analyze and design asynchronous sequential circuits
3. To apply their knowledge in diagnosing faults in digital circuits, PLA
4. To interpret architecture of CPLDs and FPGA

Text Books:
1. Donald G Givone, Digital Principles & Design, Tata McGraw Hill, 2003
2. John M Yarbrough, Digital Logic Applications and Design, Thomson Learning
3. John F Wakerly, Digital Design, Pearson Education, Delhi 2002

References:
1. Richard E. Haskell, Darrin M. Hanna, Introduction to Digital Design Using Digilent FPGA Boards, LBE Books- LLC
2. N. N. Biswas, Logic Design Theory, PHI
3. Miron Abramovici, Melvin A. Breuer and Arthur D. Friedman, Digital Systems Testing and Testable Design, John Wiley & Sons Inc.
4. Z. Kohavi, Switching and Finite Automata Theory, 2nd ed., 2001, TMH
5. Morris Mano, M.D.Ciletti, Digital Design, 5th Edition, PHI.
6. Samuel C. Lee, Digital Circuits and Logic Design, PHI

Course Plan

Module	Course content	Hours	Sem. Exam Marks
I	Analysis of clocked Synchronous Sequential Networks(CSSN)	2	15
	Modelling of CSSN – State assignment and reduction	1	
	Design of CSSN	2	
	Iterative circuits	1	
	ASM Chart and its realization	2	
II	Analysis of Asynchronous Sequential Circuits (ASC)	2	15
	Flow table reduction- Races in ASC	1	
	State assignment problem and the transition table- Design of AS	2	
	Design of Vending Machine controller.	2	

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COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC 305	Microprocessor & Microcontroller	2-1-0 -3	2015

Prerequisite: EC207 Logic Circuit Design

Course objectives:
The purpose of this course is:
1. To understand fundamental operating concepts of microprocessors and microcontrollers.
2. To communicate with various devices using controller.
3. To design a microcontroller based system with the help of the interfacing devices.
4. To program the controller to make various peripherals work for specified application.

Syllabus:
Microprocessors: 8085 architecture and its operation, microprocessor initiated operations and bus organization, pin configuration and functions, generation of control signals for external operations- fetch, IO/M, read/write, machine cycles and bus timings. Addressing modes, instruction set, instruction classification. Overview/concept of peripheral IC interfacing with 8085 microprocessor (8251, 8253, 8255, 8279). Simple examples in assembly language programming for 8085 (only for internal examination). Introduction to development tools: IDE, cross assembler, builder, linker and debugger.(not required for exam). Introduction to 8086 and comparison between 8086,80286,80386,80486 and Pentium.
Microcontrollers: 8051- features, architecture, memory organization, registers, I/O ports, pin configuration and functions. Addressing modes, instruction set, instruction classification. Assembly language programming. Interrupts in 8051. Timer/Counter programming: Operating modes, time delay generation, Waveform generation. Serial communication: RS 232 interface, registers in UART, modes of operation, programming examples for serial data transmission and reception. Interfacing of DIP switch, stepper motor, ADC, DAC, LEDs and seven segment displays, alphanumeric LCD module with 8051.

Expected outcome:
The student should be able to:
1. Distinguish various types of processor architectures.
2. Describe architectures, memory organization of 8085 microprocessor and 8051.
3. Develop programming skills in assembly for interfacing peripheral devices with 8051

Text Books:
1. Ramesh S. Goankar. 8085 Microprocessors Archiecture Application and Programming. Penram International, 5/e.
2. Kenneth J. Ayala, The 8051 Microcontroller, Cengage learning, 3/e.
3. Lyla B.Das : Microprocessors and Microcontrollers, Pearson Education, India, 2011

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References:

1. Soumitra Kumar Mandal. Microprocessors and Microcontrollers Architecture, Programming & Interfacing Using 8085, 8086 and 8051, McGraw Hill Education (2011).
2. Nagoorkani, Microprocessors and Microcontrollers 2e, McGraw Hill Education India, 2012.
3. Aditya P Mathur, Introduction to Microprocessor. Tata Mc Graw – Hill
4. Muhammed Ali Mazidi, The 8051 Microcontroller and Embedded Systems, Pearson Education, 2nd edition
5. I.Scott Mackenzie, Raphel C.-W Phan, The 8051 microcontroller, 4th edition.
6. Han Way Hung, "PIC Microcontroller, An introduction to software and hardware interfacing ", Cenage learning.
7. Muhammad Ali Mazidi " PIC Microcontroller and Embedded systems using assembly and C for PIC 18" Pearson.

Course Plan

Module	Course content	Hours	Sem. Exam Marks
I	Microprocessors: Introduction, organization of a microprocessor based system, evolution of microprocessors, 8085 architecture and its operation, microprocessor initiated operations and bus organization, pin configuration and functions, generation of control signals for external operations- fetch, IO/M, read/write.	5	15
II	Machine cycles and bus timings, Addressing modes, Instruction set, instruction classification	[illegible]	15
	Overview/concept of peripheral IC interfacing with 8085 microprocessor (8251, 8253, 8255, 8279).	3	
	Simple examples in assembly language programming for 8085 (only for internal examination)	2	0
	Introduction to development tools: IDE, cross assembler, builder, linker and debugger.(not required for exam)	3	
FIRST INTERNAL EXAM			
III	Introduction to 8086 and comparison between 8086,80286,80386,80486 and Pentium	2	15
IV	Microcontrollers: Introduction, comparison between microprocessors and microcontrollers, microcontroller families, 8051- features, architecture, memory organization, registers, I/O ports, pin configuration and functions.	6	15
	Addressing modes, instruction set, instruction classification.	2	
	Assembly language programming examples for 8051.	3	
SECOND INTERNAL EXAM			
	Interrupts in 8051: Types, interrupt source, interrupt handling and programming	2	20
	Timer/Counter programming: Operating modes, time delay generation, Waveform generation.	2	

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	Serial communication: RS 232 interface, registers in UART, modes of operation, programming examples for serial data transmission and reception	2	
VI	Interfacing: Interfacing (block schematic and assembly language programming) of DIP switch, stepper motor, ADC, DAC, LEDs and seven segment displays, alphanumeric LCD module with 8051.	6	20
END SEMESTER EXAM			

Question Paper Pattern

The question paper consists of three parts. Part A covers modules I and II, Part B covers modules III and IV and Part C covers modules V and VI. Each part has three questions. Each question has a maximum of four subparts. Among the three questions one will be a compulsory question covering both the modules and the remaining two questions will be as one question from each module, of which one is to be answered. Mark pattern is according to the syllabus with 80 % for theory and 20% for logical/numerical problems and programming.

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COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC 303	Applied Electromagnetic Theory	3-0-0-3	2015

Prerequisite: MA201 Linear Algebra & Complex Analysis, MA 101Calculus, MA 102 Differential equations

Course objectives:

The purpose of this course is:

1. To introduce basic mathematical concepts related to electromagnetic vector fields.
2. To impart knowledge on the basic concepts of electric and magnetic fields
3. To develop a solid foundation in the analysis and application of electromagnetic fields, Maxwell's equations and Poynting theorem.
4. To become familiar with propagation of signal through transmission lines and waveguides.

Syllabus:

Co-ordinate transformation, vector algebra, vector calculus, electrostatics, magneto statics, Maxwell's equations, Boundary condition, Solution of wave equation, propagation of plane EM wave in different media, Poynting vector theorem, transmission lines, Smith chart, Waveguides.

Expected outcome:

At the end of the course, students shall be able:

1. To develop a solid foundation and a fresh perspective in the analysis and application of electromagnetic fields.
2. To analyse the propagation of electromagnetic waves in different media.
3. To analyze the characteristics of transmission lines.
4. To solve the different transmission line problems using Smith chart.
5. To understand the different modes of propagation in waveguides.

Text Books:

1. Mathew N O Sadiku, Elements of Electromagnetics, Oxford University Press, 6/e, 2014.
2. William, H., Jf Hayt, and John A. Buck. Engineering Electromagnetics. McGraw-Hill, 8/e McGraw-Hill, 2014.
3. John D. Kraus, Electromagnetics, 5/e, TMH, 2010.

References:

1. Joseph A Edminister , Electromagnetics, Schaum's Outline Series McGraw Hill, 4/e, 1995
2. Nannapaneni Narayana Rao, Elements of Engineering Electromagnetics, Pearson, 6/e, 2006.
3. Umran S. Inan and Aziz S. Inan, Engineering Electromagnetics, Pearson, 2010.
4. Martin A Plonus , Applied Electromagnetics, McGraw Hill, 2/e,1978.
5. Jordan and Balmain , Electromagnetic waves and Radiating Systems, PHI, 2/e,2013
6. Matthew N.O. Sadiku & S.V. Kulkarni "'Principles of Electromagnetics', Oxford University Press Inc. Sixth Edition, Asian Edition,2015

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Course Plan			
Module	**Course content**	**Hours**	**Sem. Exam Marks**
I	Review of vector calculus, Spherical and Cylindrical coordinate system, Coordinate transformation	1	0
	Curl, Divergence, Gradient in spherical and cylindrical coordinate system.	1	
	Electric field – Application of Coulomb's law, Gauss law and Amperes current law (proof not required, simple problems only)	1	15
	Poisson and Laplace equations (proof not required, simple problems only), Determination of E and V using Laplace equation.	1	
	Derivation of capacitance and inductance of two wire transmission line and coaxial cable. Energy stored in Electric and Magnetic field.	2	
	Displacement current density, continuity equation. Magnetic vector potential. Relation between scalar potential and vector potential.	2	
II	Maxwell's equation from fundamental laws.	1	15
	Boundary condition of electric field and magnetic field from Maxwell's equations	1	
	Solution of wave equation	1	
	Propagation of plane EM wave in free space, dielectric, lossy medium, good conductor, media-attenuation, phase velocity, group velocity, skin depth.	3	
	FIRST INTERNAL EXAM		
III	Reflection and refraction of plane electromagnetic waves at boundaries for normal & oblique incidence (parallel and perpendicular polarization), Snell's law of refraction, Brewster angle.	4	15
	Power density of EM wave, Poynting vector theorem, Complex Poynting vector.	3	
	Polarization of electromagnetic wave-linear, circular and elliptical polarisation.	2	
IV	Uniform lossless transmission line - line parameters	1	15
	Transmission line equations, Voltage and Current distribution of a line terminated with load	2	
	Reflection coefficient and VSWR. Derivation of input impedance of transmission line.	2	
	SECOND INTERNAL EXAM		
V	Transmission line as circuit elements (L and C).	2	20
	Half wave and quarter wave transmission lines.	1	
	Development of Smith chart - calculation of line impedance and VSWR using smith chart.	2	
	Single stub matching (Smith chart and analytical method).	2	

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VI	Parallel-Plate Waveguide - TE & TM waves.	1	20
	The hollow rectangular wave guide – modes of propagation of wave- dominant mode, group velocity and phase velocity -derivation and simple problems only.	3	
	Attenuation in wave guides, guide wavelength and impedance -derivation and simple problems only .	3	
END SEMESTER EXAM			

Question Paper

The question paper shall consist of three parts. Part A covers I and II module, Part B covers III and IV module, Part C covers V and VI module. Each part has three questions, which may have maximum four subdivisions. Among the three questions, one will be a compulsory question covering both modules and the remaining from each module, of which one to be answered. Mark patterns are as per the syllabus with 50 % for theory and 50% for logical/numerical problems, derivation and proof.

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COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC 301	Digital Signal Processing	3-1-0-4	2015

Prerequisite: EC 202 Signals & Systems

Course objectives:
The purpose of this course is:
1. To provide an understanding of Digital Signal Processing principles, algorithms and applications
2. To study the design techniques for digital filters
3. To give an understanding of Multi-rate Signal Processing and its applications
4. To introduce the architecture of DSP processors

Syllabus
Discrete Fourier Transform and its Properties, Linear Filtering methods based on the DFT, Frequency analysis of signals using the DFT, Introduction to DCT and properties, Computation of DFT, FFT Algorithms, IDFT computation using Radix-2 FFT Algorithms, DFT Computation using Radix-4 FFT Algorithms, Efficient computation of DFT of two real sequences and a 2N-Point real sequence, Design of FIR Filters, Design of linear phase FIR Filters using window methods and frequency sampling method, Design of IIR Digital Filters from Analog Filters, IIR Filter Design, Frequency Transformations, FIR Filter Structures, IIR Filter Structures, Introduction to TMS320C67xx digital signal processor, Multi-rate Digital Signal Processing, Finite word length effects in DSP systems, IIR digital filters, FFT algorithms.

Expected outcome:
After the course, the student will understand the principle of digital signal processing and applications. The utilization of DSP to electronics engineering will also be studied.

Text Books:

1. Oppenheim A. V., Schafer R. W. and Buck J. R., Discrete Time Signal Processing, 3/e, Prentice Hall, 2007.
2. Proakis J. G. and Manolakis D. G., Digital Signal Processing, 4/e, Pearson Education, 2007.

References:

1. Lyons, Richard G., Understanding Digital Signal Processing, 3/e. Pearson Education India, 2004.
2. Ifeachor E.C. and Jervis B. W., Digital Signal Processing: A Practical Approach, 2/e, Pearson Education, 2009.
3. Mitra S. K., Digital Signal Processing: A Computer Based Approach, 4/e McGraw Hill (India), 2014.
4. Salivahanan, Digital Signal Processing,3e, Mc Graw –Hill Education New Delhi, 2014 (Smart book)
5. Chassaing, Rulph., DSP applications using C and the TMS320C6x DSK. Vol. 13. John Wiley & Sons, 2003.
6. NagoorKani, Digital Signal Processing, 2e, Mc Graw –Hill Education New Delhi, 2013
7. Singh A., Srinivasan S., Digital Signal Processing: Implementation Using DSP Microprocessors, Cenage Learning, 2012.

Course Plan

Module	Course content	Hours	Sem. Exam Marks
I	The Discrete Fourier Transform: DFT as a linear transformation, Relationship of the DFT to other transforms, IDFT	2	15
	Properties of DFT and examples Circular convolution	4	
	Linear Filtering methods based on the DFT- linear convolution using circular convolution, overlap save and overlap add methods	3	
	Frequency Analysis of Signals using the DFT	2	
II	Computation of DFT: Radix-2 Decimation in Time and Decimation in Frequency FFT Algorithms	3	15
	IDFT computation using Radix-2 FFT Algorithms	2	
	Efficient computation of DFT of Two Real Sequences and a 2N-Point Real Sequence	2	
FIRST INTERNAL EXAM			
III	Design of FIR Filters- Symmetric and Anti-symmetric FIR Filters	2	15
	Design of linear phase FIR Filters using Window methods (rectangular, Hamming and Hanning) and frequency sampling Method	6	
	Comparison of Design Methods for Linear Phase FIR Filters	1	
IV	Design of IIR Digital Filters from Analog Filters (Butterworth)	4	15
	IIR Filter Design by Impulse Invariance, and Bilinear Transformation	3	
	Frequency Transformations in the Analog and Digital Domain	2	
SECOND INTERNAL EXAM			
V	Block diagram and signal flow graph representations of filters	1	20
	FIR Filter Structures: (Linear structures), Direct Form, Cascade Form and Lattice Structure	3	
	IIR Filter Structures: Direct Form, Transposed Form, Cascade Form and Parallel Form	2	
	Computational Complexity of Digital filter structures	1	
	Computer architecture for signal processing : Introduction to TMS320C67xx digital signal processor	2	
VI	Multi-rate Digital Signal Processing: Decimation and Interpolation (Time domain and Frequency Domain Interpretation without proof)	3	20
	Finite word length effects in DSP systems: Introduction (analysis not required), fixed-point and floating-point DSP arithmetic, ADC quantization noise	2	
	Finite word length effects in IIR digital filters: coefficient quantization errors	2	

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	Finite word length effects in FFT algorithms: Round off. errors	2	.
	END SEMESTER EXAM		.

Question Paper

The question paper shall consist of three parts. Part A covers I and II module, Part B covers III and IV module, Part C covers V and VI module. Each part has three questions, which may have maximum four subdivisions. Among the three questions, one will be a compulsory question covering both modules and the remaining from each module, of which one to be answered. Mark patterns are as per the syllabus with 40 % for theory and 60% for logical/numerical problems, derivation and proof.

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	its effect on input and output impedance, Feedback amplifier circuits in each feedback topologies (no analysis required)		
	Oscillators & Tuned Amplifiers: Classification of oscillators, Barkhausen criterion, Analysis of RC phase shift and Wien bridge oscillators, Working of Hartley, Colpitts and Crystal oscillators; Tuned amplifiers, synchronous and stagger tuning	6	
	SECOND INTERNAL EXAM		
V	Power amplifiers: Classification, Transformer coupled class A power amplifier, push pull class B and class AB power amplifiers, efficiency and distortion, Transformer-less class B and Class AB power amplifiers, Class C power amplifier (no analysis required)	6	**20**
	Switching Circuits: Simple sweep circuit, Bootstrap sweep circuit, Astable, Bistable, and Monostable multivibrators, Schmitt Trigger	5	
VI	Transistor based voltage regulator: Design and analysis of shunt and series voltage regulator, load and line regulation, Short circuit protection	4	**20**
	MOSFET amplifiers: Biasing of MOSFET amplifier, DC analysis of single stage MOSFET amplifier, small signal equivalent circuit. Small signal voltage and current gain, input and output impedances of CS configuration, MOSFETCascade amplifier	5	
	END SEMESTER EXAM		

Question Paper Pattern

The question paper consists of three parts. Part A covers modules I and II, Part B covers modules III and IV and Part C covers modules V and VI. Each part has three questions. Each question can have a maximum of four subparts. Among the three questions one will be a compulsory question covering both the modules and the remaining two questions will be as one question from each module, of which one is to be answered. Mark pattern is according to the syllabus with maximum 60 % for theory, derivation, proof and 40% for logical/numerical problems.

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COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC201	NETWORK THEORY	3-1-0-4	2016

Prerequisite: Nil

Course objectives:

- To make the students capable of analyzing any linear time invariant electrical network.
- To study time domain, phasor and Laplace transform methods of linear circuit analysis.
- To study the transient response of networks subject to test signals.
- To develop understanding of the concept of resonance, coupled circuits and two port networks.

Syllabus:

Circuit variables and Circuit elements, Kirchhoff's laws, Network topology, Mesh and node analysis of network, Laplace transform, Inverse Laplace transform, Solution of differential equations by using Laplace transforms, Transient analysis of RL, RC, and RLC networks, Network functions for the single port and two ports, Parameters of two-port network, Resonance, Coupled circuits

Expected outcome:

At the end of the course students will be able to analyze the linear time invariant electrical circuits.

Text Books

1. Ravish R., Network Analysis and Synthesis, 2/e, McGraw-Hill, 2015.
2. Valkenburg V., Network Analysis, 3/e, PHI, 2011.

References:

1. Sudhakar A,S. P. Shyammohan, Circuits and Networks- Analysis and Synthesis, 5/e, McGraw-Hill, 2015.
2. Choudhary R., Networks and Systems, 2/e, New Age International, 2013.
3. Franklin F. Kuo, Network Analysis and Synthesis, 2/e, Wiley India, 2012.
4. Pandey S. K., Fundamentals of Network Analysis and Synthesis, 1/e, S. Chand, 2012.
5. Edminister, Electric Circuits – Schaum's Outline Series, McGraw-Hill, 2009.

Course Plan

Module	Course content (48 hrs)	Hours	Sem. Exam Marks (%)
I	Introduction to circuit variables and circuit elements ,Review of Kirchhoff's Laws, Independent and dependent Sources, Source transformations	3	15
	Network topology, Network graphs, Trees, Incidence matrix, Tie-set matrix and Cut-set matrix	2	
	Solution methods applied to dc and phasor circuits: Mesh and node analysis of network containing independent and dependent sources	3	
II	Network theorems applied to dc and phasor circuits: Thevenin's theorem, Norton's theorem, Superposition theorem, Reciprocity theorem, Millman's theorem, Maximum power transfer theorem	6	15

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	Laplace transform, properties Laplace Transforms and inverse Laplace transform of common functions, Important theorems: Time shifting theorem, Frequency shifting theorem, Time differentiation theorem, Time integration theorem, s domain differentiation theorem, s domain integration theorem, Initial value theorem, Final value theorem	4	
FIRST INTERNAL EXAM			
III	Partial Fraction expansions for inverse Laplace transforms, Solution of differential equations using Laplace transforms	3	**15**
	Transformation of basic signals and circuits into s-domain	2	
	Transient analysis of RL, RC, and RLC networks with impulse, step, pulse, exponential and sinusoidal inputs	3	
	Analysis of networks with transformed impedance and dependent sources.	3	
IV	Network functions for the single port and two ports, properties of driving point and transfer functions, Poles and Zeros of network functions, Significance of Poles and Zeros	3	**15**
	Time domain response from pole zero plot, Impulse Response	1	
	Network functions in the sinusoidal steady state, Magnitude and Phase response	3	
SECOND INTERNAL EXAM			
V	Parameters of two port network: impedance, admittance, transmission and hybrid parameters, Interrelationship among parameter sets	5	**20**
	Series and parallel connections of two port networks	2	
	Reciprocal and Symmetrical two port network	2	
	Characteristic impedance, Image impedance and propagation constant (derivation not required)	2	
VI	Resonance: Series resonance, bandwidth, Q factor and Selectivity, Parallel resonance	3	**20**
	Coupled circuits: single tuned and double tuned circuits, dot convention, coefficient of coupling, Analysis of coupled circuits	4	
END SEMESTER EXAM			

Question Paper Pattern (End Sem Exam)

Maximum Marks: 100 **Time : 3 hours**

The question paper shall consist of three parts. Part A covers modules I and II, Part B covers modules III and IV, and Part C covers modules V and VI. Each part has three questions uniformly covering the two modules and each question can have maximum four subdivisions. In each part, any two questions are to be answered. Mark pattern is according to the syllabus with maximum 30% for theory and 70% for logical/numerical problems, derivation and proof.

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Course code	Course Name	L-T-P - Credits	Year of Introduction
EC202	SIGNALS & SYSTEMS	3-1-0 -4	2016

Prerequisite: Nil

Course Objectives

1. To train students for an intermediate level of fluency with signals and systems in both continuous time and discrete time, in preparation for more advanced subjects in digital signal processing, image processing, communication theory and control systems.
2. To study continuous and discrete-time signals and systems, their properties and representations and methods those are necessary for the analysis of continuous and discrete-time signals and systems.
3. To familiarize with techniques suitable for analyzing and synthesizing both continuous-time and discrete time systems.
4. To gain knowledge of time-domain representation and analysis concepts as they relate to differential equations, difference equations, impulse response and convolution, etc.
5. To study frequency-domain representation and analysis concepts using Fourier analysis tools, Laplace Transform and Z-transform.

To study concepts of the sampling process, reconstruction of signals and interpolation.

Syllabus

Elementary signals, Continuous time and Discrete time signals and systems, Signal operations, Differential equation representation, Difference equation representation, Continuous time LTI Systems, Discrete time LTI Systems, Correlation between signals, Orthogonality of signals, Frequency domain representation, Continuous time Fourier series, Continuous time Fourier transform, Laplace transform, Inverse Laplace transform, Unilateral Laplace transform, Transfer function, Frequency response, Sampling, Aliasing, Z transform, Inverse Z transform, Unilateral Z transform, Frequency domain representation of discrete time signals, Discrete time Fourier series and discrete time Fourier transform (DTFT), Analysis of discrete time LTI systems using the above transforms

Expected outcome .

The student will be able to:

i. Define, represent, classify and characterize basic properties of continuous and discrete time signals and systems.
ii. Represent the CT signals in Fourier series and interpret the properties of Fourier transform and Laplace transform
iii. Outline the relation between convolutions, correlation and to describe the orthoganality of signals.
iv. Illustrate the concept of transfer function and determine the magnitude and phase response of LTI systems.
v. Explain sampling theorem and techniques for sampling and reconstruction.
vi. Determine z transforms, inverse z transforms and analyze LTI systems using z transform.

Text Book:

1. Alan V. Oppenheim and Alan Willsky, Signals and Systems, PHI, 2/e, 2009
2. Simon Haykin, Signals & Systems, John Wiley, 2/e, 2003

References:

1. Anand Kumar, Signals and Systems, PHI, 3/e, 2013.
2. B P. Lathi, Priciples of Signal Processing & Linear systems, Oxford University Press.
3. Gurung, Signals and System, PHI.
4. Mahmood Nahvi, Signals and System, Mc Graw Hill (India), 2015.
5. P Ramakrishna Rao, Shankar Prakriya, Signals and System, MC Graw Hill Edn 2013.

6. Rodger E. Ziemer, Signals & Systems - Continuous and Discrete, Pearson, 4/e, 2013

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Elementary Signals, Classification and representation of continuous time and discrete time signals, Signal operations	4	15%
	Continuous time and discrete time systems - Classification, Properties.	3	
	Representation of systems: Differential equation representation of continuous time systems. Difference equation representation of discrete systems.	2	
II	Continuous time LTI systems and convolution integral.	3	15%
	Discrete time LTI systems and linear convolution.	2	
	Stability and causality of LTI systems.	2	
	Correlation between signals, Orthoganality of signals.	2	
FIRST INTERNAL EXAMINATION			
III	Frequency domain representation of continuous time signals- continuous time Fourier series and its properties.	4	15%
	Convergence, Continuous time fourier transform and its properties.	3	
	Laplace Transform, ROC, Inverse transform, properties, unilateral Laplace transform.	3	
	Relation between Fourier and Laplace transforms.	1	
IV	Analysis of LTI systems using Laplace and Fourier transforms. Concept of transfer function, Frequency response, Magnitude and phase response.	4	15%
	Sampling of continuous time signals, Sampling theorem for lowpass signals, aliasing.	3	
SECOND INTERNAL EXAMINATION			
V	Z transform, ROC , Inverse transform, properties, Unilateral Z transform.	4	20%
	Frequency domain representation of discrete time signals, Discrete time fourier series and its properties.	4	
	Discrete time fourier transform (DTFT) and its properties	4	
VI	Relation between DTFT and Z-Transform, Analysis of discrete time LTI systems using Z transforms and DTFT, Transfer function, Magnitude and phase response.	6	20%
END SEMESTER EXAM			

Assignment: Convolution by graphical methods, Solution of differential equations.
Project: Use of Matlab in finding various transforms: magnitude and phase responses.

Question Paper Pattern (End Sem Exam)

Maximum Marks: 100 **Time : 3 hours**

The question paper shall consist of three parts. Part A covers modules I and II, Part B covers modules III and IV, and Part C covers modules V and VI. Each part has three questions uniformly covering the two modules and each question can have maximum four subdivisions. In each part, any two questions are to be answered. Mark pattern is according to the syllabus with maximum 30 % for theory and 70% for logical/numerical problems, derivation and proof.

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Course code	Course Name	L-T-P - Credits	Year of Introduction
EC204	ANALOG INTEGRATED CIRCUITS	4-0-0-4	2016

Prerequisite: Nil

Course Objectives

- To equip the students with a sound understanding of fundamental concepts of operational amplifiers
- To understand the wide range of applications of operational amplifiers
- To introduce special function integrated circuits
- To introduce the basic concepts and types of data converters

Syllabus

Differential amplifier configurations, Operational amplifiers, Block diagram, Ideal op-amp parameters, Effect of finite open loop gain, bandwidth and slew rate on circuit performance, op-amp applications-linear and nonlinear, Active filters, Specialized ICs and their applications, Monolithic Voltage Regulators - types and its applications, Data converters - specifications and types.

Expected outcome .

The students will

i. have a thorough understanding of operational amplifiers
ii. be able to design circuits using operational amplifiers for various applications

Text Books:

1. Franco S., Design with Operational Amplifiers and Analog Integrated Circuits, 3/e, Tata McGraw Hill, 2008
2. Salivahanan S. ,V. S. K. Bhaaskaran, Linear Integrated Circuits, Tata McGraw Hill, 2008

References:

1. Botkar K. R., Integrated Circuits, 10/e, Khanna Publishers, 2010
2. C.G. Clayton, Operational Amplifiers, Butterworth & Company Publ. Ltd. Elsevier, 1971
3. David A. Bell, Operational Amplifiers & Linear ICs, Oxford University Press, 2nd edition, 2010
4. Gayakwad R. A., Op-Amps and Linear Integrated Circuits, Prentice Hall, 4/e, 2010
5. R.F. Coughlin & Fredrick Driscoll, Operational Amplifiers & Linear Integrated Circuits, 6th Edition, PHI,2001
6. Roy D. C. and S. B. Jain, Linear Integrated Circuits, New Age International, 3/e, 2010
7. Sedra A. S. and K. C. Smith, Microelectronic Circuits, 6/e, Oxford University Press, 2013

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Differential amplifiers: Differential amplifier configurations using BJT, Large and small signal operations, Input resistance, Voltage gain, CMRR, Non-ideal characteristics of differential amplifier. Frequency response of differential amplifiers, Current sources, Active load, Concept of current mirror circuits, Wilson current mirror circuits (Analysis using hybrid 'pi' model only).	6	15%
	Operational amplifiers: Introduction, Block diagram, Ideal op-amp parameters, Equivalent circuit, Voltage transfer curve, Open loop op-amp configurations, Effect of finite open loop gain, Bandwidth and slew rate on circuit performance	5	
II	Op-amp with negative feedback: Introduction, Feedback	3	15%

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	configurations, Voltage series feedback, Voltage shunt feedback, Properties of practical op-amp.		
	Op-amp applications: Inverting and non inverting amplifier, DC and AC amplifiers, Summing, Scaling and averaging amplifiers, Instrumentation amplifier.	4	
FIRST INTERNAL EXAMINATION			
III	Op-amp applications: Voltage to current converter, Current to voltage converter, Integrator, Differentiator, Precision rectifiers, Log and antilog amplifier, Phase shift and Wien bridge oscillators	7	15%
IV	Astable and monostable multivibrators, Triangular and saw tooth wave generators, Comparators, Zero crossing detector, Schmitt trigger	5	15%
	Active filters: Advantages, First and second order low pass, High pass, Band pass and band reject filters, Design of filters using Butterworth approximations	5	
SECOND INTERNAL EXAMINATION			
V	Specialized ICs and its applications: Timer IC 555 : Astable and monostable operations, applications. Analog Multipliers: Introduction, Gilbert multiplier cell. Voltage Controlled Oscillator IC AD633 and their applications.	3	20%
	Phase Locked Loop – Operation, Closed loop analysis, Lock and capture range, Basic building blocks, PLL IC 565, Applications of PLL for AM & FM detection and Frequency multiplication, Frequency division, Frequency synthesizing.	4	
	Monolithic Voltage Regulators - Fixed voltage regulators, 78XX and 79XX series, Adjustable voltage regulators, IC 723 – Low voltage and high voltage configurations, Current boosting, Current limiting, Short circuit and Fold-back protection.	4	
VI	Data Converters: D/A converter, Specifications, Weighted resistor type, R-2R Ladder type.	3	20%
	A/D Converters: Specifications, Classification, Flash type, Counter ramp type, Successive approximation type, Single slope type, Dual slope type, Sample-and-hold circuits.	5	
END SEMESTER EXAM			

Assignment

1. Explain the importance of frequency compensated networks in opamps and the commonly used compensation techniques.
2. Write short notes on commercially available integrated circuits (Opamp, ADC, DAC, VCO, Analog multiplier, PLL) with pin outs and their important features

Question Paper Pattern (End Sem Exam)

Maximum Marks: 100 **Time : 3 hours**

The question paper shall consist of three parts. Part A covers modules I and II, Part B covers modules III and IV, and Part C covers modules V and VI. Each part has three questions uniformly covering the two modules and each question can have maximum four subdivisions. In each part, any two questions are to be answered. Mark patterns are as per the syllabus with maximum60 % for theory and 40% for logical/numerical problems, derivation and proof.

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COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC205	ELECTRONIC CIRCUITS	3-1-0-4	2016

Prerequisite: Nil

Course objectives:

- To develop the skill of analysis and design of various analog circuits using discrete electronic devices as per the specifications.

Syllabus:

High pass and low pass RC circuits, Differentiator, Integrator, Analysis of BJT biasing circuits, small signal analysis of transistor configurations using small signal hybrid π model, low frequency and high frequency analysis of BJT amplifiers, Cascade amplifiers, Wide band amplifiers, Feedback amplifiers, Oscillators, Tuned amplifiers, Power amplifiers, Sweep circuits and multivibrators, transistor voltage regulator, DC analysis of MOSFET circuits, small signal equivalent circuit, Small signal analysis of MOSFET amplifier circuits, Analysis of multistage MOSFET amplifiers

Expected outcome:

- At the end of the course, students will be able to analyse and design the different electronic circuits using discrete electronic components.

Text Books:

- Sedra A. S. and K. C. Smith, Microelectronic Circuits, 6/e, Oxford University Press, 2013
- Millman J. and C. Halkias, Integrated Electronics, 2/e, McGraw-Hill, 2010

References:

1. Neamen D., Electronic Circuits - Analysis and Design, 3/e, TMH, 2007
2. Rashid M. H., Microelectronic Circuits - Analysis and Design, Cengage Learning, 2/e, 2011
3. Spencer R. R. and M. S. Ghausi, Introduction to Electronic Circuit Design, Pearson, 2003
4. Razavi B., Fundamentals of Microelectronics, Wiley, 2015

Course Plan

Module	Course content (48 hrs)	Hours	Sem. Exam Marks
I	RC Circuits: Response of high pass and low pass RC circuits to sine, step, pulse and square wave inputs, Differentiator, Integrator	5	15
	BJT biasing circuits: Types, Q point, Bias stability, Stability factors, RC coupled amplifier and effect of various components, Concept of DC and AC load lines, Fixing of operating point, Classification of amplifiers	5	
II	Small signal analysis of CE, CB and CC configurations using small signal hybrid π model (gain, input and output impedance). Small signal analysis of BJT amplifier circuits, Cascade amplifier	7	15
FIRST INTERNAL EXAM			
III	High frequency equivalent circuits of BJT, Short circuit current gain, cutoff frequency, Miller effect, Analysis of high frequency response of CE, CB and CC amplifiers	4	15

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	Wide band amplifier: Broad banding techniques, low frequency and high frequency compensation, Cascode amplifier.	4	
IV	Feedback amplifiers: Effect of positive and negative feedback on gain, frequency response and distortion, Feedback topologies and	3	15

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Course code	Course Name	L-T-P - Credits	Year of Introduction
EC206	COMPUTER ORGANISATION	3-0-0-3	2016

Prerequisite: EC207 Logic Circuit Design

Course Objectives

- To impart knowledge in computer architecture.
- To impart knowledge in machine language programming.
- To develop understanding on I/O accessing techniques and memory structures.

Syllabus

Functional units of a computer, Arithmetic circuits, Processor architecture, Instructions and addressing modes, Execution of program, Micro architecture design process, Design of data path and control units, I/O accessing techniques, Memory concepts, Memory interface, Cache and Virtual memory concepts.

Expected outcome .

The students will be able to:

i. Understand the functional units of a computer
ii. Identify the different types of instructions
iii. Understand the various addressing modes
iv. Understand the I/O addressing system
v. Categorize the different types of memories

Text Books:

1. David A. Patterson and John L. Hennessey, Computer Organisation and Design, Fourth Edition, Morgan Kaufmann
2. David Money Harris, Sarah L Harris, Digital Design and Computer Architecture,M Kaufmann – Elsevier, 2009

References

1. Carl Hamacher : "Computer Organization ", Fifth Edition, Mc Graw Hill
2. John P Hayes: "Computer Architecture and Organisation", Mc Graw Hill
3. William Stallings: "Computer Organisation and Architecture", Pearson Education
4. Andrew S Tanenbaum: "Structured Computer Organisation", Pearson Education
5. Craig Zacker: "PC Hardware : The Complete Reference", TMH

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Functional units of a computer Arithmetic Circuits: Adder-carry propagate adder, Ripple carry adder, Basics of carry look ahead and prefix adder, Subtractor, Comparator, ALU	4	15%
	Shifters and rotators, Multiplication, Division	3	
	Number System: Review of Fixed point & Floating point number system	1	
II	Architecture : Assembly Language, Instructions, Operands, Registers, Register set, Memory, Constants	2	15%
	Machine Language: R-Type, I-Type, J-Type Instructions, Interpreting machine language code	3	
FIRST INTERNAL EXAMINATION			
III	MIPS Addressing modes – Register only, Immediate, Base, PC-relative, Pseudo - direct	3	15%

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	MIPS memory map, Steps for executing a program - Compilation, Assembling, Linking, Loading	3	
	Pseudo instructions, Exceptions, Signed and Unsigned instructions, Floating point instructions	3	
IV	MIPS Microarchitectures – State elements of MIPS processor	1	15%
	Design process and performance analysis of Single cycle processor, Single cycle data path, Single cycle control for R – type arithmetic/logical instructions.	3	
	Design process and performance analysis of multi cycle processor, Multi cycle data path, Multi cycle control for R – type arithmetic/logical instructions.	3	
SECOND INTERNAL EXAMINATION			
V	I/O system – Accessing I/O devices, Modes of data transfer, Programmed I/O, Interrupt driven I/O, Direct Memory Access, Standard I/O interfaces – Serial port, Parallel port, PCI, SCSI, and USB.	3	20%
	Memory system – Hierarchy, Characteristics and Performance analysis, Semiconductor memories (RAM, ROM, EPROM), Memory Cells – SRAM and DRAM, internal organization of a memory chip, Organization of a memory unit.	4	
VI	Cache Memory – Concept/principle of cache memory, Cache size, mapping methods – direct, associated, set associated, Replacement algorithms. Write policy- Write through, Write back.	3	20%
	Virtual Memory – Memory management, Segmentation, Paging, Address translation, Page table, Translation look aside buffer.	3	
END SEMESTER EXAM			

Question Paper Pattern (End Sem Exam)

Maximum Marks: 100 **Time : 3 hours**

The question paper shall consist of three parts. Part A covers modules I and II, Part B covers modules III and IV, and Part C covers modules V and VI. Each part has three questions uniformly covering the two modules and each question can have maximum four subdivisions. In each part, any two questions are to be answered. Mark patterns are as per the syllabus with maximum80 % for theory and 20% for logical/numerical problems, derivation and proof.

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COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC207	LOGIC CIRCUIT DESIGN	3-0-0-3	2016

Prerequisite:Nil

Course objectives:

- To work with a positional number systems and numeric representations
- To introduce basic postulates of Boolean algebra and show the correlation between Boolean expression
- To outline the formal procedures for the analysis and design of combinational circuits and sequential circuits
- To study the fundamentals of HDL
- To design and implement combinational circuits using basic programmable blocks
- To design and implement synchronous sequential circuits

Syllabus:

Positional Number Systems, Boolean algebra, Combinational Logic, HDL concepts ,Digital ICs, Programmable Logic Devices, Sequential Logic, Sequential Circuits

Expected outcome:

The student should able to:

1. Compare various positional number systems and binary codes
2. Apply Boolean algebra in logic circuit design
3. Design combinational and sequential circuits
4. Design and implement digital systems using basic programmable blocks
5. Formulate various digital systems using HDL

Text Books:

1. Donald D Givone, Digital Principles and Design, Tata McGraw Hill, 2003
2. John F Wakerly, Digital Design Principles and Practices, Pearson Prentice Hall, 2007

References:

1.Ronald J Tocci, Digital Systems, Pearson Education, 11th edition,2010
2.Thomas L Floyd, Digital Fundamentals, Pearson Education, 8th edition 2009
3.Moris Mano, Digital Design, Prentice Hall of India, 3rd edition, 2002
4.John M Yarbrough, Digital Logic Applications and Design, Cenage learning, 2009
5.David Money Harris, Sarah L Harris, Digital Design and Computer Architecture, Morgan Kaufmann – Elsevier, 2009

Course Plan

Module	Course content (42 hrs)	Hours	Sem. Exam Marks
I	Number systems- decimal, binary, octal, hexa decimal, base conversion	2	15
	1's and 2's complement, signed number representation Binary arithmetic, binary subtraction using 2's complement	2	
	Binary codes (grey, BCD and Excess-3), Error detection and correcting codes: Parity(odd, even), Hamming code (7,4), Alphanumeric codes : ASCII	2	

II	Logic expressions, Boolean laws, Duality, De Morgan's law, Logic functions and gates	2	15
	Canonical forms: SOP, POS, Realisation of logic expressions using K-	2	

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	map (2,3,4 variables)		
	Design of combinational circuits – adder, subtractor, 4 bit adder/subtractor, BCD adder, MUX, DEMUX, Decoder,BCD to 7 segment decoder, Encoder, Priority encoder, Comparator (2/3 bits)	4	
FIRST INTERNAL EXAM			
III	Introduction to HDL : Logic descriptions using HDL, basics of modeling (only for assignments)	**2**	**0**
	Logic families and its characteristics: Logic levels, propagation delay, fan in, fan out, noise immunity , power dissipation, TTL subfamilies	1	**15**
	NAND in TTL (totem pole, open collector and tri-state), CMOS:NAND, NOR, and NOT in CMOS, Comparison of logic families (TTL,ECL,CMOS) in terms of fan-in, fan-out, supply voltage, propagation delay, logic voltage and current levels, power dissipation and noise margin	2	
	Programmable Logic devices - ROM, PLA, PAL, implementation of simple circuits using PLA	2	
IV	Sequential circuits - latch, flip flop (SR, JK, T, D), master slave JK FF, conversion of FFs, excitation table and characteristic equations	3	**15**
	Asynchronous and synchronous counter design, mod N counters, random sequence generator	5	
SECOND INTERNAL EXAM			
V	Shift Registers - SIPO, SISO, PISO, PIPO, Shift registers with parallel LOAD/SHIFT Shift register counter - Ring Counter and Johnson Counter	3	**20**
	Mealy and Moore models, state machine ,notations, state diagram, state table, transition table, excitation table, state equations	3	
VI	Construction of state diagram – up down counter, sequence detector	3	**20**
	Synchronous sequential circuit design - State equivalence	2	
	State reduction – equivalence classes, implication chart	2	
END SEMESTER EXAM			

Assignments:

1. Simple combinational circuit design using MUX,DEMUX, PLA & PAL
2. HDL simulation of circuits like simple ALU, up-down counter, linear feedback shift register, sequence generator

Question Paper Pattern

The question paper consists of three parts. Part A covers modules I and II, Part B covers modules III and IV and Part C covers modules V and VI. Each part has three questions. Each question have a maximum of four subparts. Among the three questions one will be a compulsory question covering both the modules and the remaining two questions will be as one question from each module, of which one is to be answered. Mark pattern is according to the syllabus with maximum 50 % for theory, derivation, proof and 50% for logical/numerical problems.

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Course code	Course Name	L-T-P - Credits	Year of Introduction
EC208	ANALOG COMMUNICATION ENGINEERING	3-0-0-3	2016

Prerequisite: EC205 Electronic Circuits

Course Objectives

- To study the concepts and types of modulation schemes.
- To study different types of radio transmitters and receivers.
- To study the effects of noise in analog communication systems.
  To impart basic knowledge on public telephone systems.

Syllabus

Elements of communication system, Need for modulation, Noises, Amplitude Modulation, Amplitude modulator circuits, Demodulator circuits, AM transmitters, Types of AM, Angle modulation: principles of frequency modulation, phase modulation, AM and FM Receivers, Frequency modulator circuits, FM transmitters, FM receiver, Noise in AM and FM systems, Public telephone systems, standard telephone set, cordless telephones.

Expected outcome .

The students will be able to:

i. understand the different analog modulation schemes.
ii. understand the fundamental ideas of noises and its effect in communication systems.
iii. explain the principle and working of analog transmitters and receivers.
iv. know the basic idea of telephone systems.

Text Books:

1. Dennis Roody and John Coolen, Electronic Communication, Pearson, 4/e, 2011.
2. George Kennedy, Electronic Communication Systems, McGrawHill, 4/e, 2008.
3. Tomasi, Electronic Communications System , Pearson, 5/e, 2011.

References:

1. Blake, Electronic Communication system, Cengage, 2/e, 2012.
2. Simon Haykin, Communication Systems, Wiley 4/e, 2006.
3. Taub, Schilling, Saha, Principles of communication system, McGraw Hill, 2013.
4. Tomasi, Advanced Electronic Communications Systems, Pearson, 6/e, 2012.

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Introduction, Elements of communication systems, Need for modulation	2	15%
	Noise in communication system, Thermal noise (white noise), Shot noise, Partition noise, Flicker noise, Burst noise, Signal to noise ratio, Noise factor, Noise temperature, Narrow band noise.	3	
II	Amplitude modulation: Sinusoidal AM, Modulation index, Average power, Effective voltage and current, Nonsinusoidal modulation.	4	15%
	Amplitude modulator circuits, Amplitude demodulator circuits, AM transmitters, Noise in AM Systems.	5	
FIRST INTERNAL EXAMINATION			
III	Single Sideband Modulation: Principles, Balanced modulators, Singly & doubly balanced modulators, SSB generation, Filter method, Phasing method & Third method, SSB reception, Modified SSB systems, Pilot carrier SSB & ISB, Companded SSB.	6	15%

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IV	Angle modulation: Frequency modulation, Sinusoidal FM, Frequency spectrum, Modulation index, Average power, Non-sinusoidal modulation, Deviation ratio, Comparison of AM and FM.	4	15%
	AM & FM Receivers: Super heterodyne receiver, Tuning range, Tracking, Sensitivity and gain, Image rejection, Double conversion, Adjacent channel selectivity, Automatic Gain Control (AGC).	4	
	SECOND INTERNAL EXAMINATION		
V	Phase modulation, Equivalence between PM and FM, Sinusoidal phase modulation, Digital phase modulation.	3	20%
	Angle modulator Circuits: Varactor diode modulators, Transistor modulators. FM Transmitters: Direct and Indirect Methods.	3	
VI	Angle modulation detectors, Slope detector, Balanced slope detector, Foster-Seeley discriminator, PLL demodulator, Automatic Frequency Control (AFC), Amplitude limiters, Noise in FM systems, Pre-emphasis and De-emphasis.	4	20%
	Telephone systems, standard telephone set, basic call procedures and tones, DTMF, cordless telephones.	4	
	END SEMESTER EXAM		

Assignment

Study of

1. The telephone circuit - Local subscriber loop, Private-line circuits, Voice-frequency circuit arrangements.
2. The public telephone network - Instruments, Local loops, Trunk circuits and exchanges, Local central exchanges, Automated central office switches and exchanges.

Question Paper Pattern (End Sem Exam)

Maximum Marks: 100 **Time : 3 hours**

The question paper shall consist of three parts. Part A covers modules I and II, Part B covers modules III and IV, and Part C covers modules V and VI. Each part has three questions uniformly covering the two modules and each question can have maximum four subdivisions. In each part, any two questions are to be answered. Mark patterns are as per the syllabus with maximum 60 % for theory and 40% for logical/numerical problems, derivation and proof.

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ECT 203	LOGIC CIRCUIT DESIGN	CATEGORY	L	T	P	CREDIT
		PCC	3	1	0	4

Preamble: This course aims to impart the basic knowledge of logic circuits and enable students to apply it to design a digital system.

Prerequisite: EST130 Basics of Electrical and Electronics Engineering

Course Outcomes: After the completion of the course the student will be able to

CO 1	Explain the elements of digital system abstractions such as digital representations of information, digital logic and Boolean algebra
CO 2	Create an implementation of a combinational logic function described by a truth table using and/or/inv gates/ muxes
CO 3	Compare different types of logic families with respect to performance and efficiency
CO 4	Design a sequential logic circuit using the basic building blocks like flip-flops
CO 5	Design and analyze combinational and sequential logic circuits through gate level Verilog models.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3										
CO 2	3	3	3									
CO 3	3	3										
CO 4	3	3	3									
CO 5	3	3	3		3							

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration

150	50	100	3 hours

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Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Course project	: 15 marks

It is mandatory that a *course project* shall be undertaken by a student for this subject. The course project can be performed either as a hardware realization/simulation of a typical digital system using combinational or sequential logic. Instead of two assignments, two evaluations may be performed on the course project along with series tests, each carrying 5 marks. Upon successful completion of the project, a brief report shall be submitted by the student which shall be evaluated for 5 marks. The report has to be submitted for academic auditing. A few samples projects are given below:

Sample course projects:

1. M-Sequence Generator Psuedo random sequences are popularly used in wireless communication. A sequence generator is used to produce pseudo random codes that are useful in spread spectrum applications. Their generation relies on irreducible polynomials.A maximal length sequence generator that relies on the polynomial $P(D) = D^7 + D^3 + 1$, with each D represent delay of one clock cycle.

- An 8-bit shift register that is configured as a ring counter may be used realize the above equation.
- This circuit can be developed in verilog, simulated, synthesized and programmed into a tiny FPGA and tested in real time.
- Observe the M-sequnce from parallel outputs of shift register for one period . Count the number of 1s and zeros in one cycle.
- Count the number of runs of 1s in singles, pairs, quads etc. in the pattern.

2. BCD Subtractor

- Make 4 -bit parallel adder circuit in verilog.
- Make a one digit BCD subtracter in Verilog, synthesize and write into a tiny FPGA.
- Test the circuit with BCD inputs.

3. Digital Thermometer

- Develop a circuit with a temperature sensor and discrete components to measure and dispaly temperature.
- Solder the circuit on PCB and test it.

4. Electronic Display

- This display should receive the input from an alphanumeric keyboard and display it on an LCD diplay.
- The decoder and digital circuitry is to developed in Verilog and programmed into a tiny FPGA.

5. Electronic Roulette Wheel

- 32 LEDs are placed in a circle and numbered that resembles a roulette wheel.
- A 32-bit shift register generates a random bit pattern with a single 1 in it.
- When a push button is pressed the single 1 lights one LED randomly.
- Develop the shift register random pattern generator in verilog and implement on a tiny FPGA and test the circuit.

6. Three Bit Carry Look Ahead Adder

- Design the circuit of a three bit carry look ahead adder.
- Develop the verilog code for it and implement and test it on a tiny FPGA. item Compare the performance with a parallel adder.

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks. The questions on verlog modelling should not have a credit more than 25% of the whole mark.

Course Level Assessment Questions

Course Outcome 1 (CO1) : Number Systems and Codes

1. Consider the signed binary numbers A = 01000110 and B = 11010011 where B is in 2's complement form. Find the value of the following mathematical expression (i) A + B (ii) A – B
2. Perform the following operations (i)$D9CE_{16}-CFDA_{16}$ (ii) 6575_8-5732_8
3. Convert decimal 6,514 to both BCD and ASCII codes. For ASCII, an even parity bit is to be appended at the left.

Course Outcome 2 (CO2) : Boolean Postulates and combinational circuits

1. Design a magnitude comparator to compare two 2-bit numbers $A = A_1A_0$ and $B = B_1B_0B$
2. Simplify using K-map $F(a,b,c,d) = \Sigma m\ (4,5,7,8,9,11,12,13,15)$
3. Explain the operation of a 8x1 multiplexer and implement the following using an 8x1 multiplexer $F(A, B, C, D) = \Sigma m\ (0, 1, 3, 5, 6, 7, 8, 9, 11, 13, 14)$

Course Outcome 3 (CO3) : Logic families and its characteristics

1. Define the terms noise margin, propagation delay and power dissipation of logic families. Compare TTL and CMOS logic families showing the values of above mentioned terms.
2. Draw the circuit and explain the operation of a TTL NAND gate
3. Compare TTL, CMOS logic families in terms of fan-in, fan-out and supply voltage

Course Outcome 4 (CO4) : Sequential Logic Circuits

1. Realize a T flip-flop using NAND gates and explain the operation with truth table, excitation table and characteristic equation
2. Explain a MOD 6 asynchronous counter using JK Flip Flop
3. Draw the logic diagram of 3 bit PIPO shift register with LOAD/SHIFT control and explain its working

Course Outcome 5 (CO5) : Logic Circuit Design using HDL

1. Design a 4-to-1 mux using gate level Verilog model.
2. Design a verilog model for a hald adder circuit. Make a one bit full adder by connecting two half adder models.
3. Compare concurrent signal assignment versus sequential signal assignment.

Syllabus

Module 1: Number Systems and Codes:

Binary and hexadecimal number systems; Methods of base conversions; Binary and hexadecimal arithmetic; Representation of signed numbers; Fixed and floating point numbers; Binary coded decimal codes; Gray codes; Excess 3 code. Alphanumeric codes: ASCII. Basics of verilog -- basic language elements: identifiers, data objects, scalar data types, operators.

Module 2: Boolean Postulates and Fundamental Gates

Boolean postulates and laws – Logic Functions and Gates De-Morgan's Theorems, Principle of Duality, Minimization of Boolean expressions, Sum of Products (SOP), Product of Sums (POS), Canonical forms, Karnaugh map Minimization. Modeling in verilog, Implementation of gates with simple verilog codes.

Module 3: Combinatorial and Arithmetic Circuits

Combinatorial Logic Systems - Comparators, Multiplexers, Demultiplexers, Encoder, Decoder. Half and Full Adders, Subtractors, Serial and Parallel Adders, BCD Adder. Modeling and simulation of combinatorial circuits with verilog codes at the gate level.

Module 4: Sequential Logic Circuits:

Building blocks like S-R, JK and Master-Slave JK FF, Edge triggered FF, Conversion of Flipflops, Excitation table and characteristic equation. Implementation with verilog codes. Ripple and Synchronous counters and implementation in verilog, Shift registers-SIPO, SISO, PISO, PIPO. Shift Registers with parallel Load/Shift, Ring counter and Johnsons counter. Asynchronous and Synchronous counter design, Mod N counter. Modeling and simulation of flipflops and counters in verilog.

Module 5: Logic families and its characteristics:

TTL, ECL, CMOS - Electrical characteristics of logic gates – logic levels and noise margins, fan-out, propagation delay, transition time, power consumption and power-delay product. TTL inverter - circuit description and operation; CMOS inverter - circuit description and operation; Structure and operations of TTL and CMOS gates; NAND in TTL and CMOS, NAND and NOR in CMOS.

Text Books

1. Mano M.M., Ciletti M.D., "Digital Design", Pearson India, 4th Edition. 2006
2. D.V. Hall, "Digital Circuits and Systems", Tata McGraw Hill, 1989

3. S. Brown, Z. Vranesic, "Fundamentals of Digital Logic with Verilog Design", McGraw Hill

4. Samir Palnikar"Verilog HDL: A Guide to Digital Design and Syntheis", Sunsoft Press

5. R.P. Jain, "Modern digital Electronics", Tata McGraw Hill, 4th edition, 2009

Reference Books

1. W.H. Gothmann, "Digital Electronics – An introduction to theory and practice", PHI, 2nd edition ,2006
2. Wakerly J.F., "Digital Design: Principles and Practices," Pearson India, 4th 2008

3. A. Ananthakumar ,"Fundamentals of Digital Circuits", Prentice Hall, 2nd edition, 2016
4. Fletcher, William I., An Engineering Approach to Digital Design, 1st Edition, Prentice Hall India, 1980

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Number Systems and Codes:**	
1.1	Binary, octal and hexadecimal number systems; Methods of base conversions;	2
1.2	Binary, octal and hexadecimal arithmetic;	1
1.3	Representation of signed numbers; Fixed and floating point numbers;	3
1.4	Binary coded decimal codes; Gray codes; Excess 3 code :	1
1.5	Error detection and correction codes - parity check codes and Hamming code-Alphanumeric codes:ASCII	3
1.6	Verilog basic language elements: identifiers, data objects, scalar data types, operators	2
2	**Boolean Postulates and Fundamental Gates:**	
2.1	Boolean postulates and laws – Logic Functions and Gates, De-Morgan's Theorems, Principle of Duality	2
2.2	Minimization of Boolean expressions, Sum of Products (SOP), Product of Sums (POS)	2
2.3	Canonical forms, Karnaugh map Minimization	1
2.4	Gate level modelling in Verilog: Basic gates, XOR using NAND and NOR	2
3	**Combinatorial and Arithmetic Circuits**	
3.1	Combinatorial Logic Systems - Comparators, Multiplexers, Demultiplexers	2
3.2	Encoder, Decoder, Half and Full Adders, Subtractors, Serial and Parallel Adders, BCD Adder	3

3.3	Gate level modelling combinational logic circuits in Verilog: half adder, full adder, mux, demux, decoder, encoder	3
4	**Sequential Logic Circuits:**	
4.1	Building blocks like S-R, JK and Master-Slave JK FF, Edge triggered FF	2
4.2	Conversion of Flipflops, Excitation table and characteristic equation.	1
4.3	Ripple and Synchronous counters, Shift registers-SIPO.SISO,PISO,PIPO	2
4.4	Ring counter and Johnsons counter, Asynchronous and Synchronous counter design	3
4.5	Mod N counter, Random Sequence generator	1
4.6	Modelling sequential logic circuits in Verilog: flipflops, counters	2
5	**Logic families and its characteristics:**	
5.1	TTL,ECL,CMOS- Electrical characteristics of logic gates – logic levels and noise margins, fan-out, propagation delay, transition time, power consumption and power-delay product.	3
5.2	TTL inverter - circuit description and operation	1
5.3	CMOS inverter - circuit description and operation	1
5.4	Structure and operations of TTL and CMOS gates; NAND in TTL, NAND and NOR in CMOS.	2

Simulation Assignments (ECT203)

The following simulations can be done in QUCS, KiCad or PSPICE.

BCD Adder

- Realize a one bit paraller adder, simulate and test it.
- Cascade four such adders to form a four bit parallel adder
- Simulate it and make it into a subcircuit.
- Develop a one digit BCD adder, based on the subcircuit, simulate and test it

BCD Subtractor

- Use the above 4 -bit adder subcircuit, implement and simulate a one digit BCD subtractor.
- Test it with two BCD inputs

Logic Implementation with Multiplexer

- Develop an 8 : 1 multiplexer using gates, simulate, test and make it into a subcircuit.
- Use this subcircuit to implement the logic function $f(A, B, C) = \sum m(1, 3, 7)$
- Modify the truth table properly and implement the logic function $f(A, B, C, D) = \sum m(1, 4, 12, 14)$ using one 8 : 1 multiplexer.

BCD to Seven Segment Decoder

- Develop a BCD to seven segment decoder using gates and make it into a subcircuit.
- simulate this and test it

Ripple Counters

- Understand the internal circuit of 7490 IC and develop it in the simulator.
- Make it into a subcircuit and simulate it. Observe the truth table and timing diagrams for mod-5, mod-2 and mod-10 operation.
- Develop a mod-40 (mod-8 and mod-5) counter by cascading two such subcircuits.
- Simulate and observe the timing diagram and truth table.

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Synchronous Counters

- Design and develop a 4-bit synchronous counter using J-K flip-flops.
- Perform digital simulation and observe the timing diagram and truth table.

Sequence Generator

- Connect D flip-flops to realize and 8-bit shift register and make it into a subcircuit.
- sequence generator that relies on the polynomial $P(D) = D_7 + D_3 + 1$, with each D represent delay of one clock cycle
- Simulate and observe this maximal length pseudo random sequence.

Transfer Characteristics of TTL and CMOS Inverters

- Develop a standard TTL circuit and perform sweep simulation and observe the transfer characteristics. Compute the threshold voltage and noise margns.
- Develop and simulate standard CMOS inverter circuit and perform sweep simulation and observe the transfer characteristics. Compute the threshold voltage and noise margins.

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ELECTRONICS AND COMMUNICATION ENGINEERING

Model Question Paper

A P J Abdul Kalam Technological University

Third Semester B Tech Degree Examination

Branch: Electronics and Communication

Course: ECT 203 Logic Circuit Design

Time: 3 Hrs **Max. Marks: 100**

PART A

Answer All Questions

1	Convert 203.52_{10} to binary and hexadecimal.	(3)	K_1
2	Compare bitwise and logical verilog operators	(3)	K_1
3	Prove that NAND and NOR are not associative.	(3)	K_2
4	Convert the expression ABCD+ABC+ACD to minterms.	(3)	K_2
5	Define expressions in Verilog with example.	(3)	K_2
6	Explain the working of a decoder.	(3)	K_1
7	What is race around condition?	(3)	K_1
8	Convert a T flip-flop to D flip-flop.	(3)	K_2
9	Define fan-in and fan-out of logic circuits.	(3)	K_2
10	Define noise margin and how can you calculate it?	(3)	K_2

PART B

Answer one question from each module. Each question carries 14 mark.

Module I

11(A)	Subtract 46_{10} from 100_{10} using 2's complement arithmetic.	(8)	K_2
11(B)	Give a brief description on keywords and identifiers in Verilog with example.	(6)	K_2

OR

12(A)	Explain the floating and fixed point representation of numbers	(8)	K_2
12(A)	Explain the differences between programming lanuguages and HDLs	(6)	K_2

Module II

13(A)	Simplify using K-map $f(A, B, C, D) = \sum m(4, 5, 7, 8, 9, 11, 12, 13, 15)$ using K-maps	(7)	K_3
13(B)	Write a Verilog code for implementing above function	(7)	K_3

OR

14(A)	Write a Verilog code to implement the basic gates.	(7)	K_3
14(B)	Reduce the following Boolean function using K-Map and implement the simplified function using the logic gates $f(A, B, C, D) = \sum (0, 1, 4, 5, 6, 8, 9, 10, 12, 13, 14)$	(7)	K_3

Module III

15(A)	Design a 3-bit magnitude comparator circuit.	(8)	K_3
15(B)	Write a Verilog description for a one bit full adder circuit.	(6)	K_3

OR

16(A)	Write a verilog code to implement 4:1 multiplexer	(6)	K_3
16(B)	Implement the logic function $f(A, B, C) = \sum m(0, 1, 4, 7)$ using 8 : 1 and 4 : 1 multiplexers.	(8)	K_3

Module IV

17	Design MOD 12 asynchronous counter using T flip-flop.	(14)	K_3

OR

18(A)	Explain the operation of Master Slave JK flipflop.	(7)	K_3
18(B)	Derive the ouput Q_{n+1} in Terms of J_n, K_n and Q_n	(7)	K_3

Module V

19(A)	Explain in detail about TTL with open collector output configuration.	(8)	K_2
19(B)	Draw an ECL basic gate and explain.	(6)	K_2

OR

20(A)	Demonstrate the CMOS logic circuit configuration and characteristics in detail.	(8)	K_2
20(B)	Compare the characteristics features of TTL and ECL digital logic families	(6)	K_2

COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC302	**Digital Communication**	**4-0-0-4**	**2016**

Prerequisite: EC204 Signals and Systems, EC208 Analog Communication

Course Objectives:

- To understand the concept of Digital representation of analog source
- To understand the Performance comparison various pulse modulation schemes
- To discuss Inter Symbol Interference (ISI) problem in digital communication and to derive the Nyquist Criteria for zero ISI in data Transmission
- To analyse the need for introducing ISI in controlled manner
- To understand signal space representation of signal using Gram Schmidt orthonormalisation procedure
- To analyse the error probability for different modulation schemes like BPSK, BFSK, QPSK etc.
- To understand the principle of spread spectrum communication and to illustrate the concept of FHSS and DSSS
- To understand various Multiple Access Techniques

Syllabus: Overview of Random variables and Random process, Overall picture and relevance of digital communication, Digital Pulse modulation, Signal space concepts, Matched filter receiver, Review of Gaussian random process, Digital band pass modulation schemes, Detection of signals in Gaussian noise, Pseudo–noise sequences, Importance of synchronization, Spread spectrum communication, Diversity techniques, Multiple Access Techniques.

Expected Outcome

The students will be able to

i. Illustrate the Digital representation of analog source
ii. Compare the performance of various Digital Pulse Modulation Schemes
iii. Apply the knowledge of ISI problems in Digital communication to derive Nyquist criteria for zero ISI
iv. Analyse the need for introducing ISI in Digital Communication in a controlled manner
v. Construct signal space representation of signal using Gram Schmidt orthonormalisation procedure
vi. Compare the error probability for different digital modulation schemes like BPSK, BFSK, QPSK etc.
vii. Describe the principle of spread spectrum communication and to illustrate the concept of FHSS and DSSS
viii. Understand various Diversity Techniques

Text Books:

1. John G. Proakis, Masoud Salehi, Digital Communication, McGraw Hill Education Edition, 2014
2. Nishanth N, Digital Communication, Cengage Learning India , 2017
3. Ramakrishna Rao, Digital communication, Tata McGraw Hill Education Pvt. Limited.
4. Simon Haykin, Communication Systems, 4/e Wiley India, 2012.

References:

1. Couch: Analog and Digital Communication. 8e, Pearson Education India, 2013.
2. H.Taub and Schilling Principles of Communication Systems, , TMH, 2007
3. K.Sam Shanmugham, Digital and Analog Communication Systems, John Wiley & Sons
4. Pierre Lafrance ,Fundamental Concepts in Communication, Prentice Hall India.
5. Sheldon.M.Ross, "Introduction to Probability Models", Academic Press, 7th edition.
6. Sklar: Digital Communication, 2E, Pearson Education.
7. T L Singal, Digital Communication, McGraw Hill Education (India) Pvt Ltd, 2015

Course Plan

Module	Course content	Hours	End Sem. Exam Marks
I	**Overview of Random variables and Random process:** Random variables–continuous and Discrete, random process-Stationarity, Autocorrelation and power spectral density, Transmission of Random Process through LTI systems, PSD, AWGN	3	15
	Pulse Code Modulation (PCM): Pulse Modulation, Sampling process, Performance comparison of various sampling techniques Aliasing, Reconstruction, PAM, Quantization, Noise in PCM system	3	
	Modifications of PCM: Delta modulation, DPCM, ADPCM, ADM, Performance comparison of various pulse modulation schemes, Line codes, PSD of various Line codes	4	
II	**Transmission over baseband channel:** Matched filter, Inter Symbol Interference (ISI), Nyquist Criteria for zero ISI, Ideal solution, Raised cosine spectrum, Eye Pattern	4	15
	Correlative Level Coding - Duobinary coding, precoding, Modified duobinary coding, Generalized Partial response signalling.	3	
FIRST INTERNAL EXAM			
III	**Signal Space Analysis:** Geometric representation of signals, Gram Schmidt orthogonization procedure.	3	15
	Transmission Over AWGN Channel: Conversion of the continuous AWGN channel into a vector channel, Likelihood function, Maximum Likelihood Decoding, Correlation Receiver	4	
IV	**Digital Modulation Schemes:** Pass band transmission model, Coherent Modulation Schemes- BPSK, QPSK, BFSK. Non-Coherent orthogonal modulation schemes, Differential Phase Shift Keying (DPSK)	4	15
	Detection of Binary modulation schemes in the presence of noise, BER for BPSK, QPSK, BFSK	5	
SECOND INTERNAL EXAM			
V	**Pseudo–noise sequences**: Properties of PN sequences. Generation of PN Sequences, generator polynomials, Maximal length codes and Gold Codes.	3	20

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	Importance of synchronization: Carrier, frame and symbol/chip synchronization techniques.	2	
	Spread spectrum communication: Direct sequence spread spectrum with coherent binary phase shift keying, Processing gain, Probability of error, Anti-jam Characteristics, Frequency Hop spread spectrum with MFSK, Slow and Fast frequency hopping.	4	
VI	**Multipath channels:** classification, Coherence time, Coherence bandwidth, Statistical characterization of multi path channels, Binary signalling over a Rayleigh fading channel.	3	20
	Diversity techniques: Diversity in time, frequency and space.	2	
	Multiple Access Techniques: TDMA, FDMA, CDMA and SDMA – RAKE receiver, Introduction to Multicarrier communication- OFDM	5	
	END SEMESTER EXAM		

Question Paper Pattern (End Semester Exam)

Maximum Marks : 100 **Time : 3 hours**

The question paper shall consist of three parts. Part A covers modules I and II, Part B covers modules III and IV, and Part C covers modules V and VI. Each part has three questions uniformly covering the two modules and each question can have maximum four subdivisions. In each part, any two questions are to be answered. Mark patterns are as per the syllabus with 30% for theory and 70% for logical/numerical problems, derivation and proof.

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COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC304	VLSI	3-0-0-3	2016

Prerequisite: EC203 Solid State Devices, EC204 Analog Integrated Circuit.

Course objectives:

- To give the knowledge about IC Fabrication Techniques
- To impart the skill of analysis and design of MOSFET and CMOS logic circuits.

Syllabus:

IC Fabrication Technology, CMOS IC Fabrication Sequence, CMOS inverters, Design rules, Static CMOS Design, Dynamic CMOS circuits, Pass transistor, Read Only Memory, Random Access Memory, Sense amplifiers, Adders, multipliers, Testing of VLSI circuits.

Expected outcome:

The students will be able to design and analyse various MOSFET and CMOS logic circuits.

Text Books:

1. John P Uyemura, Introduction to VLSI Circuits and Systems, Wiley India, 2006
2. S.M. SZE, VLSI Technology, 2/e, Indian Edition, McGraw-Hill,2003

References:

1. Jan M.Rabaey, Digital Integrated Circuits- A Design Perspective, Prentice Hall, Second Edition, 2005.
2. Neil H.E. Weste, Kamran Eshraghian, Principles of CMOS VLSI Design- A Systems Perspective, Second Edition. Pearson Publication, 2005
3. Razavi - Design of Analog CMOS Integrated Circuits,1e, McGraw Hill Education India Education, New Delhi, 2003.
4. Sung –Mo Kang & Yusuf Leblebici, CMOS Digital Integrated Circuits- Analysis & Design, McGraw-Hill, Third Ed., 2003.
5. Yuan Taur & Ning, Fundamentals of Modern VLSI Devices, Cambridge University Press, 2008

Course Plan

Module	Course content	Hours	End Sem. Exam Marks
I	**Material Preparation**- Purification, Crystal growth (CZ and FZ process), wafer preparation **Thermal Oxidation-** Growth mechanisms, Dry and Wet oxidation, Deal Grove model.	4	15
	Diffusion- Fick's Laws, Diffusion with constant surface concentration and from a constant source, diffusion techniques. **Ion implantation**-Technique, Range Theory, annealing.	3	
II	**Epitaxy :** Vapour phase epitaxy and molecular beam epitaxy **Lithography-** Photo lithographic sequence, Electron Beam Lithography, Etching and metal deposition	4	15
	Methods of isolation Circuit component fabrication: transistor, diodes, resistors, capacitors, N-well CMOS IC Fabrication Sequence	3	
	FIRST INTERNAL EXAM		

III	**CMOS inverters**- DC characteristics, switching characteristics, power dissipation	4	15

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	Layout Design rules, Stick Diagram and layout of CMOS Inverter, two input NAND and NOR gates	4	
IV	**MOSFET Logic Design** -Pass transistor logic, Complementary pass transistor logic and transmission gate logic , realization of functions	6	15
	SECOND INTERNAL EXAM		
V	**Read Only Memory**-4x4 MOS ROM Cell Arrays(OR,NOR,NAND) **Random Access Memory** –SRAM-Six transistor CMOS SRAM cell, DRAM –Three transistor and One transistor Dynamic Memory Cell	4	20
	Sense amplifiers –Differential Voltage Sensing Amplifiers Introduction to PLDs and FPGAs, Design of PLAs.	3	
VI	**Adders**- Static adder, Carry-By pass adder, Linear Carry-Select adder, Square- root carry- select adder **Multipliers**-Array multiplier	4	20
	END SEMESTER EXAM		

Question Paper Pattern (End Semester Exam)

Maximum Marks : 100 **Time : 3 hours**

The question paper shall consist of three parts. Part A covers modules I and II, Part B covers modules III and IV, and Part C covers modules V and VI. Each part has three questions uniformly covering the two modules and each question can have maximum four subdivisions. In each part, any two questions are to be answered. Mark patterns are as per the syllabus with 70% for theory and 30% for logical/numerical problems, derivation and proof.

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COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC306	Antenna & Wave Propagation	3-0-0-3	2016

Prerequisite: EC303 Applied Electromagnetic Theory

Course objectives:

- To learn the basic working of antennas.
- To study various antennas, arrays and radiation patterns of antennas.
- To understand various techniques involved in various antenna parameter measurements.
- To understand the propagation of radio waves in the atmosphere.

Syllabus:

Antenna and antenna parameters, Duality of antennas, Derivation of electromagnetic fields and directivity of short dipole and half wave dipole, Measurement of antenna parameters. Antenna arrays and design of Endfire, broadside, binomial and Dolphchebyshev arrays, Principles of practical antennas. Traveling wave antennas, principle and applications of V and rhombic antennas Principles of Horn, Parabolic dish antenna and Cassegrain antenna, Log periodic antenna array and Helical antenna. Design of rectangular Patch antennas. Principle of smart antenna, Radio wave propagation, Different modes, effect of earth's magnetic field. Fading and diversity techniques.

Expected outcome:

The student will be able to know:

i. The basic working of antennas.
ii. Various antennas, arrays and radiation patterns of antennas
iii. Various techniques involved in various antenna parameter measurements.
iv. The propagation of radio waves in the atmosphere.

Text Books:

1. Balanis, Antenna Theory and Design, 3/e, Wiley Publications.
2. John D. Krauss, Antennas for all Applications, 3/e, TMH.

References:

1. Collin R.E, Antennas & Radio Wave Propagation, McGraw Hill. 1985.
2. Jordan E.C. & K. G. Balmain, Electromagnetic Waves & Radiating Systems, 2/e, PHI.
3. Raju G.S.N., Antenna and Wave Propagation, Pearson, 2013.
4. Sisir K.Das & Annapurna Das, Antenna and Wave Propagation, McGraw Hill,2012
5. Terman, Electronics & Radio Engineering, 4/e, McGraw Hill.
6. Thomas A. Milligan, Modern Antenna Design, IEEE PRESS, 2/e, Wiley Inter science.

Course Plan

Module	Course content	Hours	End Sem. Exam Marks
I	Basic antenna parameters - gain, directivity, beam solid angle, beam width and effective aperture calculations. Effective height - wave polarization - antenna temperature - radiation resistance - radiation efficiency - antenna field zones - principles of reciprocity. Duality of antennas.	7	15
II	Concept of retarded potential. Field, directivity and radiation resistance of a short dipole and half wave dipole. Measurement of radiation pattern, gain, directivity and impedance of antenna	7	15
	FIRST INTERNAL EXAM		
III	Arrays of point sources - field of two isotropic point sources - principle of pattern multiplication - linear arrays of 'n' isotropic point sources. Grating lobes.	4	15
	Design of Broadside, Endfire & Binomial arrays. Design of DolphChebyshev arrays.	4	
IV	Basic principle of beam steering. Travelling wave antennas. Principle and applications of V and rhombic antennas. Principles of Horn, Parabolic dish antenna, Cassegrain antenna (expression for E, H andGain without derivation).	6	15
	SECOND INTERNAL EXAM		
V	Principle of Log periodic antenna array and Helical antenna. Antennas for mobile base station and handsets.	3	20
	Design of rectangular Patch antennas. Principle of smart antenna.	3	
VI	Radio wave propagation , Modes , structure of atmosphere, sky wave propagation , effect of earth's magnetic field, Ionospheric abnormalities and absorption, space wave propagation, LOS distance	4	20
	Field strength of space wave, duct propagation, VHF and UHF Mobile radio propagation, tropospheric scatter propagation, fading and diversity techniques.	4	
	END SEMESTER EXAM		

Question Paper Pattern (End semester exam)

Max. Marks : 100 **Time : 3 hours**

The question paper shall consist of three parts. Part A covers modules I and II, Part B covers modules III and IV, and Part C covers modules V and VI. Each part has three questions uniformly covering the two modules and each question can have maximum four subdivisions. In each part, any two questions are to be answered. Mark patterns are as per the syllabus with 50% for theory and 50% for logical/numerical problems, derivation and proof.

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Course Plan			
Module	Course content	Hours	End Sem. Exam Marks
I	Introduction to Embedded Systems– Components of embedded system hardware–Software embedded into the system – Embedded Processors - CPU architecture of ARM processor (ARM9) – CPU Bus Organization and Protocol.	4	15
	Design and Development life cycle model - Embedded system design process – Challenges in Embedded system design	3	
II	Serial Communication Standards and Devices - UART, HDLC, SCI and SPI.	3	15
	Serial Bus Protocols - I2C Bus, CAN Bus and USB Bus. Parallel communication standards ISA, PCI and PCI-X Bus.	3	
FIRST INTERNAL EXAM			
III	Memory devices and systems - memory map – DMA - I/O Devices – Interrupts - ISR – Device drivers for handling ISR – Memory Device Drivers – Device Drivers for on-board bus.	6	15
IV	Programming concepts of Embedded programming – Features of Embedded C++ and Embedded Java (basics only). Software Implementation, Testing, Validation and debugging, system-on-chip.	6	15
	Design Examples: Mobile phones, ATM machine, Set top box	1	0
SECOND INTERNAL EXAM			
V	Inter Process Communication and Synchronization -Process, tasks and threads –Shared data– Inter process communication - Signals – Semaphore – Message Queues – Mailboxes – Pipes – Sockets – Remote Procedure Calls (RPCs).	8	20
VI	Real time operating systems - Services- Goals – Structures - Kernel - Process Management – Memory Management – Device Management – File System Organization. Micro C/OS-II RTOS - System Level Functions – Task Service Functions – Memory Allocation Related Functions – Semaphore Related Functions. Study of other popular Real Time Operating Systems.	8	20
END SEMESTER EXAM			

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Question Paper Pattern (End semester exam)

Maximum Marks : 100 **Time : 3 hours**

The question paper shall consist of three parts. Part A covers modules I and II, Part B covers modules III and IV, and Part C covers modules V and VI. Each part has three questions uniformly covering the two modules and each question can have maximum four subdivisions. In each part, any two questions are to be answered. Mark patterns are as per the syllabus with 100 % for theory.

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COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC366	**Real Time Operating Systems**	**3-0-0-3**	**2016**

Prerequisite: EC206 Computer Organization

Course objectives:

- To understand the basics of operating systems tasks and basic OS architectures and develop these to RTOS
- To understand concepts of task scheduling
- To understand problems and issues related with multitasking
- To learn strategies to interface memory and I/O with RTOS kernels
- To impart skills necessary to develop software for embedded computer systems using a real-time operating system.

Syllabus:
Introduction to OS and RTOS, Process management of OS/RTOS, Process Synchronization, Memory and I/O management, Applications of RTOS

Expected outcome:
At the end of the course the students will be familiar with operating systems. They will have an in depth knowledge about the real time operating systems and its applications.

Text Books:

1. C.M. Krishna and G.Shin, Real Time Systems, McGraw-Hill International Edition, 1997.
2. Jean J Labrosse, Embedded Systems Building Blocks Complete and Ready-to-use Modules in C, CMP books, 2/e, 1999.

References:

1. Jean J Labrosse , Micro C/OS-II, The Real Time Kernel, CMP Books, 2011
2. Sam Siewert, V, Real-Time Embedded Components and Systems: With Linux and RTOS (Engineering), 2015
3. Tanenbaum, Modern Operating Systems, 3/e, Pearson Edition, 2007.
4. VxWorks: Programmer's Guide 5.4, Windriver, 1999
5. Wayne Wolf, Computers as Components: Principles of Embedded Computing System Design, 2/e, Kindle Publishers, 2005.

Course Plan

Module	Course content	Hours	End Sem. Exam Marks
I	Operating system objectives and functions, Virtual Computers, Interaction of O. S. & hardware architecture, Evolution of operating systems	2	15
	Architecture of OS (Monolithic, Microkernel, Layered, Exo-kernel and Hybrid kernel structures)	3	
	Batch, Multi programming, Multitasking, Multiuser, parallel, distributed & real –time O.S.	3	
II	Uniprocessor Scheduling: Types of scheduling	2	15
	Scheduling algorithms: FCFS, SJF, Priority, Round Robin	3	
	UNIX Multi-level feedback queue scheduling, Thread Scheduling, Multiprocessor Scheduling concept	3	

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III	Concurrency: Principles of Concurrency, Mutual Exclusion H/W Support, software approaches, Semaphores and Mutex, Message Passing techniques	2	15
	Classical Problems of Synchronization: Readers-Writers Problem, Producer Consumer Problem, Dining Philosopher problem.	3	
	Deadlock: Principles of deadlock, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, An Integrated Deadlock Strategies.	3	
IV	Memory Management requirements, Memory partitioning: Fixed, dynamic, partitioning	3	15
	Memory allocation Strategies (First Fit, Best Fit, Worst Fit, Next Fit), Fragmentation, Swapping, Segmentation, Paging, Virtual Memory, Demand paging	2	
	Page Replacement Policies (FIFO, LRU, Optimal, clock), Thrashing, Working Set Model	3	
SECOND INTERNAL EXAM			
V	I/O Management and Disk Scheduling: I/O Devices, Organization of I/O functions	2	20
	Operating System Design issues, I/O Buffering, Disk Scheduling (FCFS, SCAN, C-SCAN, SSTF), Disk Caches	3	
VI	Comparison and study of RTOS: Vxworks and µCOS	3	20
	Case studies: RTOS for Control Systems.	3	
END SEMESTER EXAM			

Question Paper Pattern (End semester exam)

Maximum marks: 100 **Time: 3 hours**

The question paper shall consist of three parts. Part A covers modules I and II, Part B covers modules III and IV, and Part C covers modules V and VI. Each part has three questions uniformly covering the two modules and each question can have maximum four subdivisions. In each part, any two questions are to be answered. Mark patterns are as per the syllabus with 50 % for theory and 50% for logical/numerical problems, derivation and proof.

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EC14 303 NETWORK ANALYSIS & SYNTHESIS

Teaching scheme: **Credits 4**
3 Hours lecture and 1 hour tutorial per week

Objectives

- *To expose the students to the basic concepts of electric circuits and their analysis in time and frequency domain*
- *To introduce the concept of filter circuits and design of passive filters*
- *To introduce the techniques of network synthesis*

Module I (15 hours)
Basic Circuit elements: R, L, C and mutually coupled circuits-voltage current relationship- Independent and dependent Sources. **Analysis of electrical networks**: Loop and Nodal analysis. **Network theorems**: Thevenin, Norton, Superposition, Source transformations, Maximum Power Transfer theorems. Time domain analysis of R-L and R-C circuits- initial conditions. **S-Domain analysis of circuits**: Review of Laplace transform- Transforms of basic signals- transformation of a circuit into S-domain, Analysis of the transformed circuit- mutually coupled circuits, transient analysis of RC, RL and LC networks with Impulse, step, pulse, ramp and exponential inputs- step response of RLC network

Module II (13 hours)
Network functions: The concept of complex frequency- driving point and transfer functions-Impulse response-Poles and Zeros of network functions-their locations and effects on the time and frequency domain responses-Restriction of poles and zeros in the driving point and transfer function, Time domain behaviour from the pole-zero plot, Bode plot. **Two-port network parameters**: Impedance, admittance, transmission and hybrid-Conversion formulae. Analysis of interconnected two port networks-parallel, series, and cascade connections of two port networks.

Module III (12 hours)
Filters: Brick wall Specifications, Types of filtering, Butterworth Low-Pass Transfer Characteristic, Basic Passive realization of Butterworth filters, Chebyshev Approximation, Characteristics. **Frequency transformations**: Transformation to high pass, band pass and band elimination filters. **Attenuators**: Types of attenuators, T and Bridged T attenuators - compensated attenuators.

Module IV (12 hours)
Elements of realizability Theory: Causality and stability-Hurwitz Polynomials-Positive Real Functions- Elementary Synthesis Procedures. **Synthesis of One-Port Networks**: Properties of L-C Admittance Functions, Synthesis of L-C Driving point Admittances- Properties of R-C Driving point Impedances, Synthesis of R-C Impedances or R-L Admittances-Properties and Synthesis of R-L Impedances and R-C admittances.

Text Books

1. Van Valkenberg, *Network Analysis*, Prentice-Hall of India
2. Franklin F. Kuo, *Network Analysis and Synthesis*, Wiley India, Second Edition.
3. Edminister, *Electric Circuits – Schaum's Outline Series*, McGraw-Hill.
4. William H Hayt & Jack E Kemmerly, *Engineering Circuit Analysis*, TMH

Reference Books

1. DeCarlo/Lin, Linear Circuit Analysis, Oxford University Press, Secondedition
2. D. Roy Choudhary, Networks and Systems, New Age International Publishers, Second Edition

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions 4 x 15 marks=60 marks

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

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Pin 680 597 Kerala

EC14 304: SOLID STATE DEVICES

Teaching scheme **Credits: 4**
3 hours lecture and 1 hour tutorial per week

Objectives
- *To impart the basic concepts of semiconductor Physics*
- *To create an insight into the working of different conventional electronic devices*

Module I (12 hours)
Energy bands and charge carriers in semiconductors - direct and indirect band gap semiconductors - concept of effective mass - intrinsic and extrinsic semiconductors - Fermi level - electron and hole concentrations at equilibrium - temperature dependence of carrier concentrations - conductivity and mobility - quasi Fermi level - diffusion and drift of carriers - Einstein relation - continuity equation

Module II (14 hours)
PN junctions - contact potential - space charge at a junction - current flow at a junction - carrier injection - diode equation - minority and majority carrier currents - capacitance of pn junctions - reverse bias breakdown - zener and avalanche breakdown - abrupt and graded junctions – short diodes - Schottky barrier - rectifying and ohmic contacts - tunnel diode - varactor diode - zener diode - GaAs isotope diodes - Metal semiconductor junctions

Module III (13 hours)
Bipolar junction transistors-Minority carrier distribution and terminal currents-the coupled diode model-switching –Drift in the base region-Base narrowing -Avalanche breakdown-Kirk effect-frequency limitations of transistor –capacitance and charging times- Hybrid-pi model

Module IV (13 hours)
Junction FET - pinch off and saturation - gate control - VI characteristics
MOS capacitor - accumulation, depletion and strong inversion - threshold voltage - MOSFET - p channel and n channel MOSFETs - depletion and enhancement mode MOSFETs – small signal model
UJT – operation –VI characteristics
Power Diodes - SCR- Insulated Gate Bipolar Transistor – Power MOSFETs

Text Books
1 Ben G Streetman and Sanjay Banerjee: *Solid State Electronic Devices*, (Fifth Edition) Pearson Education
2 Neamen, *Semiconductor Physics & Devices*, Pearson Education
3 Sze S M, *Physics of Semiconductor Devices*, John Wiley
4 Pierret R F, *Semiconductor Device Fundamentals*, Pearson Education
5 Tyagi M S, *Introduction to Semiconductor Materials & Devices*, John Wiley
6 Sima Dimitrijev, *Physics of Semiconductor Devices,* Oxford University Press

Reference Books
1. Sah C T, *Solid State Electronics*, World Scientific
2. Muller & Camins, *Device Electronics for Integrated Circuits*, John Wiley
3. Dipankar Nagchoudhuri : *Microelectronic Devices*, Pearson Education

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving and descriptive SHORT questions 8x 5 marks=40 marks

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/ DESCRIPTIVE questions *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

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EC14 305 ELECTRONIC CIRCUITS I

Teaching scheme **Credits: 4**
3 hours lecture and 1 hour tutorial per week

Objectives

- *To impart the basic idea of constructing passive devices*
- *To develop the skill of analysis and design of various circuits using electronicdevices*

Module I (1 3 H o u r s)
Resistors- Types and tolerances -AF and RF chokes-transformers-Type of capacitors- specification and constructional details - Half wave, full wave and Bridge rectifiers(Analysis and Design)- derivation of rectifier specifications like PIV, DC output voltage, ripple factor, efficiency, transformer utilization factor - analysis and design of filters with rectifiers - L, C, LC and pi filters

Module II (1 3 H o u r s)
Diode circuit models-DC-low frequency and high frequency small signal models- applications- diode clipping and clamping circuits, voltage multiplier circuits - Regulators - zener diode regulator- emitter follower output regulator - series pass transistor feedback voltage regulator- short circuit protection and fold back limiting - load and line regulation curves

Module III (1 3 H o u r s)
BJT circuit models - small signal equivalent models-the hybrid and T model of transistor- BJT amplifiers- biasing - load line - bias stabilization - stability factor - bias compensation - analysis and design of CC, CE and CB configurations - RC coupled multistage amplifiers - high frequency hybrid pi model-the cut off frequencies, unity gain bandwidth

Module IV (1 3 H o u r s)
FET amplifiers: Biasing of JFET and MOSFET - small signal equivalent circuit models- Analysis and design of common source, common drain and common gate amplifier configurations - gain function -Low frequency and high frequency responses- Use of open circuit and short circuit time constants in finding the cut-off frequencies-Low and high frequency response of common emitter and common source amplifier - Emitter followers and source followers.

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Text books

1. Sedra A.S & Smith K.C., *Microelectronic Circuits,* Oxford University Press
2. Millman & Halkias : *Integrated Electronics*, MGH. 1996

References

1. Horenstein M.N: *Microelectronic circuits and Devices* PHI
2. Gray & Meyer:*Analysis and Design of Analog Integated Circuits;* John Wiley
3. Schilling D.L. & Belove C.: *Electronic Circuits,* McGraw Hill,
4. Spencer & Ghausi, *Introduction to Electronic Circuit Design*; Pearson Education
5. Thomas L.Floyd and David Buchla: *Fundamentals of Analog Circuits,Pearson*
6. Robert L Boylestad and Louis Nashelsky: *Electronic Devices and Circuit theory*, Pearson

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions 4 x 15 marks=60 marks

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

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EC14 306 ELECTRICAL ENGINEERING

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives

- *To study the operation, performance and characteristics of different types of electrical machines*
- *To familiarise various electrical measuring instruments.*

Module I (12 hours)
Review of transformers – equivalent circuit – phasor diagram – voltage regulation – losses and efficiency – open circuit and short circuit test – Autotransformer – saving of copper – 3 phase transformer - Δ-Δ, Y-Y, Δ - Y, Y - Δ connections – applications. Principle of indicating instruments – moving coil, moving iron and dynamometer type instruments - principle and working of induction type energy meter

Module II (14 hours)
Review of DC generators – DC generator on no load – open circuit characteristics – Armature reaction and commutation (basics only) - load characteristics of shunt, series and compound generators – Review of dc motors – performance characteristics of shunt, series and compound motors – starter – need of starter - 3 point starter –losses in DC machines – power flow diagram – efficiency – speed control – armature voltage control, armature resistance control & field control – applications of dc motor

Module III (12 hours)
Review of alternators – distribution and chording factor – EMF equation – armature reaction – phasor diagram – voltage regulation – predetermination of voltage regulation by EMF method – synchronous motors – rotating magnetic field - principle of operation – starting of synchronous motors – shunting – applications of synchronous motors.

Module IV (14 hours)
Review of 3-phase induction motor – slip – rotor frequency – equivalent circuit – phasor diagram – torque equation – torque-slip characteristics – losses and efficiency – power flow diagram – no-load and blocked rotor tests – starting of 3-phase induction motors – direct-on-line, auto transformer, star-delta and rotor resistance starting – speed control of induction motor – stator voltage control, stator frequency control, rotor resistance control – applications of induction motors

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Text Books
1. P.S. Bimbhra, Electrical Machinery, Khanna Publishers

Reference Books
1. Ashfaq Hussain, *Electrical Machines*, Dhanpat Rai & Co
2. D.P. Kothari & I.J. Nagrath, *Electrical Machines*, Tata McGraw Hill Publishing Company Limited

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions 4 x 15 marks=60 marks

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

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EC14 403 SIGNALS AND SYSTEMS

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives

- *To introduce the student to the idea of signals , system analysis and its characterization.*
- *To provide a foundation to numerous other courses that deal with signal and systemconcepts directly or indirectly: viz: communication, control, instrumentation etc.*

Module 1 (13 hours)

Introduction to signals and systems- Classification of signals-basic operations on signals- elementary signals- concept of system- properties of systems-stability, invertibility, time invariance, linearity, causality, memory- Time domain representation for Linear Time Invariant Systems -Impulse response representation for LTI systems-Convolution sum, convolution integral and their evaluation - properties of impulse response representation- differential equation and difference equation representation for LTIsystems.

Module II (13 hours)

Fourier representation of continuous time signals- Fourier transform- existence of the Fourier integral- Properties of Fourier representation- energy spectral density and power spectral density- frequency response of LTI systems- correlation theory of deterministic signals- condition for distortionless transmission through an LTI system-transmission of a rectangular pulse through an ideal low pass filter-Hilbert transform-sampling and reconstruction.

Module III (13 hours)

Laplace transform analysis of systems-Unilateral and Bilateral Laplace Transforms, properties-relation between transfer function and differential equation- causality and stability- inverse system- determining the frequency response from poles and zeros.
Fourier representation of discrete time signals- discrete t ime Fourier series and discrete t ime Fourier transform- Properties.

Module IV (13 hours)

Z transform-properties of the region of convergence- properties of the Z- transform-analysis of LTI systems- relating transfer function and difference equation- stability and causality- inverse systems- determining the frequency response from poles and zeros-Unilateral Z-transform- -Solving difference Equations.

Text Books

1. S. Haykin and B. V. Veen, Signals and Systems, John Wiely & Sons, NY
2. A.V Oppenheim, A. S. Wilsky and S. H. Nawab, Signals and Systems, 2nd ed. PHI.
3. A. Anand Kumar, Signals and Systems, 2nd ed. PHI

Reference Books

1 R.E. Zeimer, W.H. Tranter and D. R. Fannin, Signals and Systems: Continuous and Discrete, 4th ed., Pearson Education, Delhi.
2. Charles L. Phillips, John Parr, Eve Riskin, Signal,Systems and Transform, 4th ed. Pearson.
3. J.B. Gurung, Signals and Systems, PHI

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

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EC14 404 ELECTRONIC CIRCUITS II

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objective

To develop the skill of analysis and design of various circuits using electronic devices.

Module 1 (13 hours)
Feedback amplifiers-the general feedback structure - effects of negative feedback-Analysis of negative feedback amplifiers -Stability-study of stability using Bode Plots. Positive feedback and oscillators - analysis and design of RC phase shift, Wein bridge, LC and crystal oscillators - stabilization of oscillations-UJT relaxation Oscillators

Module II (14 hours)
Differential Amplifiers -The BJT differential pair- Large and small signal operation-MOS differential amplifier- Large and small signal operation -Nonideal characteristics of the differential amplifier - Differential amplifier with active load- concept of CMRR - methods to improve CMRR - Frequency response analysis.

Module III (13 hours)
Pulse response switching characteristics of a BJT - BJT switches with inductive and capacitive loads - nonsaturating switches - emitter follower with capacitive loading-RC differentiator and integrators Multivibrators - principles & analysis of Astable, monostable and bistable multivibrators-triggering methods-Schmitt trigger analysis of emitter coupled circuit-analysis of sweep circuits-principles of miller and bootstrap circuits.

Module IV (12 hours)
Power amplifier - class A, B, AB, C, D & S power amplifier - harmonic distortion-efficiency -wide band amplifier - broad banding techniques - low frequency and high frequency compensation -cascode amplifier -broad banding using inductive loads - Darlington pairs.

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Text Books

1. Sedra A.S & Smith K.C., Microelectronic Circuits, Oxford University Press
2. Millman J. & Taub H., Pulse, Digital & Switching Waveforms, Tata McGraw Hill

Reference Books

1. Milman & Halkias, Integrated Electronics, McGraw Hill
2. Gray & Meyer, Analysis and Design of Analog Integated Circuits; John WileySchilling D.L. & Belove C., Electronic Circuits, McGraw Hill
3. Robert L Boylestad and Louis Nashelsky: Electronic Devices and Circuit theory, Pearson
4. Spencer & Ghausi, Introduction to Electronic Circuit Design; Pearson Education
5. Venkata Rao K, Rama Sudha K, Manmadha Rao G., Pulse and Digital Circuits:Pearson Education
6. Electronics for Analog Signal Processing - I, Prof. K. RadhakrishnaRao, IIT Madras (nptel.iitm.ac.in)
7. Electronics for Analog Signal Processing - II, Prof. K. RadhakrishnaRao, IIT Madras (nptel.iitm.ac.in)
8. Analog Circuits, Prof. Shanthi Pavan, IIT Madras (VLSI Group, IIT Madras - Video Lectures)
9. Analog Integrated Circuit Design, Prof. Nagendra Krishnapura, IIT Madras (VLSI Group, IIT Madras - Video Lectures)
10. Analog ICs, Prof. K. RadhakrishnaRao, IIT Madras (nptel.iitm.ac.in)
11. Circuits and Electronics, Prof. Anant Agarwal, MIT(ocw.mit.edu)

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions 4 x 15 marks=60 marks

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

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EC14 405 DIGITAL ELECTRONICS

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives

This paper exposes the students to digital fundamentals. Through learning this paper students are expected to gain knowledge in designing combinational as well as synchronous sequential circuits

Module I (13 hours)

Boolean algebra: Theorems and operations- Boolean expressions and truth tables-Duality and Inversion- Multiplying out and factoring expressions- Exclusive-OR and equivalence operations-Positive and Negative Logic.
Combinational logic design using truth table- Minterm and Maxterm expansions- Incompletely specified functions.

Minimization Techniques: Algebraic Method, Karnaugh maps (including 5 and 6 variable) – Quine-McCluskey method- Multi-output circuits- Multi-level circuits- Design of circuits with universal gates.

Module II (13 hours)

Number Representation: Fixed point - Floating point - 1's complement - 2's complement. Binary Codes: BCD- Gray code- Excess 3 code- Alpha Numeric codes – Error detecting and correcting codes- properties- Code conversion circuits-Number systems (Binary, Octal and Hexadecimal): conversions and arithmetic operations.
Arithmetic circuits: adders and subtractors- ripple carry adders- carry look ahead adders- adder cum subtractor-BCD Adder and Subtractor.
Combinational logic design using MSI circuits: Multiplexers- Demultiplexers- Decoders-Encoders- ALU- Digital Comparators -Parity Generators.
Introduction to digital logic families: Characteristics- Basic working of a TTL NAND gate ,ECL gate and CMOS logic gate.

Module III (13 hours)

Latches and Flip-Flops: SR latch- SR Flip Flop- JK Flip Flop- D Flip flop - T Flip Flop- Flip Flops with preset and clear inputs- Triggering methods and their circuits -Conversion of one type of flip flop to another – Excitation table – Applications of Flip Flops.
Shift Registers: right shift- left shift- bi directional- SISO- SIPO- PISO- PIPO- universal shift registers. Synchronous counter: Design, Lock out condition.
Asynchronous counter operation- Up counter- Down counter- Up/ down counter-Mod *n* counters. Other types of Counters: Ring counter- Johnson counter- BCD counter.

Module IV (13 hours)

Synchronous sequential circuits: Finite State Machines- Mealy & Moore types- Basic design steps- Design of counters using Sequential Circuit Approach – FSM as an Arbiter circuit– ASM charts.
Asynchronous sequential circuits: Analysis and Synthesis- State Reduction and State Assignment- Hazards.

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Text Books

1 Stephen Brown and Zvonko Vranesic, *Fundamentals of Digital Logic with VHDL Design*, TMH
2. Charles H. Roth, Jr. *Fundamentals of Logic Design, 5th edition*, Thomson Books/Cole
3. R P Jain, Modern Digital Electronics, Tata McGraw Hill

Reference

1. John F Wakerly, *Digital Design- Principles and Practices*(Third edition), Pearson
2. Mano M M, *Digital Design,* PHI
3. Thomas L Floyd & R.P Jain, *digital Fundamentals* (Eight edition), Pearson

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions 4 x 15 marks=60 marks

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

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EC14 406 ANALOG COMMUNICATION

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objectives

- *To impart the basic concepts of analog modulation schemes*
- *To develop understanding about performance of analog communication systems*

Module I (13 hours)

Signals and Spectra - Line Spectra and Fourier Series - Fourier Transforms and Continuous Spectra - Time and Frequency Relations - Signal Distortion in Transmission - Band pass signals and systems - Amplitude modulation -Signals and Spectra of AM, DSB-SC, SSB & VSB- Modulators and transmitters. Exponential continuous wave modulation - Signals and Spectra of FM & PM - Narrow band case, Tone modulation, Transmission bandwidth and Distortion - Generation and Detection of FM and PM - Interference, De-emphasis and Pre-emphasis, Capture effect.

Module II (13 hours)

Receivers for continuous wave modulation - Superheterodyne Receivers, Receiver specifications, Multiplexing systems - Frequency division, Quadrate carrier and Time division Phase locked loop operation, Synchronous detection and Frequency synthesis - FM detection, Analog Pulse Modulation - Signals and Spectra of Pulse Amplitude Modulation (PAM) and Pulse Time Modulation (PWM/PPM).

Module III (13 hours)

Probability and Sample Space - Random Variables and Probability Functions - Statistical Averages - Probability Models - Random Processes - Ensemble Averages and Correlation Functions - Ergodic and Stationary Processes - Gaussian Processes - Random Signals - Power Spectrum - Filtered Random Signals - Noise - Different types - noise equivalent band width - Baseband Signal Transmission With Noise - Baseband Pulse Transmission With Noise.

Module IV (13 hours)

Noise in analog modulation systems - Bandpass noise - System models, Quadrature components, Envelope and Inphase - Linear continuous wave modulation with noise - Synchronous detection - Envelope detection and threshold effect - Exponential continuous wave modulation with noise - Post detection noise - Destination S/N - FM threshold effect - Comparison of continuous wave modulation systems - Analog Pulse Modulation withNoise.

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Text Books

1. Bruce Carlson., Communication Systems, Tata - McGraw Hill.
2. Lathi B.P., Modern Digital and Analog Communication Systems, Oxford University Press.
3. Ziemer R.E. & Tranter W.H., Principles of Communication, John Wiley.
4. Leon W. Couch, Digital and Analog Communication Systems, Pearson Education.
5. Taub H. & Schilling, Principles of Communication Systems, Tata - McGrawHill.

Reference Books

1 Simon Haykin, Communication Systems, John Wiley.
2 Dennis Roddy, John Coolen, Electronic Communications, Pearson Education.
3 Sam Shanmugam K., Digital and Analog Communication Systems, John Wiley.
4 Tomasi, Electronic Communications Systems, Pearson Education.
5 Proakis & MasoudSalehi, Fundamentals of Communication systems ,Pearson Education.

Web resources:

1. Principles of Communication, Prof. V. VenkatRao, IIT Madras (nptel.iitm.ac.in)
2. Communication Engineering, Prof. Surendra Prasad, IIT Delhi (nptel.iitm.ac.in).
3. Probabilistic Systems Analysis and Applied Probability, Prof. John Tsitsiklis, MIT(ocw.mit.edu).

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions — *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/ DESCRIPTIVE questions — *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

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EC14 501: COMPUTER ORGANISATION AND ARCHITECTURE

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives

- *To impart the basic idea of memory and system organisation and architecture of Computers.*

Module I (13 hours)
Basic structure of computer hardware and software - addressing methods - computer arithmetic - number representations - fast adders - fast multiplication - integer division - floating point numbers and operations.

Module II (13 hours)
The processing unit - instruction execution cycle - sequencing of control signals - hardwired control - microprogrammed control - control signals - micro instructions - microprogram sequencing - branch address modification - prefetching of micro instructions.

Module III (13 hours)
Memory organization - Semiconductor RAM memories - internal organization - Bipolar and MOS devices - Dynamic memories - multiple memory modules and interleaving - cache memories-mapping functions - replacement algorithms - virtual memory - address translation - page tables - memory management units - Secondary memory - disk drives - organization and operations.

Module IV (13 hours)
Input-output organizations-accessing I/O devices-direct memory access (DMA) - interrupts-interrupt handling-handling multiple devices-device identification -vectored interrupts - interrupt nesting - Daisy chaining - I/O interfaces - serial and parallel standards - buses - scheduling- bus arbitration-bus standards. Introduction to parallel organizations - multiple processor organization- symmetric multiprocessors -cache coherence - non uniform memory access - vector computation - introduction to CISC and RISC architectures - comparisons

Text Books

1. Hamacher C.V, Computer Organisation, McGraw Hill.
2. Morris Mano, Computer system architecture, Pearson.
3. John P Hayes, Computer Architecture and Organization McGraw Hill.

Reference Books

1. William Stallings, Computer Architecture and Organization, Pearson.
2. Patterson D. A & Hennessy J. L, Computer Organization & Design, Morgan Kaufman.

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions — *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical DESCRIPTIVE questions — *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

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EC14 502: LINEAR INTEGRATED CIRCUITS

Teaching scheme **Credits:** 4
3 hours lecture and 1 Hour tutorial per week

Objectives

- *To develop the skill of analysis and design of various circuits using operationalamplifiers*
- *To develop designskills to design various circuits using different data conversion systems*

Module I (14 hours)
Various stages of an operational amplifier - simplified schematic circuit of op-amp 741 - need for compensation - lead, lag and lead- lag compensation schemes - typical op-amp parameters - slew rate - power supply rejection ratio - open loop gain - unity gain bandwidth - offset current & offset voltage
Linear Op-Amp circuits – basic configurations-ideal Op-Amp circuit analysis –The 741 Op-Amp circuit parameters-DC analysis –small signal analysis –Gain ,frequency response and slew rate of the 741 –summing and different amplifiers-Differentiator and integrator –I-V and V-I converters-Instrumentation amplifier, isolation amplifier - log and antilog amplifiers analog multipliers – Voltage Comparators-Schmitt trigger

Module II (14 hours)
Signal generators-Phase shift and Wien Bridge Oscillators-Astable and Monostable Circuits-Linear sweep circuits.
Active filters-filter transfer function-Butterworth and Chebyshev filters-First order and second order function for low-pass, high-pass, band –pass, band-stop and all –pass filters- Sallen-key LPF and HPF-Delyiannis-Friend band Pass filters-twin –tee notch filter-Second order LCR Resonator and realizations of various types-Filters based on inductor replacement-switched capacitor filters

Module III (14 hours)
Timer IC 555 – internal diagram – working - multivibrators with timer IC 555
Data converters-definitions and specifications – DAC - Weighted resistor and R-2R DAC-Bipolar DAC.
ADC - flash, integrating type, Counter Ramp, pipeline, tracking and Successive approximation, dual slope & oversampling ADCs - sigma - delta ADC
Linear voltage regulators- protection mechanisms-LM 723 Functional-diagram-Design of voltage regulator using 723-Three terminal Voltage regulators-functional operation of 78xx series IC and design of fixed and adjustable regulators

Module IV (10 hours)
Phase locked loops- operation of first and second order PLLs-Lock and Capture range-LM565PLL-Application of PLL as AM/FM/FSK/ detectors, frequency translators, phase shifter, tracking filter, signal synchronizer and frequency synthesizer. Voltage controlled oscillator

Text Books

1. Sergio Franco , *Design with Operational Amplifiers& Analog integrated Circuits*; McGraw Hil
2. Jacob Baker R., Li H.W. & Boyce D.E., *CMOS- Circuit Design, Layout & Simulation*', PHI
3. Fiore J.M., *Operational Amplifiers and Linear Integrated Circuits*, JaicoPublishing House
4. Gayakwad, *Operational Amplifiers*, Jaico Publishing House

Reference Books

1. Roy Choudari.'Linear Integrated Circuits'
2. Coughlin R.F. & Driscoll F.F., *Operational Amplifiers and Linear IntegratedCircuits*, Pearson Education
3. Schumann & Valkenberg, *Design of Analog Filters*, Oxford University Press
4. Gray & Meyer, *Analysis and Design of Analog Integated Circuits*; John Wiley
5. Sedra A.S. & Smith K.C., *Microelectronic Circuit*', Oxford University Press

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions 4 x 15 marks=60 marks

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

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EC14 503 DIGITAL COMMUNICATION

Teaching scheme **Credits: 4**

3 hours lecture and 1 hour tutorial per week

Objectives

- *To impart the basic concepts of various digital modulation schemes*
- *To develop understanding about digital transmitters & Receivers*

Module I (13 hours)

Sampling Theory and Practice - Ideal Sampling and Reconstruction - Practical Sampling and Aliasing - Flat-Top Sampling - Sampling theorem for bandpass signals - Waveform coding - quantization - PCM - DPCM - delta modulation - adaptive delta modulation - line coding schemes- ON-OFF, NRZ, Bipolar, Manchester signalling and differential encoding.

Module II (13 hours)

Shaping - Nyquist criterion for zero ISI - signalling with duobinary pulses - eye diagram- equalizer, scrambling and descrambling - signal space concepts -geometric structure of the signal space - L^2 space-distance, norm and inner product -orthogonality -base

band data transmission- matched filter receiver - intersymbol interference - Gram-Schmidt orthogonalization procedure.

Module III (13hours)

Review of Gaussian random process - optimum threshold detection - optimum receiver for

AWGN channel - matched filter and correlation receivers - decision procedure - maximum a- posteriori probability detector - maximum likelihood detector - probability of error - bit error rate - Optimum receiver for coloured noise- carrier and symbol synchronisation.

Module IV (13 hours)

Digital modulation schemes - coherent binary schemes - ASK, FSK, PSK, MSK coherent M-array schemes - calculation of average probability of error for different modulation schemes - power spectra of digitally modulated signals - performance comparison of different digital modulation schemes.

Text Books

1. Sklar, Digital Communication, Pearson Education.
2. Bruce Carlson., Communication Systems, Tata - McGraw Hill
3. Taub H. & Schilling, Principles of Communication Systems, Tata - McGraw Hill.
4. Proakis J.G., Digital Communications, McGraw Hill.
5. Leon W. Couch, Digital and Analog Communication Systems, PearsonEducation

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Reference Books

1. Simon Haykin, Communication Systems, John Wiley.
2. Dennis Roddy, John Coolen, Electronic Communications, Pearson Education
3. Sam Shanmugam K., Digital and Analog Communication Systems, John Wiley.
4. Glover and Grant, Digital Communications, Pearson Education.
5. Rice, Digital Communications, Pearson Education.
6. Proakis and Salehi., Fundamentals of Communication Systems, Pearson Education.
7. Lathi B.P., Modern Digital and Analog Communication Systems, Oxford University Press.
8. M. K. Simon, S. M. Hinedi, and W. C. Lindsey, Digital Communication Techniques, Prentice Hall
9. Tri T. Ha, Theory and Design of Digital Communication Systems, Cambridge University Press

Web resources:

1. Digital Communication, Prof. Bikash Kumar Dey, IIT Bombay(nptel.iitm.ac.in)\
2. Digital Communication, Prof. SaswatChakrabarti, Prof.R.V. Rajakumar, IIT Kharagpur (nptel.iitm.ac.in)
3. Principles of Digital Communications I, Prof. LizhongZheng, Prof. Robert Gallager, MIT

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions 4 x 15 marks=60 marks

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

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Since 1968

EC14 504: ELECTROMAGNETIC FIELD THEORY

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives

- *To impart the knowledge of electric, magnetic fields and the equations governing them as well as time varying field*
- *To develop understanding about guided waves & transmission lines*

Module I (13hours)
Review of vector analysis: Cartesian, Cylindrical and Spherical co-ordinates systems- Co-ordinate transformations. Vector fields: Divergence and curl- Divergence theorem- Stokes theorem.
Static electric & Magnetic field: Gauss's law. Electrical scalar potential- different types of potential distribution- Potential gradient- Energy stored-Boundary conditions Capacitance-Steady current and current density in a conductor-Equation of continuity- energy stored in magnetic fields- Magnetic dipole-Amperes law for a current element. Electric and Magnetic boundary conditions- vector magnetic potential-Magnetic field intensity.

Module II (13 hours)
Maxwell's equations and travelling waves: conduction current and displacement current- Maxwell's equations- Plane waves- Poynting theorem and Poynting vector- Plane electromagnetic waves- Solution for free space condition- Uniform plane wave-wave equation for conducting medium- Wave polarization- Poisson's and Laplace equations. Linear, elliptical and circular polarization.

Module III (14 hours)
Guided waves between parallel planes- transverse electric and transverse magnetic waves and its characteristics, wave equations for conducting medium, wave propagation in conductors and dielectric, depth of penetration, reflection and refraction of plane waves by conductor and dielectric, Poynting vector and flow of power.

Module IV (12hours)
Transmission lines & Waveguides: -Transmission line equations- transmission line parameters- Skin effect- VSWR- Characteristic impedance- Stub matching- Smith chart - Phase velocity and group Velocity. Theory of waveguide transmission-Rectangular waveguides- TE modes-TM modes- mathematical analysis- circular wave guide- modes of propagation- dominant modes- cut off wave length cavity resonators-applications.

Text Books

1. Elements of Electromagnetics– Mathew N.O. Sadiku, Oxford Pub, 3rd Edition
2. Engineering Electromagnetics – W.H. Hayl, Tata Mc Graw Hill Edition, 5th Edition
3. Introduction to Electrodynamics– David J. Griffithe, Prentice Hall India, 3rd Edition
4. Electromagnetic waves and Radiating Systems:Edward C jordan,Keith G. Balman

Reference Books

1. Electromagnetics: J. D. Kraus, Mc Graw Hill Publications.
2. Field & Wave Electromagnetic: Cheng, Pearson Education.
3. Electromagnetics: Edminister, Schaum series, 2 Edn.
4. Network Analysis: Van Valkenberg

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions 4 x 15 marks=60 marks

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

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EC14 505: MICROPROCESSORS AND MICROCONTROLLERS

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives

- *To introduce the student with knowledge about architecture, interfacing and programming with 8086 microprocessors and 8051 microcontrollers. It gives a brief introduction to ARM 7 and ARM 9 micro controllers.*
- *After studying this subject, the student should be able to design microprocessor/controller based system for any relevant applications.*

Module I (13 hours)

Brief history of Microprocessors, Von Neumann and Harvard architecture-Distinction between CISC and RISC computers Intel 8086 processor- Internal Architecture of 8086 /8088 microprocessors- Bus Interface Unit(BIU) and Execution Unit(EU) - Address space, Data organization, registers, memory segmentation and addressing, stack, I/O space Programming concepts- Assembly programming using instructions for data transfer ,arithmetic, logical , shift and rotate operations and string manipulations -Procedures-Macros-ASCII operation- use of
MASM

Module II (13 hours)

Hardware structure of 8086 microprocessor -minimum and maximum mode-basic read and write machine cycle timing- Coprocessor and Multiprocessor configuration - hardware organization of address space-control signals and I/O interfaces- Memory devices, circuits and sub system design - various types of memories, memory address decoding -Interrupts

Module III (13 hours)

I/O interfacing circuits -Hand shaking, serial and parallel interfacing-Address decoding-Interfacing chips-Programmable peripheral interfacing (8255)-Internal block diagram-Modes of operation Programmable communication interface(8251)-Basics of serial communication-Internal block diagram of 8251 Programmable timer(8253)- Internal block diagram of 8253-Different Modes DMA controller(8237/8257)-Internal block diagram- Programmable interrupt controller(8259)- features - Internal block diagram-Interrupt sequence for an 8086 based system-Keyboard display interface(8279)- Keyboard interface-Display interface

Module IV (13 hours)

Intel 8051 microcontroller -Architecture-Program and Data memory organization- Addressing modes-Software overview-Ports-Timer-Interrupt- Serial port-Introduction to ARM processors - features of ARM 7 and 9 processors

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Text Books

1. Lyla B Das, The x86 Microprocessors Architecture, Programming and Interfacing (8086 to Pentium)
2. Muhammad Ali Mazidi, Janice Gillispie Mazidi and Rolin D Mckinlay.' The 8051 Microcontrollers and Embedded Systems using Assembly and C ‖ 2nd Edition Pearson Publishers.
3. Triebal W A & Singh A., The 8088 and 8086 microprocessors McGraw Hill
4. Andrew N. Sloss, Dominic Sysmes, Chris Wright - Arm System Developers Guide-Designing and Optimizing System software, Morgan Kaufmann Publishers

Reference Books

1. Intel Data Book vol.1, Embedded Microcontrollers and Processors.
2. Hall D.V., Microprocessors and Interfacing McGrawHill.
3. Mohammed R., Microprocessor & Microcomputer based system design, Universal Book Stall.

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

Note: One of the assignments shall be simulation of VHDL programs

University Examination Pattern

PART A: Analytical/problem solving SHORT questions *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving/ DESCRIPTIVE questions 4 x 15 marks=60 marks

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

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Note: One of the assignments shall be simulation of continuous systems using any technical computing software

University Examination Pattern

PART A: Analytical/problem solving SHORT questions *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions 4 x 15 marks=60 marks

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

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EC14 601: RADIATION AND PROPAGATION

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objective

- *To impart the basic concepts of radiating structures and their arrays*
- *To give understanding about analysis and synthesis of arrays*
- *To give idea about basic propagation mechanisms*

Module I (13 hours)
Retarded potentials: Radiation, retarded potential -Radiation from an A.C current element-monopoles and dipoles-power radiated from a dipole
Antenna Parameters: Introduction, Isotropic radiators, Radiation pattern, Gain -radiation intensity-Directive gain, Directivity, antenna efficiency - Reciprocity theorem & its applications, effective aperture, radiation resistance, terminal impedance, noise temperature, elementary ideas about self &mutual impedance, front-to-back ratio, antenna beam width, antenna bandwidth, antenna beam efficiency, antenna beam area or beam solid angle, polarization, antennatemperature.

Module II (13 hours)
Antenna Arrays: Introduction, various forms of antenna arrays, arrays of point sources, non-isotropic but similar point sources, multiplication of patterns, arrays of n-isotropic sources of equal amplitude and spacing (Broad-side & End-fire array cases), array factor, directivity and beam width, array of n-isotropic sources of equal amplitude and spacing end-fire array with increased directivity, scanning arrays, Dolph-Tchebysceff arrays, tapering of arrays, binomial arrays, continuous arrays, rectangular arrays, superdirective arrays.

Module III (13 hours)
VLF, LF and MF antennas- Introduction, effects of ground on antenna performance, effects of antenna height, efficiency of electrically short antenna, medium frequency antennas, high frequency antennas, fundamental antenna (i.e. half wave dipole or dipole antenna), long wire antenna, V and inverted V antenna,
Rhombic antenna, traveling wave antenna, radio direction finders, loop antennas,
VHF, UHF, SHF Antennas- Introduction. Folded dipole antenna, Yagi-Uda antenna, and helical antenna, slot antenna, microstrip or patch antennas, and turnstile antenna, frequency independent antennas- log periodic antenna, and microwave antennas- Microstrip antenna, fractal antenna.

Module IV (13 hours)
Factors involved in the propagation of radio waves: the ground wave-Reflection of radio waves by the surface of the earth-space wave propagation-considerations in space wave propagation-atmospheric effects in space wave propagation-ionosphere and its effects on radio waves -mechanism of ionosphere propagation-refraction and reflection of sky waves by ionosphere-ray paths-skip distance-maximum usable frequency-vertical and oblique incidence-fading of signals - selective fading-diversity reception, Duct Propagation.

Text books:

1. Electromagnetic waves & Radiating Systems– Jordan & Balman, Prentice Hall India
2. Warren L Stutzman and Gary A Thiele, —Antenna Theory and Design‖, 2ndEd, John Wiley and Sons Inc. 1998
3. Constantine. A. Balanis: —Antenna Theory- Analysis and Design‖, Wiley India, 2nd Edition, 2008

Reference Books

1. Kraus, ―Antennas‖, Tata McGraw Hill, NewDelhi, 3‖ Edition,2003

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions *8x 5 marks=40 marks*

Candidates have to answer FIVE questions out of EIGHT. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions 4 x 15 marks=60 marks

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

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Text Books

1. G. Keiser, 'Optical Fiber Communication', 3rd Edition, Tata Mc Graw Hill new delhi, 2000
2. John M.Senior . _Optical Fiber Communication Principles & Practice' ,PHI Publication
3. D.F. Mynbaev and L. Scheiner. 'Fiber Optic Communication Techniques', Person Education New Delhi

Text Books

1. Optical Electronics:Ajoy Ghatak, K Thyagarajan
2. Textbook on Optical Fiber Communicaton and its Applications:S.C.Gupta

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions — *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Simple Problem solving DESCRIPTIVE questions — *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

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Text Books

1. Weste & Harris, *CMOS VLSI Design*, Pearson Education
2. Plummer, Deal & Griffin, *Silicon VLSI Technology*, Pearson Education
3. Rabaey J.M., *Digital Integrated Circuits - A Design Perspective*, Pearson Education
4. Weste & Eshraghian , *Principles of CMOS VLSI Design*, Addison Wesley
5. S K Gandhi, *VLSI Fabrication Principles.*, John Wiley
6. Sung-Mo Kang & Yusuf Leblebici, *CMOS Digital Integrated Circuits - Analysis & Design*, McGrawHill
7. Nagchoudari., *Principles of Microelectronic Technology*, Wheeler Publishing

Reference Books

1. Yuan Taur & Ning T.H., *Fundamentals of Modern VLSI Devices*, Cambridge Univ. Press
2. Baker. Li & Boyce, *CMOS - Circuit Design, Layout & Simulation*, PHI
3. Sze S M, *VLSI Technology*, McGrawHill
4. Ken Martin, *Digital Integrated Circuit Design*, Oxford Univ. Press
5. Eshraghian & Pucknell,, *Essentials of VLSI Circuits & Systems*, PHI

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions — *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/ DESCRIPTIVE questions — *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

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EC14 604: DIGITAL SIGNAL PROCESSING

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives

- *To impart basic ideas (i) in the transforms used in digital domain (ii) in the design and hardware realization of digital filters*

Module I (13 hours)
Review of Discrete Time Fourier series and Discrete Time Fourier Transform-Frequency do- main sampling- Discrete Fourier Transform-Properties-Circular convolution-Linear convolution using DFT-Linear filtering of long data sequences- Overlap add and overlap save methods- Computation of DFT-Decimation in Time and Decimation in Frequency algorithms.

Module II (13 hours)
Structures for realization of discrete time systems-Signal flow graph representation- structures for FIR and IIR systems-direct form, cascade form, parallel form-lattice and transposed structures-Representation of numbers & errors due to rounding and truncation-Quantization of filter coefficients-round off effects in digital filters-Limit cycle oscillations, scaling to prevent overflow

Module III (13 hours)
Design of Digital filters-Types of digital filters -FIR and IIR filters -specifications of digital Filters-Design of FIR filters -Linear phase Characteristics-Window method, Optimal method and Frequency Sampling method-Design of IIR filters from analog filters -Impulse invariant and bilinear transformation methods- Frequency transformation in the analog and digitaldomains

Module IV (13 hours)
Computer Architectures for signal processing-Harvard Architecture, Pipelining, Multiplier-Accumulator, Special Instructions for DSP, extended parallelism-General Purpose DSP Processors-Implementation of DSP Algorithms for various operations-Special purpose DSP hardware-Hardware Digital filters and FFT processors-Case study and overview of TMS320 series processor, ADSP 21XX processor

Text Books

1. Oppenheim A. V., Schafer R. W., Discrete-Time Signal Processing, Prentice Hall/Pearson.
2. John G. Proakis, Dimitris G. Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, Prentice Hall of India Pvt. Ltd., 1997.
3. Emmanuel C. Ifeacher, Barry W. Jervis, Digital Signal Processing: A Practical Approach, Pearson Education 2004
4. Li Tan,DSP-Fundamentals & Applications, Elsevier, New Delhi, 2008
5. Roberto Cristi, Modern Digital Signal Processing, Cengage learning India pvt. Ltd.,2004,4th Indian reprint 2009, New Delhi

Reference Books

1. Mitra S. K., Digital Signal Processing : A Computer Based Approach, Tata McGraw-Hill
2. B Venkataramani & M.Bhaskar, Digital Signal Processors-Architecture,3. Programming and Applications, Tata Mcgraw Hill
3. Dag Strannbby & William Walker,DSP & Applications. Elsevier, New Delhi, 2nd Ed. 2004
4. Vinay K Ingle, John G Proakis, DSP- A MATLAB based approach ,Cengage learning India
5. Sen M. Kuo and Woon-Seng Gem, Digital Signal Processors, Pearson

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions 4 x 15 marks=60 marks

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

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EC14 605: CONTROL SYSTEMS

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objective

- *To impart the basic theory behind the analysis of continuous anddiscrete Systems in time and frequency domains*
- *To introduce concepts about the state space modeling of systems.*

Module I (13 hours)
General Schematic Diagram of Control Systems-Open loop and Closed loop systems – Merits and demerits-Concepts of feed back –Role of computers in Automatic Control –Modeling of Continuous Time Systems. Basic ideas of Functions of Complex Variables ,Mapping Process, Analytic functions, poles and zeros.
Transfer functions-block diagrams-order and type-signal flow graph –Mason's Gain formula-Block diagram reduction using direct techniques and signal flow graphs –examples-derivation of transfer function of simple systems from physical relations -low pass RLC series network –spring mass damper –DC servomotor for position and speed control –low pass active filter

Module II (13 hours)
1. Time Domain analysis:

Analysis of Continuous Time systems-Transient and steady State Responses-Standard Test Signals-Response comparisons for various Root locations in the S-plane-Time Domain Solutions of First order systems- Step Response of Second order system –Time domain specifications –Relationships between Damping ratio and the amount of Overshoot for a second Order system - Effects of derivative and Integral Control on the Transient response - Performance of feed back Control systems - Steady state Response-steady state error –computations of steady state error –error constants - Concepts of Stability –Routh-Hurwitz Criterion - Construction of root locus.

2. Frequency Domain Analysis:

Frequency Domain Plots-Polar and Bode Plots-Theory of Nyquist Criterion Frequency Response characteristics- Frequency domain specifications- computation of gain and phase Margins from Bode Plot - Theory of Lag,Lead, and Lag-Lead compensators.

Module III (13 hours)
Modeling of discrete-time systems-sampling-mathematical derivations for sampling-sample and hold--solutions of difference Equations using Z-transforms-example of sampled data systems –mapping between s plane and z plane –cyclic and multi-rate sampling (definitions only) –analysis of discrete time systems-pulse transfer function-examples-stability –Jury's criterion –bilinear transformation-stability analysis after bilinear transformation –stability analysis Routh-Hurwitz techniques-

Module IV (13 hours)
State Space Analysis: Introduction-Definitions and explanations of the terms STATE, STATE VARIABLES, STATE VECTOR AND STATE SPACE-State Space Representations of Linear Time-invariant System with i) single input and output ii) multi variable systems iii) SISO System in which forcing
Function involves-Eigen values-phase variable and Diagonal forms-Invariance of Eigen values under linear transformation-Diagonilisation
Solutions of Linear Time-invariant State Equations-Homogeneous and Non-homogeneous case(example up to second order only)- Matrix Exponential- Laplace Transform approach to the

solutions of state equations-State Transition Matrix-properties.
State Space representation of Discrete Time Systems-Relation between Transfer function /Transfer

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EC14 606 SATELLITE COMMUNICATION

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives
- *To impart the basic concepts of satellite communication and systems*
- *To develop understanding about the link design and the latest trends in satellite communication*

Module I (13 hours)
Satellite Orbits: Orbital mechanics-Kepler's laws, locating the satellite in orbit,orbital elements; look angle determination-subsatellite point, azimuth and elevation angle calculation;orbital perturbations-longitudinal and inclination changes; launches and launch vehicles-ELVs, placing satellites into geostationary orbit;orbital effects in communication system performance-doppler shift, range variations, solar eclipse, sun transit outage

Module II (13 hours)
Communication Satellites- Satellite subsystem; Attitude and orbit control system (AOCS); Telemetry, Tracking, Command and Monitoring (TTC&M); power systems; communications subsystem-description, transponders; satellite antennas-basic antenna types, satellite antennas in
practice

Module III (13hours)
Satellite link design and Satellite access- Basic transmission theory, system noise temperature and G/T ratio; Downlink design-link budget; Uplink design; design for specified C/N, uplink and downlink attenuation in rain, communication link design procedure; system design examples.

Module IV(13 hours)
Multiple access schemes-FDMA, TDMA, CDMA, DAMA; VSAT systems-basic techniques, VSAT earth station engineering, system design; DBS systems-C-band and Ku0band home TV, digital DBS; satellite mobile systems; GPS

Text Books

1. Timothy Pratl, Charles Bostian & Jeremy Allnutt,' Satellite communications',2nd Ed., Wiley India, New Delhi, 2008
2. Dennis Roddy, _Satellite Communications', 4th Ed., Tata Mc-Graw-Hill, New Delhi, 2009
3. Tri T. Ha, _Digital Satellite Communications' , 2nd Ed., Tata Mc-Graw-Hill, New Delhi, 2009

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

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University Examination Pattern

PART A: *Analytical/problem solving SHORT questions* *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: *Analytical/ DESCRIPTIVE questions* *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

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EC14 701 INFORMATION THEORY AND CODING

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objective

- *To provide basic concepts of Information theory*
- *To enable the students to propose, design and analyse suitable coding/decoding scheme for a particular digital communication application*

Module I (12 Hours)
Information theory-information and entropy-properties of entropy - entropy of a binary memoryless source- extension of a memoryless source-source coding theorem-Shannon-Fano coding- Huffman coding-Lempel-Ziv coding - discrete memoryless channel - binary symmetric channel- mutual information - properties - channel capacity- channel coding theorem.

Module II (14 Hours)
Introduction to algebra-groups- fields -binary field arithmetic- construction of Galois field GF(2m)- basic properties of Galois field GF(2m)- properties of minimal polynomial - computations using GF(2m) arithmetic-vector spaces-matrices - Linear Block Codes -generator matrices-parity check matrices-
encoder for linear systematic code-syndrome and error correction-minimum distance- error correction and error detection capabilities.

Module III (13 Hours)
Cyclic Codes: polynomial description-algebraic properties – generator and parity check matrices of cyclic codes- encoding of cyclic codes-syndrome computation-error detection - decoding of cyclic codes- Binary Primitive BCH codes-generator polynomial -parity check matrix- decoding of BCH codes, nonbinary BCH Codes- Reed Solomon codes- basic concepts of coding and decoding

Module IV (13 Hours)
Coding - convolutional codes- binary non-systematic feed forward encoder -generator matrix- time domain and transform domain representation- state diagram and Trellis diagram representation of convolutional codes- distance properties of convolutional codes- maximum likelihood decoding- Viterbi decoding- interleaved convolutional codes.

Text Books

1. Simon Haykin, Communication Systems,John Wiley
2. ShuLin, Daniel J Costello.Jr, Error Control Coding, 2nd edition., Pearson

Reference Books

1. Das J.Malik A.K.,ChatterjeeP.K.,Principles of DigitalCommunications, NewAge International
2. Simon Haykin, Digital Communications, John Wiley
3. Taub & Schilling, Principles of Communication System,TATA McGraw Hill
4. Symon Haykins and Michael Moher, Modern Wireless Communication,Pearson Education
5. Sklar, Digital Communications, Pearson Education
6. Couch, Digital and Analog Communication System, Pearson Education

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Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions 4 x 15 marks=60 marks

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

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EC14 702 MICROWAVE ENGINEERING

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives

- *To give the basic ideas about the characteristics and applications of microwave frequency bands*
- *To understand the working of various microwave passive and active devices and circuits.*

Module I (13 hours)
Characteristic, features and applications of microwaves- Scattering matrix representation of microwave networks, properties of scattering matrices, properties and s-matrices for typical network such as section of uniform transmission line, 3-port networks (reciprocal and nonreciprocal), T-junctions, directional coupler, magic tee, ferrite devices, isolator, circulators

Module II (12 hours)
Generation of microwaves by tubes, limitations of conventional tubes, klystron amplifiers - analysis, reflex klystron oscillator-analysis, magnetrons, traveling wave tube (TWT), backward wave oscillator (BWO)-basic principles. Millimetre wave tubes-introduction

Module III (13 hours)
High frequency limitations of transistors, microwave transistors, varactors, Manley Rowe relations, parameteric amplifiers and frequency multipliers, tunnel diodes, Gunn effect, Gunn Diode oscillators, Avalanche effect, IMPATT & TRAPATT diodes, PIN diodes and their applications, Schottky barrier and backward diodes.

Module IV (14 hours)
Planar transmission lines such as stripline, microstrip line, slotline etc. VSWR measurement, microwave power measurement, impedance measurement, frequency measurement. Microwave filters, Analysis of infinite periodic structures, Terminated periodic structures, k-β Diagrams and Wave velocities, Filter design by the image parameter method, Constant K filter sections, m-derived filter sections and Composite filters.

Text Books

1. Liao S.Y.,‖Microwave devices and Circuits‖, Prentice Hall Of India, New Delhi, 3rd Ed. 2006

Reference Books

1. Rizzi P.A.,Microwave Engineering,Passive Circuits Hall of India
2. Pozar D.M .,‖ Microwave Engineering, John Wiley
3. Annapurna Das and Sisir Das, Microwave Engineering, Tata-McGraw Hill ,New Delhi, 2008

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A:	*Analytical/problem solving SHORT questions* Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.	*8x 5 marks=40 marks*
PART B:	*Analytical/ DESCRIPTIVE questions* Two questions from each module with choice to answer one question.	*4 x 15 marks=60 marks*

Maximum Total Marks: 100

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EC14 703: DIGITAL SYSTEM DESIGN

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives

- *After learning this subject students must be able to simulate and implement typical digital circuits*

Module I (12 hours)
Introduction to VHDL - Behavioral, Data flow and structural description -Identifiers, Data objects, Data types, Delay models -Transport vs Inertial Delay - Simulation Deltas - Sequential Processing - Process Statement - Signal Assignment vs Variable Assignment - Assert and report statements - Subprograms and functions- Packages - Predefined Attributes - Configurations- Subprogram Overloading - VHDL synthesis - Design Examples

Module II (14 hours)
Finite State machines: Design of finite state machines -state tables -state graphs - General models for sequential networks - Derivations of State Graphs and Tables Reduction of state Tables State Assignment - Sequential Network Design- Design examples using the FSM approach - sequence detector, multiplier Impediments to Synchronous design: Clock Skew, Gating the clock, Asynchronous inputs Synchronizer Failure and Metastability Timing hazards : Static Hazards, Dynamic Hazards, Designing hazard free circuit.

Module III (13 hours)
Designing with Programmable devices: Programmable Logic Arrays- Programmable Array Logic- sequential- combinational PLDs (Eg: PAL14L4 &PAL12H6), Sequential PLDs (Eg: PAL16R4)- Simple PLDs (Eg: 22V10)- Complex Programmable Logic Devices (Eg: XC9500)- Field Programmable Gate Arrays (Eg: XC 4000 & FLEX 10K)

Module IV (13 hours)
Introduction to Testing and Diagnosis Digital System Testing: Fault models - fault equivalence - fault location- fault dominance - single and multiple stuck faults - Testing for single stuck faults - Algorithms - random test generation - Testing for bridging faults Design for Testability: Design for Testability: Ad-hoc design for testability techniques - Classical scan designs - Boundary scan standards - Built-in-self-test - Test pattern generation - BIST architecture examples

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Text Books

1. J. Bhasker, A VHDL Primer, Pearson Education, 2000
2. Charles H Roth, Jr , Lizy Kurien John, Digital Design using VHDL , Cengage Publishers, India Second Edition
3. Kenneth L Short, VHDL for Engineers , Pearson Education ,2009
4. John F Wakerly, Digital Design Principles and Practices, Pearson Education, Fourth Edition

Reference Books

1. Stephen Brown & Zvonko Vranesic, Fundamentals of Digital Logic with VHDL design, Tata McGraw Hill
2. Douglas L Perry, VHDL:Programming by example, Mc Graw Hill, Fourth Edition
3. Reiner W. Hartenstein, Andres Keevallik ,Field-Programmable Logic and Applications. From FPGAs to Computing Paradigm, Springer
4. Kevin Skahill, VHDL for Programmable Logic, Pearson Education
5. Stephen Brown,Zvonnko Vranesic,Fundamentals of digital logic design with VHDL, Mc Graw Hill,2006

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions 4 x 15 marks=60 marks

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

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EC14 704(A) INTERNET TECHNOLOGY

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives

- *To make the student aware of the various protocols used in internet.*

Module I (13 hours)
Computer networks and the internet-principles of application-layer protocols-HTTP- FTP-e-mail DNS-socket programming with TCP/UDP-web servers-web pages design using HTML and XML

Module II (13 hours)
Multimedia networking–applications – streaming stored audio and video-internet telephony-RTP-scheduling and policing mechanisms-integrated services- RSVP-differentiated services-network management-the internet network management framework

Module III (13 hours)
Network security –E-mail security-privacy-S/MIME-IP security-overview-architecture-authentication-header and payload-combining security associations-key management- web security-SSL and transport layer security – SET-systems security-intruders and viruses-firewalls-design-trusted systems.

Module IV (13 hours)
Mobile internet-mobile network layer-mobile IP-dynamic host configuration protocol-ad hoc networks-mobile transport layer-implications of TCP on mobility-indirect TCP-snooping TCP-Mobile TCP-transmission –selective retransmission –transaction –oriented TCP support for mobility-file system-WAP protocols –WML –WML script- wireless telephony applications

Text Books

1. Kurose J.F.& Ross K.W.,Computer Networking: A Top-Down Approach Featuring the Internet,Addison Wesley,Modules I&II
2. Stallings W.,Cryptography and Network Security Principles and practice.,Pearson Education Asia,ModuleIII
3. Schiller J.,Mobile Communications,Addison Wesley,Module IV

Reference Books

1. Deitel H.M.,Deitel P.J.& Nieto T.R.,Internet And World Wide Web: How to Program, Pearson Education
2. Greenlaw R& Hepp E,In-line/On-line;Fundamentals Of the Internet And the World Wide Web, Tata Mc Graw Hill
3. Sharma V & Sharma R,Developing e-Commerce Sites: An Integrated Approach ,Addison Wesley
4. Singhal et. Al S.,The Wireless Application Protocol, Pearson Education Asia
5. Goncalves M.,Firewalls : A Complete Guide, Tata Mc Graw Hill

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/ DESCRIPTIVE questions *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

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EC14 704(B) TELEVISION AND RADAR ENGINEERING

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objective
- *To give the basic ideas & operating principles of different types of b/w as well as color CTV and radar (both transmitter and receiver) and their uses.*
- *To create the awareness about the different standards of TV systems used in different countries and their basic principles.*

Module I (13 hours)
Principles of TV- image continuity- Horizontal and vertical scanning- number of scanning lines- flicker- interlaced scanning fine structure – Composite video signal- VSB transmission and reception- Channel bandwidth - positive and negative modulation- Transmitter – receiver – monochrome picture tube- CCD camera

Module II (13 hours)
Colour TV- compatibility- Three colour theory- Grassmans laws- -luminance, hue and saturation - Colour TV Camera tube- Picture tube- Pincushion correction techniques- auto degaussing circuits- frequency interleaving- Bandwidth for color signal transmission- modulation of colour difference signals- colour burst- weighting factors- -principles of NTSC,PAL and SECAM coder and decoder- Block Diagram of Digital T.V-Transmitter- receiver- HDTV, Concept of Plasma Screen

Module III (13 hours)
Radar system- Simple form of radar equation- Radar block diagram- radar frequencies- Prediction of range performance- minimum detectable signal- receiver noise- pulse reception- frequency and range ambiguities- antenna parameter – Doppler effect- system losses and propagation effects.

Module IV (13 hours)

CW Radar – Simple CW radar- Intermediate frequency CW radar- FM- CW radar- FM- CW altimeter- Multiple frequency CW radar- Pulse doppler MTI radars- Delay line canceller- blind speed- tracking radar- A scope and PPI display

Text Books
1. Gulati R.R., Modern Television Engineering ,Wiley Eastern Ltd.
2. Michael Robin& Michael Poulin, Digital Television Fundamentals, Mc Graw Hill
3. Bernard Grob& Charles E. Herndon,Basic Television and Video Systems,
4. Skolnik Introduction to Radar Systems,Mc Graw Hill,Kogakusha Ltd.

Reference Books
1. Dhake A.M.,Television Engineering,Tata Mc Graw Hill
2. Damacher P. Digital Broadcasting ,IEE Telecommunication Series

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A:	*Analytical/problem solving SHORT questions*	*8x 5 marks=40 marks*
	Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.	
PART B:	*DESCRIPTIVE questions*	*4 x 15 marks=60 marks*
	Two questions from each module with choice to answer one question.	
		Maximum Total Marks: 100

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EC14 704(C) EMBEDDED SYSTEMS

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objective

- *To give ideas about embedded systems and system development*
- *To impart knowledge about real time operating systems and microcontrollers*

Pre-requisite: EC14 505 Microprocessors and Microcontrollers

Module I (13hours)
Introduction to Embedded Systems: Characteristics of Embedded systems, Categories of Embedded System- Requirements of Embedded Systems, Challenges and Issues in Embedded Software Development, Role of processor selection in Embedded System (Microprocessor V/s Micro-controller), Software embedded into a system-General ideas of Processor and Memory organization -

Processor and memory selection– Interfacing to Memory and I/O devices- Devices and Buses- Device Drivers and Interrupt Servicing mechanisms- Applications of Embedded Systems in Consumer Electronics, Control System, Biomedical Systems, Handheld computers, Communication devices.

Module II (13 hours)
Real time operating systems: Task and Task States, tasks and data, Message queues-Timer Function-Events-Memory Management, Interrupt Routines in an RTOS environment, basic design Using RTOS. OS services. I/O subsystems. Network operating system. Real time embedded system OS.OS security- Real-Time Embedded Software Development

Module III (13hours)
Microcontroller: PIC microcontroller- architecture- Internal registers and timer/Clock initialization, Interrupts - programming. Introduction to AVR8515 microcontroller.16 and 32 bit microcontrollers.

8096/80196 family. ARM processor- architecture – applications - Motorola 68HC11/ 68HC12 family of microcontrollers. Internal architecture. Addressing modes and instruction set. Interrupts.

Module IV (13 hours)
Embedded system development: Interfacing of external Memory. Interfacing Analog and digital blocks, interfacing of different peripheral devices such as LED, LCD, Graphical LCD, Switches, Relay, stepper motors, ADC, DAC and various sensors. Introduction to-assembler, compiler, cross compilers and Integrated Development Environment (IDE).

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Text Books

1. Rajkamal —Embedded Systems Architecture; Programming and Design‖; Tata McGraw Hill Publications.,New Delhi, 3rd Wd.2008
2. Sreve Heath,'Embedded system design', Elsevier, 2nd Ed. New Delhi, 2003
3. Steve Farber ,ARM System –on-chip , ,Second Edition,2000 Pearson Education
4. K.J. Ayala ,The 8051 Microcontroller , Penram International
5. J B Peatman, Design with PIC Microcontrollers, Prentice Hall
6. Dhananjay Gadre ,Programming and Customizing the AVR Microcontroller,MGH
7. S.Furbur, ARM system Architecture, Addition wesley, 1996.

Reference Books

1. Raj Kamal, Microcontrollers Architecture, programming, Interfacing and System Design, Pearson Education.
2. Dr K.V.K.K..Prasad ,Embedded /Real-Time systems :Concepts ,Design &Programming., DreamTech Publishers.,2004
3. Jonathan.W.Valvano, Embedded Microcomputer Systems, Real Time Interfacing, Publishedby Thomson Brooks/Col, 2002.
4. G.H. Miller, Microcomputer Engineering, 3d edition, Pearson Education.
5. Louis L. Odette ,'Intelligent Embedded Systems' , Addison-Wesley, 1991
6. Microchip Manual for PIC 18F 452

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/ DESCRIPTIVE questions *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

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EC14 704(D): NANOTECHNOLGY

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives

- *To provide basic knowledge about nano/microdevices, mathematical modeling of electromechanical systems and applications*

Module I (11hours)
Biological analogies of Nano and Micro-electromechanical systems (NMEMS)-Fabrication of MEMS- assembling and packing –applications of NMEMS

Module II (15 hours)
Mathematical models and design of NMEMS- NMEMS architecture-electro magnetics and its applications is NMEMS –Molecular and Nano structure dynamics-molecular wires and molecular circuits-thermo analysis and heat equation.

Module III (14 hours)
Carbon nanotubes and nono devices-structural design of nano and MEM actuators and sensors-configurations and structural design of motion nano and micro-structures.

Module IV (12 hours)
Algebra of sets-direct current micro machines-mathematical models of induction motors-micro synchronous machines-single phase reluctance motors-stepper motors-synchronous reference frames-control of NMEMS

Text Books

1 Lyschevski,Sergey Edward,Nano and Microelectromechanical Systems: Fundamentals of Nano and micro engineering,CRC Press,2000

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/ DESCRIPTIVE questions *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

EC14 704(E) IMAGE AND VIDEO PROCESSING

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives

- *To give ideas & techniques of image & video processing*
- *To impart knowledge about image filtering, restoration & reconstruction*

Pre-requisite: EC14 604 Digital Signal Processing

Module I (11hours)

Introduction: 2D systems, Mathematical preliminaries – Fourier Transform, Z Transform, Optical & Modulation transfer function, Matrix theory, Random signals, Discrete Random fields, Spectral density function. Image Perception: Light, Luminance, Brightness, Contrast, MTF of the visual system, Visibility function, Monochrome vision models, Fidelity criteria, Color representation, Chromaticity diagram, Color coordinate systems, Color difference measures, Color vision model, Temporal properties of vision.

Module II (15 hours)

Image Sampling and Quantization: Introduction, 2D sampling theory, Limitations in sampling & reconstruction, Quantization, Optimal quantizer, Compander, Visual quantization. Image Transforms: Introduction, 2D orthogonal & unitary transforms, Properties of unitary transforms, DFT, DCT, DST, Hadamard, Haar, Slant, KLT, SVD transform. Image Representation by Stochastic Models: Introduction, one-dimensional Causal models, AR models, Non-causal representations, linear prediction in two dimensions.Image Enhancement: Point operations, Histogram modeling, spatial operations, Transform operations, Multi-spectral image enhancement, false color and Pseudo-color, Color Image enhancement.

Module III (14 hours)

Image Filtering & Restoration: Image observation models, Inverse & Wiener filtering, Fourier Domain filters, Smoothing splines and interpolation, Least squares filters, generalized inverse, SVD and Iterative methods, Maximum entropy restoration, Bayesian methods, Coordinate transformation & geometric correction, Blind de-convolution.
Image Analysis & Computer Vision: Spatial feature extraction, Transform features, Edge detection, Boundary Extraction, Boundary representation, Region representation, Moment representation, Structure, Shape features, Texture, Scene matching & detection, Image segmentation, Classification Techniques.
Image Reconstruction from Projections: Introduction, Radon Transform, Back projection operator, Projection theorem, Inverse Radon transform, Fourier reconstruction, Fan beam reconstruction, 3D tomography. Image Data Compression: Introduction, Pixel coding, Predictive techniques, Transform coding, Inter-frame coding, coding of two tone images, Image compression standards.

Module IV (12 hours)

Video Processing: Fundamental Concepts in Video – Types of video signals, Analog video, Digital video, Color models in video, Video Compression Techniques – Motion compensation, Search for motion vectors, H.261, H.263, MPEG I, MPEG 2, MPEG 4, MPEG 7 and beyond, Content based video indexing

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Text Books

1 K. Jain, —Fundamentals of Digital Image Processing‖, Pearson Education (Asia) Pte. Ltd./Prentice Hall of India, 2004.
2 . Z. Li and M.S. Drew, —Fundamentals of Multimedia‖, Pearson Education (Asia) Pte. Ltd., 2004.
3. R. C. Gonzalez and R. E. Woods, —Digital Image Processing‖, 2nd edition, Pearson Education (Asia) Pte. Ltd/Prentice Hall of India,2004.
4. M. Tekalp, —Digital Video Processing‖, Prentice Hall, USA, 1995.

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/ DESCRIPTIVE questions *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

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EC14 705(A) SOFT COMPUTING

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives

- *To acquaint the students with the important soft computing methodologies- neural networks, fuzzy logic, genetic algorithms and genetic programming*

Module I (12 Hours)
Artificial Intelligent systems – Neural Networks, Fuzzy Logic and Evolutionary Programming concepts. Artificial Neural Networks – Biological neural networks – Model of an artificial neuron-Comparison between biological neuron and artificial neuron– Basic models of artificial neural network –Learning methods – Activation function and terminologies of ANN- Mc Culloch Pitts Neuron – Linear Separability – Hebb network – Perceptron Networks , Adaline, Madaline.

MODULE II (14 Hours)

Back propagation Networks : Architecture - Multi layer perceptron –Back propagation learning – Input layer, Hidden Layer , Output Layer computations, Calculation of error, Training of ANN, Back propagation Algorithm, Momentum and Learning rate, Selection of various parameters in BP networks- Radial Basis Function Networks [T. B. 1].

Variations in standard BP algorithms – Decremental iteration procedure, Adaptive BP, GA based BP, Quick prop training, Augmented BP networks, Sequential learning Approach for single hidden layer Neural networks.

Module III (13 Hours)

Fuzzy sets and crisp sets-Fuzzy sets –Fuzzy set operations-Fuzzy relations- Membership functions – Features of the membership functions-Fuzzification- Methods of membership value assignments-Defuzzification- Defuzzification methods-Fuzzy Rule Base and approximate reasoning- Truth values and tables in fuzzy logic, Fuzzy propositions, Formation of rules, Decomposition of rules, Aggregation of fuzzy rules- Fuzzy Inference Systems- Construction and Working Principle of FIS-Methods of FIS- Mamdani FIS and Sugeno FIS- Fuzzy Logic Control Systems- Architecture and Operation of FLC System- FLC System Models- Application of FLC Systems.

Module IV (13 Hours)
Genetic Algorithms- Basic Concepts- Creation of off- springs- Working Principle- Encoding- Fitness function- Reproduction- Roulette- Wheel Selection, Boltzmann Selection- Tournament selection-Rank Selection- Steady- State Selection- Elitism- Generation gap and steady state replacement-Inheritance operators- Cross Over- Inversion and deletion- Mutation Operator- Bit- wise operators-Generational Cycle- Convergence of Genetic Algorithm- Differences and Similarities between GA and other traditional methods- Applications.

Text Books

1. S. N. Sivanandam, S. N. Deepa, *Principles of Soft Computing,* Wiley India Pvt. Ltd.[Module I& III]
2. R.Rajasekharan and G.A. Vijayalakshmi Pai, *Neural Networks, Fuzzy Logic and Genetic Algorithms- Synthesis and Applications,* Prentice Hall of India. [Module II & IV]

Reference Books

1. Fakhreddine O.Karray & Clarence De Silva, *Intelligent Systems Design, Theory, Tools and Application*, Pearson Education
2. S. Haykins, *Neural Networks – A Comprehensive Foundation* , Prentice Hall 2002.
3. L. Fausett, *Fundamentals of Neural Networks*, Prentice Hall 1994.
4. T.Ross, *Fuzzy Logic with Engineering Applications*, TMH
5. D.E. Goldberg, *Genetic Algorithms in search, Optimization and Machine Learning*, Addison Wesley MA, 1989.
6. John Yen, Reza Lengari, *Fuzzy Logic- Intelligence, Control and Information,* Pearson Education

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/ DESCRIPTIVE questions *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

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EC14 705(B) HIGH SPEED DIGITAL DESIGN

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives

- *To give the basic ideas involved in high speed digital design*
- *To understand the transmission line effects and cross talk and the effects of terminations & vias*

Module I (13 hours)
Introduction to high-speed digital design - frequency, time and distance - capacitance and inductance effects - high speed properties of logic gates - speed and power - measurement techniques - rise time and bandwidth of oscilloscope probes - self inductance, signal pickup and loading effects of probes - observing crosstalk

Module II (13hours)
Transmission line effects and crosstalk - transmission lines - point to point wiring - infinite uniform transmission lines - effects of source and load impedance - special transmission line cases - line impedance and propagation delay - ground planes and layer stacking - crosstalk in solid ground planes, slotted ground planes and cross-hatched ground planes - near and far end crosstalk

Module III (13 hours)
Terminations and vias - terminations - end, source and middle terminations - AC biasing for end terminations - resistor selection - crosstalk in terminators - properties of vias - mechanical properties of vias - capacitance of vias - inductance of vias - return current and its relation to vias

Module IV (13 hours)
Stable reference voltage and clock distribution - stable voltage reference - distribution of uniform voltage - choosing a bypass capacitor - clock distribution - clock skew and methods to reduce skew - controlling crosstalk on clock lines - delay adjustments - clock oscillators and clock jitter

Text Books

1. Howard Johnson & Martin Graham, -High Speed Digital Design: A Handbook of Black Magic‖, Prentice Hall PTR
2. Dally W.S. & Poulton J.W., -Digital Systems Engineering‖, Cambridge University Press
3. Masakazu Shoji, -High Speed Digital Circuits‖, Addison Wesley Publishing Company

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

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University Examination Pattern

PART A: Analytical/problem solving SHORT questions — *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/ DESCRIPTIVE questions — *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

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EC14 705(C) ANTENNA THEORY AND DESIGN

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives

- *To impart the concepts of different types of antennas and antenna arrays-analysis & synthesis*
- *To develop understanding about design and modeling of antenna using computational methods*

Pre-requisites: EC14 601 Radiation & Propagation

Module I (13 hours)
Antenna Fundamentals: Radiation mechanism – over view, Electromagnetic Fundamentals, Solution of Maxwell's Equations for Radiation Problems, Ideal Dipole, Radiation Patterns, Directivity and Gain, Antenna Impedance, Radiation Efficiency. Antenna Polarization
Arrays: Array factor for linear arrays, uniformly excited, equally spaced Linear arrays, pattern multiplication, directivity of linear arrays, nonuniformly excited -equally spaced linear arrays, Mutual coupling, multidimensional arrays, phased arrays, feeding techniques, perspective on arrays.

Module II (13 hours)
Types of Antennas: Traveling - wave antennas, Helical antennas, Biconical antennas, sleave antennas, and Principles of frequency independent Antennas, spiral antennas, and Log - Periodic Antennas. Aperture Antennas- Techniques for evaluating Gain, reflector antennas - Parabolic reflector antenna principles, Axi -symmetric parabolic reflector antenna, offset parabolic reflectors, dual reflector antennas, Gain calculations for reflector antennas, feed antennas for reflectors, field representations, matching the feed to the reflector, general feed model, feed antennas used in practice.
Microstrip Antennas-Introduction, rectangular patch, circular patch, bandwidth, coupling, circular polarization, arrays and feed network

Module III (13 hours)
Antenna Synthesis: Formulation of the synthesis problem, synthesis principles, line sources shaped beam synthesis, linear array shaped beam synthesis — Fourier Series, Woodward — Lawson sampling method, comparison of shaped beam synthesis methods, low side lobe narrow main beam synthesis methods- Dolph Chebyshev linear array, Taylor line source method.

Module IV (13 hours)
CEM for Antennas : Introduction to computational electromagnetics, Introduction to method of moments-Pocklington's integral equation, source modeling, weighted residuals. Introduction to Finite Difference Time Domain Method-Finite difference and Yee's algorithm, cell size, numerical stability and dispersion. Absorbing boundary conditions. Introduction to geometrical optics

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Text Books

1. Warren L Stutzman and Gary A Thiele, -Antenna Theory and Designl, 2ndEd, John Wiley and Sons Inc. 1998
2. Constantine. A. Balanis: -Antenna Theory- Analysis and Designl, Wiley India, 2nd Edition, 2008
3. Kraus, -Antennasl, Tata McGraw Hill, NewDelhi, 3ll Edition, 2003

Reference Books

2. R.E.Collin, Antennas and Microwave propagation, Tata Mc-Graw Hill,2004
3. R.C.Johnson and H.Jasik,Antenna Engineering hand book, Mc-Graw Hill,1984
4. I.J.Bhal and P.Bhartia,Micro-strip antennas,Artech house,1980

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions 4 x 15 marks=60 marks

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

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EC14 705(E) BIO MEDICAL INSTRUMENTATION

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives

- To impart knowledge about the principle and working of different types of bio-medical electronic equipments/devices

Module I (13 hours)
Electrical activity of excitable cells-SD curve-functional organization of the peripheral nervous system-electrocardiogram (in detail with all lead systems)-electroencephalogram-electromyogram –electroneurogram- electrode –electrolyte interface-polarisation-polarisable and non polarisable electrodes- surface electrodes –needle electrodes-micro electrodes- practical hints for using electrodes-_skin- electrodes' equivalent circuit-characteristics of _bio-amplifiers'

Module II (13 hours)
Blood pressure-direct measurements-harmonic analysis of blood pressure waveform-system for measuring venous pressure-heart sounds- phonocardiography-cardiac catheterization-indirect blood pressure measurement –electromagnetic blood flow meters-ultrasonic blood flow meters-impedance plethysmography –photo plethysmography-_indicator- dilution'method for blood flow determination –spirometry-measurement of various respiratory parameters- respiratory plethysmography-chamber plethysmography

Module III (13 hours)
Measurement of gas flow rate cardiac pacemakers and other electric stimulators-defbrillators and cardio converters –blood plumps –hemodialysis-ventilators –infant incubators-drug delivery devices-lithotripsy-therapeutic applications of laser
Module IV (13 hours)
Physiological effects of electricity-important susceptibility parameters-macro shock hazards-micro shock hazards-protection against shock-electrical isolation- electrical safety analyzers-measurements of pH,pC2, and PO2

Text Books

1. Webster J,' Medical Instrumentation-Application and Design', John Wiley
2. Handbook of Biomedical Instrumentation, Tata-Mc graw Hill, New Delhi

Reference Books

1. Geddes& Baker,'Principles of Applied Biomedical Instrumentation', Wiley
2. Encyclopedia of Medical Devices and Instumentation Wiley
3. Bronzino,Hand book of Biomedical Engineering, IEEE press book

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: DESCRIPTIVE solving SHORT questions — *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/ DESCRIPTIVE questions — *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

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Semester End Examination *(Maximum Marks-100)*

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EC14 801 DATA AND COMMUNICATION NETWORKS

Teaching scheme **Credits:** 4
4 hours lecture and 1 hour tutorial per week

Objectives

- *To give the basic ideas of data communication networks-queuing theory, architecture and protocol*
- *To understand the concept of switching networks*

Module I (10hours)
Queueing Theory: Markov chain-discrete time and continuous time Markov chains- Poisson Process M/M/1 Queue Little's formula M/M/m/m queueing models.
Layered Architectures in Data networks: OSI standards architecture and protocols.

Module II (14hours)
Data link layer-ARQ retransmission strategies Flow control and congestion control in network layer-error control, stop and wait, Sliding windows, Automatic Repeat (ARQ)Asynchronous Protocols, - X MODEM, Y MODEM, Synchronous protocols – Character Oriented and Bit oriented protocols (HDLC). Routing functions and routing algorithm shortest path routing virtual circuit and datagram networks.TCP/IP protocols

Module III (14 hours)
Local Area Networks IEEE 802 standards CSMA/CD, Random access Aloha-pure and slotted aloha Random access using CSMA/CD. Ethernet, Token Bus, Token ring, FDDI ,ATM Networks, , Routing in ATM networks, Distributed Queue Dual Bus, SONET, SDH- X .25 Protocols,

Module IV (14 hours)
Circuit switching: Elements of Traffic Engg. GoS and Blocking Probability. Incoming traffic and service time characterization. Analysis of blocking models and delay models- Erlang formulae.Digital switching networks, Two stage -Three stage and N- stage switches, combination Switches Blocking probability analysis of multistage switches-Lee's approximation.

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Text Books

1. JeanWalrand & Pravin Varaiya,‖High Performance Communication Networks‖ Morgan Kaufman Publishers
2. Behrus A. Forouzan etal. -Data Communication and Networking‖, 4th Edition, Tata McGraw-Hill, 2000.
3. Bertsekas D.& Gallager R.,‖Data Networks‖ Prentice Hall ofIndia
4. William Stallings, -Data and Computer Communication‖, Fifth Edition, Prentice Hall of India, 1997.
5. Andrew S.Tanenbaum, -Computer networks‖. Third Edition. prentice Hall of India, 1996.
6. Viswanathan T.,Telecommunication Switching Systems and Networks,Prentice Hall of India Pvt Ltd.
7. Schwartz M., Telecommunication Networks-Protocols,Modeling and Analysis,Addison Wesley Publishing Company

References

1. Flood J E., Telecommunication Switching Traffic and Networks,Pearson Education Pvt Ltd.
2. Freeman R L ., Telecommunication System Engineering ,Wiley Inter Science Publications
3. Das J.,Review of Digital Communication ,New Age Internal (p) Ltd.,Publishers

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/ DESCRIPTIVE questions *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

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EC14 803 WIRELESS MOBILE COMMUNICATION

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week ·

Objective

- *To provide a strong background in the basics of wireless mobile communication*
- *To impart knowledge about the existing GSM and CDMA mobile communication technology*

Module I (13Hrs)
Cellular concept -frequency reuse- co channel interference-adjacent channel interference- power control for reducing interference-improving capacity in cellular systems-cell splitting-sectoring- hand off strategies-channel assignment strategies- Trunking and Erlang capacity calculations.

Module II (13Hrs)
Mobile radio propagation- free space propagation model- ground reflection model- large scale path loss- small scale fading and multipath propagation-impulse response model of a multi- path channel- parameters of a mobile multipath channel- multi path delay spread-doppler spread- coherence bandwidth- coherence time- time dispersion and frequency selective fading- frequency dispersion and time selective fading.

Module III (13Hrs)
Fundamental concepts of spread spectrum systems-performance of direct sequence spread spectrum systems- analysis of DSSS- processing gain and anti jamming margin-frequency hopped spread spectrum systems. Multi user detection in CDMA. RAKE receiver concepts, Diversity , combining methods - space time processing.

Module IV (13Hrs)
Standards of wireless communication systems- GSM, IMT -2000, UMTS, Wideband CDMA, Wi-Fi, Wi-Max. GSM architectures, objectives, servicing frequency bands-GSM sub sys- tems, Radio link features in GSM. Introduction to multi carrier communication: OFDM, MC CDMA.

Text Books:

1. Rappaport T.S, Wireless Communication Principles and practices, Pearson Education Asia, New Delhi, 3rd Ed. 2003.
2. Andrea Goldsmith, Wireless Communications, Cambridge University press
3. Vijay k Garg, Joseph E Wilkes, Principles and Applications of GSM, Pearson Education
4. A.J Viterbi, CDMA- Principles of Spread Spectrum, Addison Wesley.

Reference books:

1. Kamilo Feher, Wireless Digital Communication, PHI.
2. A F Molisch, Wireless communications, Wiley India, 2008.

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Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions — *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/ DESCRIPTIVE questions — *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

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EC14 804(D) MOBILE COMPUTING

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives
- *To give basic concepts of mobile computing*
- *To impart knowledge about various wireless systems , LANs and Mobile IP*

Module I (13 hours)
Personal Communications Services Architecture, Mobility management-handoff management-network signalling- -GSM- GPRS-DECT-UMTS/ WCDMA-IMT 2000- IS 95-cdma2000satellite networks-basics-parameters and configurations-mobile number portability-FAMA-DAMA-broadcast systems-DAB-DVB

Module II (13 hours)
WLANs (Wireless LANs)- Wi-Fi-IEEE 802.11- architecture-services- IEEE 802.11a & 802.11b standard-HIPERLAN-, Bluetooth -IEEE 802. 15-WiMAX-IEEE 802.16

Module III (13 hours)
Wireless Networking: MAC protocols, Routing, Transport, Ad-hoc networking.
Mobile IP-dynamic host configuration protocol-Routing-DSDV-DSR-Alternative metrics

Module IV (13 hours)
Wireless Application Protocol (WAP): The Mobile Internet standard-architecture-cpomponents of WAP standard WAP Gateway and Protocols-WAP2.0- wireless mark up Languages (WML)-basics

Text Books

1. Jochen Schiller,'Mobile Communications', PHI/Pearson Education, 2nd Ed., 2003
2. William stallings,'Wireless communications & Networks', 2ndEd, Pearson education,New Delhi, 2005
3. Lin., _Wireless & Mobile Architectures', Wiley India, New Delhi, 2009

Reference Books

1. Mosa Ali Abu-Rgheff,'Introduction to CDMA wireless communications', Academin Press-Elsevier, 2007
2. A F Molisch, _Wireless communications',Wiley India, 2005
3. Ivan Stojmenovic,'Handbook of Wirelss Networks and Mobile Computing', Wiley India, New Delhi, 2002
4. Steele,'GSM, CDMAOne & 3G systems Wiley India,New Delhi, 2008
5. kaveh Pahlavan, prasanth Krishnamoorthi.'Principles of wireless networks', PHI/Pearson Education, 2003
6. Uwe Hansmann, lother Merk, Martin S Nicklons and Thomas Srober,‖Principles of mobile computing', Springer, Newyork, 2003
7. Hazysztof Wesolowshi,'Mobile Communication Systems',John Wiley& Sons Ltd. 2002

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Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions — *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/ DESCRIPTIVE questions — *4 x 15 marks=60 marks*

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

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EC14 805(E) ADVANCED DIGITAL SIGNALPROCESSING

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives

- *To give ideas of multirate systems and filter banks*
- *To impart knowledge about wavelet transforms & their applications*

Pre-requisite: EC14 604 Digital Signal Processing

Module I (14hours)
Multirate system fundamentals: Basic multirate operations, up-sampling and down sampling: Time domain and frequency domain analysis, Identities of multirate operations, Interpolator and decimator design, Rate conversion, Polyphase representation.

Module II (14 hours)
Multirate Filter banks: Maximally decimated filter banks, Quadrature mirror filter (QMF) banks, Polyphase representation, Errors in the QMF banks: Aliasing and Imaging Method of cancelling aliasing error, Amplitude and phase distortion, Prefect reconstruction (PR) QMF banks, PR condition, M-channel perfect reconstruction filter banks, Paraunitary PR Filter Banks

Module III (14 hours)
Wavelets: Fundamentals of signal decomposition - brief overview of Fourier transform and short time Fourier transform - time frequency resolution - Continuous wavelet transform - different wavelets- DWT - wavelet decomposition - approximation of vectors in nested linear vector spaces - example of MRA - orthogonal wavelet
decomposition based on the Haar wavelet - digital filter implementation of the Haar wavelet decomposition

Module IV (11 hours)
Wavelet applications: Image compression - EZW algorithm - Audio compression - signal denoising techniques- different types- edge detection. Lossless compression

Text Books

1. P. P. Vaidyanathan, Multirate Systems and Filter Banks, Pearson Education, Delhi, 2004
2. K. P. Soman and K. I. Ramachandran, Insight into Wavelets, Prentice Hall of India, New Delhi, 2004
3. G. Strang and T. Nguyen, Wavelets and Filter Banks, Wellesley-Cambridge Press, MA, 1996
4. Li Tan,'DSP-Fundamentals & Applications', Elsevier, New Delhi, 2008

Reference Books

1. M. Vetterli and J. Kovacevic, Wavelets and Subband Coding, Prentice-Hall, Englewood Cliffs, N. J., 1995
2. S. K. Mitra, Digital Signal Processing: A Computer Based Approach, 2nd ed., Tata Mc-Graw Hill, New Delhi, 2001
3. C. S. Burrus, R. A. Gopinath, and H. Guo, Introduction to Wavelets and Wavelet Transforms: A Primer, Prentice Hall, Englewood Cliffs, N. J., 1997

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions 4 x 15 marks=60 marks

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

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08 EC 6321CMOS VLSI DESIGN

Credits: 4-0-0: 4

Pre-requisites: Nil **Year: 2015**

Course Objectives:

- To design and develop the CMOS circuits and system with subsystems
- To interpret and analyze the basic characteristics of CMOS

Syllabus

MOS device design equations, DCcharacteristics, CMOS logic structures, design strategies, verification and testing, Data path operation, multiplication, and memory elements control FSM

Course Outcome:

Upon completion of the course, student will be able to design and develop simple circuits for a processor with CMOS Technology

TEXT BOOKS:

1. Neil. H.E. Weste and K. Eshragian, "Principles of CMOS VLSI Design". 2nd Edition. Addison-Wesley , 2000.

2. Douglas a. Pucknell and K. Eshragian., "Basic VLSI Design" 3rd Edition. PHI, 2000.

3. R. Jacob Baker, Harry W. LI., & David K. Boyce., "CMOS Circuit Design", 3rd Indian reprint, PHI, 2000.

REFERENCE BOOKS:

1. Semiconductor Devices Modelling and Technology Nandita Das Guptha , Amitava Das Guptha; Prentice Hall India
2. Operation and Modeling of The MOS transistor : YannisTsividis 2/e Oxford Uni- versity Press

3. Kang &Leblebigi "CMOS Digital IC Circuit Analysis & Design"- McGraw Hill, 2003

4. Weste and Eshraghian, "Principles of CMOS VLSI design" Addison-Wesley, 2002

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MODULE : 1 MOS Transistors, MOS Transistor Switches, CMOS Logic, Circuit and System Representations, MOS Transistor Theory - Introduction MOS Device Design Equations,	8	15
MODULE : 2 The Complementary CMOS Inverter-DC Characteristics, Static Load MOS Inverters, The Differential Inverter, The Transmission Gate, The Tri State Inverter, Bipolar Devices, Resistance Estimation Capacitance Estimation, Inductance, Switching Characteristics CMOS-Gate Transistor Sizing, Power Dissipation, Sizing Routing Conductors, Charge Sharing, Design Margining, Reliability.	8	15
FIRST INTERNAL TEST		
MODULE : 3 CMOS Logic Gate Design, Basic Physical Design of Simple Gate, CMOS Logic Structures, Clocking Strategies, I/O Structures, Low Power Design	8	15
MODULE : 4 Design Strategies CMOS Chip Design Options, Design Methods, Design Capture Tools, Design Verification Tools, Design Economics, Data Sheets,	8	15
SECOND INTERNAL TEST		
MODULE : 5 CMOS Testing -Manufacturing Test Principles, Design Strategies for Test, Chip Level Test Techniques, System Level Test Techniques, Layout Design for Improved Testability.	10	20
MODULE : 6 Data Path Operations-Addition/Subtraction, Parity Generators, Comparators, Zero/One Detectors, Binary Counters, ALUs, Multiplication, Shifters, Memory Elements, Control-FSM, Control Logic Implementation.	10	20

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Course Objectives:

- A foundation in fundamental of sequential circuits
- Practice in designing sequential circuits-mealy ,moore and FM charts
- An introduction to VHDL basing

Syllabus

Design of multiple output sequential circuits, introduction to PLDS, state diagram, state table minimization of mealy and moor machine, Race conditions and cycles, Hazards, FM charts, Different modeling in VHDL, Model simulation, Synthesis –Issues, Timing simulation

Course Outcome:

After completion of this course students are able to design-sequential circuits, multiple output combination circuits & SM charts..Also to write VHDL programs & simulate

Text Books: One or two text books only (if required)

1. “Fundamentals of Digital Design”, Charles H.Roth, Jr., PWS Pub.Co., 1998.

2. “Digital Design Fundamentals”, Kenneth J Breeding, Prentice Hall, Englewood Cliffs, New Jersey.1989.

References:

1. Kevin Skahill, "VHDL for Prgrammable Logic", Addison -Wesley, 1996

2. Z. Navabi, "VHDL Analysis and Modeling of Digital Systems", McGRAW-Hill, 1998

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COURSE PLAN

08 EC 6331Advanced Digital System Design (L-T-P : 3-0-0) CREDITS:3		
MODULE S	**Contact hours**	**Sem.Exam Marks;%**
MODULE : 1 Introduction - Design of Combinational Systems – Multiple output combination circuit design – McCluskey method- Introduction to PLDs - PROM based design - PAL - Arithmetic PAL devices – Study based on PAL22V10, CPLDs (MAX3000A CPLD).	6	15
MODULE:2 Mealy Machine, Moore Machine, State diagrams, State table minimization, Incompletely specified sequential machine	6	15
FIRST INTERNAL TEST		
MODULE : 3 Asynchronous sequential circuit design (fundamental mode), Derivation of excitation table, Designing with SM charts – State machine charts, Derivation of SM charts, and Realization of SM charts.	6	15
MODULE : 4 Hazards, Race conditions and cycles, Static and dynamic hazards, Methods for avoiding races and hazards, essential hazards	6	15
SECOND INTERNAL TEST		
MODULE : 5 Introduction to HDL – Behavioral modeling - Data flow modeling- Structural modeling- Basic language elements – Entity-Architecture- Configurations - Subprograms and operator overloading- Packages and libraries	7	20
MODULE : 6 VHDL advanced features - Model simulation - Hardware modeling examples. Synthesis. Timing Simulation. VHDL Synthesis Issues.	8	20

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COURSE PLAN

08 EC 6341VLSI Fabrication Technology (L-T-P : 3-0-0) CREDITS:3		
MODULES	Contact hours	Sem.Exam Marks;%
MODULE : 1 Introduction, Electronic-Grade Silicon, Czochralski Crystal Growing, Silicon Shaping, Process Considerations**Epitaxy:** Introduction, Vapour-Phase Epitaxy, Molecular Beam Epitaxy, Silicon on Insulators, Epitaxial Evaluation.	6	15
MODULE : 2 Introduction, Optical Lithography, Electron Lithography, X-ray Lithography, Ion Lithography. Optical contrast,contrastcurve,MTF	6	15
FIRST INTERNAL TEST		
MODULE : 3 Reactive Plasma Etching: Introduction, Plasma Properties, Feature-Size Control and Anisotropic Etch Mechanisms, Other Properties of Etch Processes, Reactive Plasma-Etching Techniques and Equipment, Specific Etch Processes,P-well,N-well,twin-well process	6	15
MODULE : 4 Ion Implantation:Introduction, Range Theory, Implantation Equipment, Annealing, Shallow Junctions, High-Energy Implantation, isolation methods-PN junction, Trench isolation,ohmic contacts	6	15
SECOND INTERNAL TEST		
MODULE : 5 Metallization: Introduction, Metallization Applications, Metallization Choices, Physical Vapor Deposition, Patterning, Metallization Problems, New Role of Metallization, Testing of VLSI circuits	7	20
MODULE : 6 VLSI Process Integration: Introduction, Fundamental Considerations for IC Processing, , CMOS IC Technology,, Bipolar IC Technology, IC Fabrication, Stick diagram-rules for stick diagram, design rules Packaging of VLSI Devices: Introduction, Package Types, Packaging Design Considerations	8	20

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08 EC 6351(A): ELECTRONIC SYSTEM DESIGN

Pre-requisites: Nil | **Credits: 3-0-0: 3**
Year: 2015

Course Objectives:

- To make students to practical circuits design issues and techniques
- To make students aware of various filtering systems, electrostatic discharges etc

Syllabus:

Practical analog and mixed signal circuit design issues and techniques, practical logic circuit design and issues, Electromagnetic compatibility, Balancing & Filtering in Electronic Systems, Protection against Electrostatic Discharges (ESD), Packaging & Enclosures of Electronic System, Cooling in/of Electronic System

Course Outcome:

Students who successfully complete this course will be able to Practical analog and mixed signal circuit design issues and techniques, practical logic circuit design and issues

TEXT BOOKS:

1. Electronic Instrument Design, 1st edition; by: Kim R. Fowler; Oxford University Press.
2. Noise Reduction Techniques in Electronic Systems, 2nd edition; by: Henry W. Ott John Wiley & Sons.
3. Digital Design Principles & Practices, 3rd edition by: John F. Wakerly; Prentice Hall International, Inc.
4. Operational Amplifiers and linear integrated circuits, 3rd edition by: Robert F. Coughlin; Prentice Hall International, Inc
5. Intuitive Analog circuit design by: Mark. T Thompson; Published by Elsevier

REFERENCE BOOKS:

1. Printed Circuit Boards - Design & Technology, 1st edition; by: W Bosshart; Tata McGraw Hill.
2. ADesigner'sGuidetoInstrumentationAmplifiers;by:CharlesKitchinandLewCounts; Seminar Materials @ http://www.analog.com
3. Errors and Error Budget Analysis in Instrumentation Amplifier Applications; by: Eamon Nash; Application note AN-539@ http://www.analog.com

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COURSE PLAN

08 EC 6351(A) : ELECTRONIC SYSTEM DESIGN(L-T-P : 3-0-0) CREDITS:3		
MODULE S	Contact hours	Sem.Exam Marks;%
MODULE : 1 Passive components: Understanding and interpreting data sheets and specifications of various passive and active components, non-ideal behavior of passive components,. Op amps: DC performance of op amps: Bias, offset and drift. AC Performance of operational amplifiers: band width, slew rate and noise. Properties of a high quality instrumentation amplifier	6	15
MODULE : 2 Design issues affecting dc accuracy & error budget analysis in instrumentation amplifier applications. Isolation amplifier basics. Active filers: design of low pass, high pass and band pass filters. ADCs and DACs: Characteristics, interfacing to microcontrollers. Selecting an ADC. Power supplies: Characteristics, design of full wave bridge regulated power supply. Circuit layout and grounding in mixed signal system.	6	15
FIRST INTERNAL TEST		
MODULE : 3 **Practical Logic Circuit Design Issues and Techniques:** Understanding and interpreting data sheets & specifications of various CMOS&BiCMOS family Logic devices. Electrical behavior (steady state & dynamic) of CMOS &BiCMOS family logic devices. Benefits and issues on migration of 5-volt and 3.3 volt logic to lower voltage supplies. CMOS/TTL Interfacing Basic design considerations for live insertion. JTAG/IEEE 1149.1 design considerations	6	15
MODULE : 4 Design for testability, Estimating digital system reliability. Digital circuit layout and grounding. PCB design guidelines for reduced EMI. Designing for (EMC), EMC regulations, typical noise path, methods of noise coupling, methods of reducing interference in electronic systems. Cabling of Electronic Systems: Capacitive coupling, effect of shield on capacitive coupling, inductive coupling, effect of shield on inductive coupling, effect of shield on magnetic coupling, magnetic coupling between shield and inner conductor, shielding to prevent magnetic radiation, shielding a receptor against magnetic fields. coaxial cable versus shielded twisted pair, ribbon cables	6	15
SECOND INTERNAL TEST		

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MODULE : 5 Grounding of Electronic Systems: Safety. grounds, signal grounds, single-point ground systems, multipoint-point ground systems, hybrid grounds, functional ground layout, practical low frequency grounding, hardware grounds, grounding of cable shields, ground loops, shield grounding at high frequencies. Balancing & Filtering in Electronic Systems: Balancing, power line filtering, power supply decoupling, decoupling filters, high frequency filtering, and system bandwidth.	7	20
MODULE : 6 Protection Against Electrostatic Discharges (ESD):Static generation, human body model, static discharge, ESD protection in equipment design, software and ESD protection, ESD versus EMC.Packaging& Enclosures of Electronic System: Effect of environmental factors on electronic system (environmental specifications), nature of environment and safety measures. Packaging's influence and its factors. Cooling in/of Electronic System: Heat transfer, approach to thermal management, mechanisms for cooling, operating range, basic thermal calculations, cooling choices, heat sink selection.	8	20

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08 EC 6351(B): DIGITAL INTEGRATED CIRCUIT DESIGN

Credits: 3-0-0: 3

Pre-requisites: Nil **Year: 2015**

Course Objectives:

- To make students to idea about digital integrated circuits
- To make students aware of CMOS logics, arithmetic circuits using CMOS

Syllabus:

CMOS inverters, Static CMOS design combinational and sequential circuits, Arithmetic circuits in CMOS VLSI, Bipolar gate design

Course Outcome:

Students who successfully complete this course will be able to idea about Basic CMOS circuits in VLSI, and to design integrated circuits using CMOS logic

TEXT BOOKS:

1. Sung-Mo Kang & Yusuf Leblebici, CMOS Digital Integrated Circuits - Analysis & Design, MGH, Second Ed., 1999
2. Jan M Rabaey, Digital Integrated Circuits - A Design Perspective, Prentice Hall, 1997
3. Ken Martin, Digital Integrated Circuit Design, Oxford University Press, 2000
4. R. J. Baker, H. W. Li, and D. E. Boyce, CMOS circuit design, layout and simulation. New York: IEEE Press, 1998.
5. Analysis and Design of Digital Integrated Circuits, Third Edition, David A. Hodges, Horace G. Jackson, and Resve A. Saleh, McGraw-Hill, 2004.

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COURSE PLAN

08 EC 6351(B) DIGITAL INTEGRATED CIRCUIT DESIGN (L-T-P : 3-0-0) CREDITS:3		
MODULE S	**Contact hours**	**Sem.Exam Marks;%**
MODULE : 1 CMOS inverters -static and dynamic characteristics, CMOS NAND, NOR and XOR Gates. Calculation or delay times of CMOS Inverter	6	15
MODULE : 2 Static CMOS design combinational and sequential circuits -Method of Logical Effort for transistor sizing -power consumption in CMOS gates- Low power CMOS design	6	15
FIRST INTERNAL TEST		
MODULE : 3 CMOS transmission gates-Simple circuit using TG-basic principle of pass transistor logic-Voltage bootstrapping-CMOS ring oscillator	6	15
MODULE : 4 Bipolar gate Design- BiCMOS logic - static and dynamic behaviour -Delay and power consumption in BiCMOS Logic.	6	15
SECOND INTERNAL TEST		
MODULE : 5 Arithmetic circuits in CMOS VLSI - Adders- multipliers- shifter -CMOS memory design - SRAM and DRAM	7	20
MODULE : 6 Dynamic CMOS logic-Precharge/ evaluable logic-cascading problem-domino logic-cascading domino logic gates-Charge sharing in domino logic-realisation of simple functions using domino logic-NORA logic-True single phase clock dynamic logic	8	20

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08 EC 6351(C): DESIGNING WITH MICROCONTROLLERS

Credits: 3-0-0: 3

Pre-requisites: Nil **Year: 2015**

Course Objectives:

- To make students know about 8051 microcontrollers.
- To make students aware of various ARM processors

Syllabus:

18-Bit 8051 Microcontroller, 32- Bit ARM920T Processor Core Introduction, Programmers Model,Cache,memory management, ARM instruction set, ARM 9 microcontroller architecture

Course Outcome:

Students who successfully complete this course will be able to know about 18 bit microcontrollers and different ARM processors

TEXT BOOKS:

1. Intel Hand Book on "Embedded Microcontrollers", 1ST Edition
2. Muhammad Ali Mazidi, Janice GillispieMazidi, Rolin D. McKinlay, "The 8051 Microcontroller and Embedded Systems using Assembly and C", 2Nd Edition, Prentice Hall
3. ARM Company Ltd. "ARM Architecture Reference Manual– ARM DDI 0100E"
4. DavidSeal"ARMArchitectureReferenceManual",2001AddisonWesley,England; Morgan Kaufmann Publishers

REFERENCE BOOKS:

1. Ayala,KennethJ"8051Microcontroller-Architecture,Programming&Applications",1ST Edition, Penram International Publishing
2. Steve Furber, "ARM System-on-Chip Architecture", 2ND Edition, Pearson Education
3. Predko,Myke,"ProgrammingandCustomizingthe8051Microcontroller", 1st Edition, McGraw Hill International

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COURSE PLAN

08 EC 6351(C): DESIGNING WITH MICROCONTROLLERS (L-T-P : 3-0-0) CREDITS:3		
MODULE S	**Contact hours**	**Sem.Exam Marks;%**
MODULE 1: 18-Bit 8051 Microcontroller: Introduction to Embedded Systems.8-Bit Microcontrollers: A popular 8-bit Microcontroller (Intel 8051) is covered under this section Architecture: CPU Block diagram, Memory Organization, Program memory, Data Memory, Interrupts Peripherals: Timers, Serial Port, I/O Port Programming: Addressing Modes, Instruction Set, Programming Microcontroller based System Design: Timing Analysis, Case study with reference to 8-bit 8051 Microcontroller. A typical application design from requirement analysis through concept design, detailed hardware and software design using 8-bit 8051 Microcontrollers.	6	15
MODULE : 2 32- Bit ARM920T Processor Core Introduction:RISC/ARM Design Philosophy, About the ARM920T Core, Processor Functional Block Diagram Programmers Model: Data Types, Processor modes, Registers, General Purpose Registers, Program Status Register, CP15 Coprocessor, Memory and memory mapped I/O, Pipeline, Exceptions, Interrupts and Vector table, Architecture revisions, ARM Processor Families.Cache:Memory hierarchy and cache memory, Cache Architecture – Basic Architecture of a Cache, Basic operation of a cache controller, Cache and main memory relationship, Set Associativity Cache Policy – Write policy, Cache line replacement policies, allocation policy on a cache miss Instruction Cache, Data Cache, Write Buffer and Physical Address TAG RAM	6	15
FIRST INTERNAL TEST		
MODULE:3 Memory Management Units: How virtual memory works, Details of the ARM MMU, Page Tables, Translation Look-aside Buffer, Domains and Memory access permissions ARM Instruction Set: Data Processing instructions, Branch instructions, Load - Store instructions, Software Interrupt Instruction, Program Status Register Instruction, Loading Constants Thumb Instruction Set: Thumb register usage, ARM-Thumb interworking, Branch instruction, Data processing instructions, Load - store instructions, stack instructions, software interrupt instructions. Interrupt Handling: Interrupts, Assigning interrupts, Interrupt latency, IRQ & FIQ exceptions, Basic interrupt stack design and implementation, Non-nested Interrupt handle	6	15
MODULE : 4 ARM9 Microcontroller Architecture: A popular ARM9 Microcontroller from Atmel (AT91RM9200) is covered under this sectionAT91RM9200 Architecture: Block Diagram, Features, Memory Mapping Memory Controller (MC), Memory Controller Block Diagram, Address Decoder, External Memory Areas, Internal Memory Mapping	6	15
SECOND INTERNAL TEST		

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MODULE : 5 External Bus Interface (EBI), Organization of the External Bus Interface, EBI Connections to Memory Devices External Memory Interface, Write Access, Read Access, Wait State ManagementAT91RM9200PERIPHERALSInterrupt Controller: Normal Interrupt, Fast Interrupt, AIC System Timer (ST):Period Interval Timer (PIT), Watchdog Timer (WDT), Real time Timer (RTT)Real Time Clock (RTC), Parallel Input/output Controller (PIO)	7	20
MODULE : 6 AT91RM9200 PERIPHERALS: Universal Synchronous Asynchronous Receiver Transceiver (USART):Block Diagram, Functional Description, Synchronous and Asynchronous Modes Development& Debugging Tools for Microcontroller based Embedded Systems: Software and Hardware tools like Cross Assembler, Compiler, Debugger, Simulator, In-Circuit Emulator (ICE), Logic Analyzer etc. Brief Architecture of Power PC.	8	20

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Course Objectives

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SEMESTER 2

08 EC 6312 ANALOG VLSI DESIGN

Credits: 3-0-0: 3
Pre-requisites: Nil **Year: 2015**

Course Objectives:

- A foundation in the fundamentals of Analog VLSI Design;
- Ability to design of IC MOS Amplifiers and PLL
- An introduction to challenges facing in Analog IC Design;

Syllabus

Fundamental concepts and overview; Analog MOS Models ; Active and Passive device fabrication; Basics of single stage CMOS amplifiers; CMOS Differential Amplifiers; Design of single and two stage CMOS Op-amps ; High frequency Op-amps; Design of non-linear and wave shaping circuits ; Switched capacitor circuits; Design of DPLL and DLL; Basics of CMOS data converters.

Course Outcome:

Students who successfully complete this course will have demonstrated an ability to apply the fundamental concepts of Analog VLSI Design; ability to design IC MOS Amplifiers; ability to design DPLL which is used in various fields. Students will be familiarized with the challenges in Analog IC design.

Text Books: One or two text books only (if required)

1. "Analog Integrated Circuit Design", David. A. Johns and Ken Martin, John Wiley and Sons, 2001.
2. "Design of Analog CMOS Integrated Circuit", BehzadRazavi, Tata McGraw HILL, 2002.
3. "CMOS Analog Circuit Design", Philip Allen & Douglas Holberg, Oxford University Press, 2002.

References:

"AnalogVLSI – Signal Information andProcessing", Mohammed Ismail&Feiz, John Wiley and Sons.

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COURSE PLAN

08 EC 6312 ANALOG VLSI DESIGN (L-T-P : 3-0-0)CREDITS:3		
MODULE S	Contact hours	Sem.Exam Marks;%
MODULE : 1 Analog MOS transistor models Temperature effects and Noise in MOS transistor MOS resistors, characterization of resistive, capacitive elements and MOS devices	6	15
MODULE : 2 Passive and active CMOS current sink/ sources– basics of single stage CMOS amplifiers common Source, common gate and source follower stages frequency response.	6	15
FIRST INTERNAL TEST		
MODULE : 3 CMOS Differential Amplifiers: CMOS Operational Amplifiers one stage and two stage gain boosting Common mode feedback (CMFB) Cascode and Folded cascade Structures	6	15
MODULE : 4 High Performance Opamps – High speed/ high frequency opamps, micro power opamps, low noise opamps and low voltage opamps. Current mirrors, filter implementations	6	15
SECOND INTERNAL TEST		
MODULE : 5 Supply independent and temperature independent references Band gap references PTAT current generation and constant Gm biasing – CMOS comparators – Multipliers and wave shaping circuits – effects due to nonlinearity and mismatch in MOS circuits. Switched Capacitor Circuits: First and Second Order Switched Capacitor Circuits,	7	20
MODULE : 6 Switched Capacitor filters, CMOS oscillators, simple and charge pump CMOS PLLsnon ideal effects in PLLs, Delay locked loops and applications, basics of CMOS data converters – Medium and high speed CMOS data converters, Over samplingconverters.	8	20

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08 EC 6322 CAD OF VLSI CIRCUITS

Credits: 3-0-0: 3
Pre-requisites: Nil **Year: 2015**

Course Objectives:

- This objective is to provide the idea about various CAD tools front end back end design

Syllabus

Fundamental concepts and overview; Various CAD Tools for front end and Back end design, Introduction to VLSI Methodologies, Introduction to Design Tools, Layout Algorithms Circuit partitioning, Dataflow modeling

Course Outcome:

Students who successfully complete this course will have demonstrated an ability to apply the fundamental concepts of CAD of VLSI circuits.

Text Books:

1. N.A. Sherwani, " Algorithms for VLSI Physical Design Automation ", 1999.
2. S.H. Gerez, " Algorithms for VLSI Design Automation ", 1998.4. J. Bhasker, "A VHDL Primer", Addison-Weseley Longman Singapore Pte Ltd. 1992
3. Drechsler, R., *Evolutionary Algorithms for VLSI CAD*, Kluwer Academic Publishers, Boston, 1998.
4. Verilog HDL by Samir Palnitkar

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COURSE PLAN

08 EC 6322 CAD of VLSI Circuits(L-T-P : 3-0-0) CREDITS:3		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE : 1 Various CAD Tools for front end and Back end design, Schematic editors, Layout editors, Place and Route tools	6	15
MODULE : 2 Introduction to VLSI Methodologies - VLSI Physical Design Automation - Design and Fabrication of VLSI Devices - Fabriction process	6	15
FIRST INTERNAL TEST		
MODULE : 3 Introduction to Design Tools: Introduction & Familiarity with Design Tools from various vendors e.g. Synopsis, Mentor Tools etc. Verilog Basics - Modeling Levels - Data Types - Modules and Ports - Instances - Basic Language Concepts	6	15
MODULE : 4 Dataflow modelling – Behavioural modeling Modelling and Simulation of systems/subsystems using Verilog HDL. Typical case studies.	6	15
MODULE : 5 Layout Algorithms Circuit partitioning, placement, and routing algorithms; Design rule verification; Circuit Compaction; Circuit extraction and post-layout simulation	7	20
MODULE : 6 Automatic Test Program Generation; Combinational testing D-Algorithm and PODEM algorithm; Scan-based testing of sequential circuits; Testability measures for circuits.	8	20

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08 EC 6332 TESTING AND VERIFICATION OF VLSI CIRCUITS

Credits: 3-0-0: 3

Pre-requisites: Nil **Year: 2015**

Course Objectives:

- To study the issues in testing; understand the fundamentals of VLSI and system testing with fault models and simulation
- To explore the concept in boundary scan,BIST for logic and memories with simple intellectual property of core based design in SoC

Syllabus

Scope and issues in testing and verification of ic,s-introduction to test benches and verilog test bench code unity-various fault models-boundary scan-ATPG-BIST-simple IP's design for memory and core RISC CPU design

Course Outcome:

- Upon completion of the course with laboratory practice.
- Students will obtain the skill in writing test bench coding for combinational, sequential circuits
- Able to analyze and identify simple fault models to combinational and sequential circuits

Text Books:

1. M.Abramovici, M. A. Breuer, A. D. Friedman, "Digital Systems Testing and Testable Design" Piscataway, New Jersey: IEEE Press, 1994

2. M. Bushnell and V. D. Agarwal, "Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits", Kluwer Academic Publishers, 2000

3. T.Kropf, "Introduction to Formal Hardware Verification", Springer Verlag, 2000.

4. P. Rashinkar, Paterson and L. Singh, "System-on-a-Chip Verification-Methodology and Techniques", Kluwer Academic Publishers, 2001.

5. SamihaMourad and YervantZorian, "Principles of Testing Electronic Systems", Wiley (2000).

REFERENCES

1. "SoCVerification Methodology andTechniques", PrakashRashinkar Peter Patersonand Leena Singh .Kluwer Academic Publishers, 2001.

2. "Reuse Methodology manual for System On A Chip Designs", Michael Keating,

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COURSE PLAN

08 EC 6332 TESTING AND VERIFICATION OF VLSI CIRCUITS (L-T-P : 3-0-0) CREDITS:3		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE : 1 **Introduction**: Scope of testing and verification in VLSI design process; Issues in testand verification of complex chips, embedded cores and SOCs, Fault models	6	15
MODULE : 2 Test coding: Introduction to test benches, writing test benches in Verilog HDL.	6	15
FIRST INTERNAL TEST		
MODULE : 3 Fundamentals of VLSI testing, Automatic test pattern generation, Design for testability	6	15
MODULE : 4 Scan design: Test interface and boundary scan	6	15
MODULE : 5 System Testing and test for SOCs, Iddq testing, Delay fault testing, BIST for testing of logic and memories, Test automation.	7	20
MODULE : 6 Design Verification Techniques based on simulation, analytical and formal approaches, Functional verification, Timing verification, Formal verification, Basics of equivalence checking and model checking. Verification of simple IPs: Memory verification, FIFO verification and Verification of RISC CPU	8	20

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08 EC 6342(A)LOW POWER VLSI DESIGN

Credits: 3-0-0: 3

Pre-requisites: Nil **Year: 2015**

Course Objectives:

- skills to effectively apply analytical and simulation techniques for power analysis of CMOS VLSI
- Utilize probabilistic analysis

Syllabus

Probabilistic Power Analysis, Circuit –Transistor and Gate Sizing, Equivalent Pin Ordering, Advanced Techniques –Adiabatic Computation, Power Estimation - Synthesis for Low Power - Design and Test of Low Voltages - CMOS Circuits. Low Power Static RAM Architectures -Low Energy Computing

Course Outcome:

On successful completion of this subject, the student should be capable of

- Analyze the requirements of low power CMOS VLSI design
- Applying effective simulation techniques for power analysis
- Optimizing power at various levels of design abstraction
- Constructing low energy computing system

Text Books:

1. Gary Yeap" Practical Low Power Digital VLSI Design ", 1997.
2. Kaushik Roy, Sharat Prasad, " Low Power CMOS VLSI Circuit Design ", 20003.
   A.P.Chandrakasan and R.W. Broadersen, Low power digital CMOS design, Kluwer,1995

REFERENCE BOOKS:

1. CMOS Analog Circuit Design", Philip Allen & Douglas Holberg, Oxford University Press, 2002.

2. Rabaey, Pedram, "Low power design methodologies" Kluwer Academic, 1997

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COURSE PLAN

08 EC 6342(A)LOW POWER VLSI DESIGN (L-T-P : 3-0-0) CREDITS:3		
MODULE S	**Contact hours**	**Sem.Exam Marks;%**
MODULE : 1 Introduction –Charging and Discharging of Capacitance, Short Circuit Current in CMOS Circuits, CMOS Leakage Current, Static Current, Basic Principles of Low Power Design, Low Power Figure of Merits. Simulation Power Analysis-SPICE Circuit Simulation, Gate Level Logic Simulation, Architecture Level Analysis, Data Correlation Analysis, Monte Carlo Simulation.	6	15
MODULE:2 : Probabilistic Power Analysis- Random Logic Signals, Static Probability, Transition Density, Techniques of Power Analysis, Gate Level Power Analysis, Power Estimation using Entropy-Combinational logic systems, Sequential logic systems.	6	15
FIRST INTERNAL TEST		
Circuit –Transistor and Gate Sizing, Equivalent Pin Ordering, network Restructuring and Reorganization, Special Latches and Flip Flops, Low Power Digital Cell Library, Logic –Gate Reorganization, Signal Gating, Logic Encoding, State Machine Encoding, Pre-computation Logic. Special Techniques –Power Reduction in Clock Networks, CMOS Floating Node, Low Power Bus, Low Power Techniques for SRAM, Architecture and Systems-Power and Performance Management, Switching Activity Reduction, Parallel Architecture with Voltage Reduction.	6	15
MODULE : 4 Advanced Techniques –Adiabatic Computation, Pass Transistor Logic Synthesis, Asynchronous Circuits, Reversible Logic Circuits, Elimination of Garbage outputs	6	15
SECOND INTERNAL TEST		
MODULE : 5 Physics of Power Dissipation in CMOS FET Devices- MIS Structure, Energy band representations, Threshold Voltage, Surface Space Charge Region, Threshold Voltage, Depletion Region Analysis- Depth of Depletion Region, Inversion Layer thickness, Charge in Inversion Layer, Long Channel MOSFET- Body Effect, Sub-threshold Current, Sub-threshold Swing.	7	20

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MODULE : 6 Power Estimation - Synthesis for Low Power - Design and Test of Low Voltages - CMOS Circuits. Low Power Static RAM Architectures -Low Energy Computing UsingEnergy Recovery Techniques – Software Design for Low Power.	8	20

08 EC 6342(C)DESIGN OF DIGITAL SIGNAL PROCESSING

Credits: 3-0-0: 3

Pre-requisites: Nil **Year: 2015**

Course Objectives:

- To study detail in detail about digital signal processors
- Make a knowledge about current trends in digital signal processors

Syllabus

Digital signal processor, algorithms, applications and current trends in digital signal processors

Course Outcome:

On successful completion of this subject, the student should be capable of

- Analyze the Digital signal processors
- Analyze the applications and current trends

Text Books:

1. Digital Signal Processing Implementation Using the TMS320C6000 DSP Platform, 1st Edition; by: NaimDahnoun
2. DSP Applications using 'C' and the TMS320C6X DSK, 1st Edition; by: RulphChassaing
3. Digital Signal Processing: A System Design Approach, 1st Edition; by: David J Defatta J, Lucas Joseph G &Hodkiss William S; John Wiley
4. Digital Signal Processing with Field Programmable Gate Arrays: 2nd Edition, by: U. Meyer – Base, Springer
5. Real - Time Digital Signal Processing: Implementations, Applications, and Experiments with the TMS320C55X, Kuo, Sen M, Lee, Bob H, John Wiley & Sons Ltd.

REFERENCE BOOKS:

1. Digital Signal Processing, Third Edition, Sanjit K. Mitra, Tata McGRWA Hill
2. Digital Signal Processing – A Practical Guide for Engineers and Scientists, Steven W Smith, Elsevier

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COURSE PLAN

08 EC 6342(C) DESIGN OF DIGITAL SIGNAL PROCESSING (L-T-P : 3-0-0) CREDITS:3		
MODULE S	**Contact hours**	**Sem.Exam Marks;%**
MODULE : 1 **Digital Signal Processor:** TMS320C6713 or any other popular DSP from Texas Instruments is covered under this module Architecture: CPU Architecture, Internal Memory, CPU Data Paths control Programming: Instruction Set and Addressing Modes	6	15
MODULE : 2 Code Composer Studio, Code Generation Tools, Code Composer Studio Debug Tools DSP Peripherals: Multichannel Buffered Serial Port, Transmission & Reception Timers Memory of DSP: Internal Data/Program Memory External Memory Interface	6	15
FIRST INTERNAL TEST		
MODULE : 3 **Digital Signal Processing Algorithms:** Filter Design: FIR Digital filter design. Fourier Transform: DFT, FFT, Spectral Analysis,DTMF Speech Processing Algorithms	6	15
MODULE : 4 Real-time Implementation: Implementation of Real-time FIR Digital filter using DSP.Implementation of Real-time Fast Fourier Transform applications using the DSP Implementation of DTMF Tone Generation and Detection. Implementation of Speech processing applications	6	15
SECOND INTERNAL TEST		
MODULE :5 **Current trends in Digital Signal Processor:** FPGA Technology, DSP Technology Requirements, Design implementation, Multiply Accumulator (MAC) and Sum of Product (SOP), Implementation of Serial/Parallel Convolver using FPGAs,FPGA Based DSP System Design	7	20
MODULE : 6 FIR filters, FIR Theory, Designing FIR filters, Direct Window Design method, Constant Coefficient FIR Design, Direct FIR Design, Cooley-Tukey FFT Algorithm implementation using FPGA	8	20

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08 EC 6352(A) HIGH SPEED DIGITAL DESIGN

Credits: 3-0-0: 3
Pre-requisites: Nil **Year: 2015**

Course Objectives:

- To study detail in high speed digital circuits
- Power distribution and noise in high speed digital circuits

Syllabus

Introduction to high speed digital design, Power distribution and noise, Signalling convention and circuits, Timing convention and synchronizations

Course Outcome:

On successful completion of this subject, the student should be capable of

- Analyze the basic idea of high speed digital design
- Analyze the power distribution and noise

Text Books:

1. Howard Johnson and Martin Graham, "High Speed Digital Design: A Handbook of Black Magic",3rd Edition, (Prentice Hall Modern Semiconductor Design Series' Sub Series: PH Signal Integrity Library), 2006
2. Stephen H. Hall, Garrett W. Hall, and James A. McCall " System Design",Wiley , 2007
3. Kerry Bernstein, K.M. Carrig, Christopher M. Durham, and Patrick R. Hansen "High Speed CMOS Design Styles", Springer Wiley 2006
4. Ramesh Harjani "Design of High-Speed Communication Circuits (Selected Topics in Electronics and Systems)" World Scientific Publishing Company 2006

REFERENCE BOOKS:

1. William S. Dally & John W. Poulton; Digital Systems Engineering, Cambridge University Press, 1998
2. Masakazu Shoji; High Speed Digital Circuits, Addison Wesley Publishing Company, 1996
3. Jan M, Rabaey, et all; Digital Integrated Circuits: A Design perspective, Second Edition, 2003

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COURSE PLAN

08 EC 6352(A) HIGH SPEED DIGITAL DESIGN(L-T-P : 3-0-0) CREDITS:3		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE : 1 Frequency, time and distance - Capacitance and inductance effects - High seed properties of logic gates - Speed and power	6	15
MODULE : 2 Modelling of wires -Geometry and electrical properties of wires - Electrical models of wires - transmission lines - lossless LC transmission lines - lossy LRC transmission lines - special transmission lines	6	15
FIRST INTERNAL TEST		
MODULE : 3 Power supply network - local power regulation - IR drops - area bonding - onchip bypass capacitors - symbiotic bypass capacitors - power supply isolation	6	15
MODULE : 4 Noise sources in digital system - power supply noise - cross talk – inter symbol interference. **Signalling convention and circuits**-Signalling modes for transmission lines -signalling over lumped transmission media	6	15
SECOND INTERNAL TEST		
MODULE : 5 signalling over RC interconnect - driving lossy LC lines - simultaneous bi-directional signalling - terminations - transmitter and receiver circuits- **Timing convention and synchronisation**-Timing fundamentals - timing properties of clocked storage elements	7	20
MODULE : 6 signals and events -open loop timing level sensitive clocking - pipeline timing - closed loop timing - clock distribution - synchronization failure and meta stability - PLL and D LL based clock aligners	8	20

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08 EC 6352(B) SOC DESIGN AND VERIFICATION

Pre-requisites: Nil

Credits: 3-0-0: 3
Year: 2015

Course Objectives:

- To familiarize the design of SoC process using few techniques and verify the issues regarding that andalso todesign the communication architecture for SoC's
- Power distribution and noise in high speed digital circuits

Syllabus

Introduction to system on chip design process, Marco design process, SoC verification, Design of communication architecture of SoC's

Course Outcome:

On successful completion of this subject, the student should be capable of

- Analyze the SoC design process
- Analyze the design of communication architecture for SoC's

Text Books:

1. "SoC Verification Methodology and Techniques", Prakash Rashinkar Peter Paterson and Leena Singh. Kluwer Academic Publishers, 2001.

2. "Reuse Methodologymanualfor System On A ChipDesigns", MichaelKeating, Pierre Bricaud, Kluwer Academic Publishers, second edition,2001.

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COURSE PLAN

08 EC 6352(B) SOC DESIGN AND VERIFICATION (L-T-P : 3-0-0) CREDITS:3		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE 1 : **System On Chip Design Process:** A canonical SoC Design, SoC Design flow waterfall vs spiral, top down vs Bottom up. Specification requirement, Types of Specification	6	15
MODULE : 2 System Design process, System level design issues, Soft IP Vs Hard IP, Design for timing closure, Logic design issues Verification strategy, On chip buses and interfaces, Low Power, Manufacturing test strategies.	6	15
FIRST INTERNAL TEST		
MODULE:3 **Macro Design Process:** Top level Macro Design, Macro Integration, Soft Macro productization, Developing hard macros, Design issues for hard macros, Design, System Integration wit reusable macros.	6	15
MODULE : 4 **SoC Verification:** Verification technology options, Verification methodology, Verification languages, Verification approaches, and Verification plans.	6	15
SECOND INTERNAL TEST		
MODULE : 5 System level verification, Block level verification, Hardware/software co verification and Static net list verification. Verification architecture, Verification components, Introduction to VMM, OVM and UVM.	7	20
MODULE : 6 **Design of Communication Architectures For SoCs:** On chip communication architectures, System level analysis for designing communication, Design space exploration, Adaptive communication architectures, Communication architecture tuners, Communication architectures for energy/battery efficient systems. Introduction to bus functional models and bus functional model based verification.	8	20

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08 EC 6352(C) NANO ELECTRONICS

Credits: 3-0-0: 3

Pre-requisites: Nil **Year: 2015**

Course Objectives:

- To impart the idea of nano electronics technology in detail for the application of devices

Syllabus

Introduction to nano-electronics, Characterization, in organic semiconductor nanostructures, Fabrication techniques, physical processes. Methods of measuring properties structure, Applications

Course Outcome:

On successful completion of this subject, the student should be capable of

- Analyze the fundamentals of nano electronics
- Analyze the methods of measuring structures

Text Books:

1. Ed Robert Kelsall,IanHamley,MarkGeoghegan, " Nanoscale science and technology" ,John wiley and sons,2007.
2. Charles P Poole,Jr,Frank J owens, "Introduction to Nanotechnology",Johnwiley,copyright 2006,Reprint 2011.
3. Ed William A Goddard III,Donald W Brenner,SergeyEdwardLyshevski,Gerald J Lafrate, " Hand Book of Nanoscience Engineering and Technology" ,CRC press,2003

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COURSE PLAN

08 EC 6352(C) NANO ELECTRONICS(L-T-P : 3-0-0) CREDITS:3		
MODULE S	Contact hours	Sem.Exam Marks;%
MODULE : 1 **Introduction:** Overview of nano science and engineering. Development milestones in micro fabrication and electronic industry. Moores law and continued miniaturization., Classification of Nanostructures, Electronic properties of atoms and solids: Isolated atom, Bonding between atoms, Giant molecular solids, Free electron models and energy bands, crystalline solids, Periodicity of crystal lattices, Electronic conduction, effects of nano meter length scale, Fabrication methods: Top down processes, Bottom up processes methods for templating the growth of nano materials, ordering of nano systems.	6	15
MODULE : 2 **Characterization**: Classification, Microscopic techniques, Field ion microscopy, scanning probe techniques, diffraction techniques: bulk, surface, spectroscopy techniques: photon, radiofrequency, electron, surface analysis and dept profiling: electron, mass, Ion beam, Reflectrometry, Techniques for property measurement: mechanical, electron, magnetic, thermal properties	6	15
FIRST INTERNAL TEST		
MODULE : 3 .**Inorganic semiconductor nanostructures**: overview of semiconductor physics. Quantum confinement in semiconductor nanostructures: quantum wells, quantum wires, quantum dots, super-lattices, band offsets, electronic density of states.	6	15
MODULE : 4 **Fabrication techniques**: requirements of ideal semiconductor, epitaxial growth of quantum wells, lithography and etching, cleaved edge over growth, growth of vicinal substrates, strain induced dots and wires, electro statically induced dots and wires, Quantum well width fluctuations, thermally annealed quantum wells, semiconductor nano crystals, collidal quantum dots, self- assembly techniques.	6	15
SECOND INTERNAL TEST		
MODULE : 5 **Physical processes:** modulation doping, quantum hall effect, resonant tunneling, charging effects, ballistic carrier transport, Inter band absorption, intra band absorption, Light emission processes, phonon bottleneck, quantum confined stark effect, nonlinear effects, coherence and dephasing, characterization of semiconductor nanostructures: optical electrical and structural **Methods of measuring properties:structure:**atomic,crystallography,microscopy,spectroscopy. Properties of	7	20

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nanoparticles: metal nano clusters, semiconducting nano particles, rare gas and molecular clusters, methods of synthesis(RF, chemical, thermolysis, pulsed laser methods)		
MODULE : 6 Carbon nanostructures and its applications(field emission and shielding, computers, fuel cells, sensors, catalysis).Self assembling nanostructure molecular materials and devices: building blocks, principles of self assembly, methods to prepare and pattern nanoparticles, template nanostructures, liquid crystal meso phases. Nanomagnetic materials and devices: magnetism, materials, magneto resistance, nanomagnetism in technology, challenges facing nanomagnetism.**Applications**: Injection lasers, quantum cascade lasers, single photon sources, biological tagging, optical memories, coulomb blockade devices, photonic structures, QWIP's, NEMS, MEMS.	**8**	**20**

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THIRD SEMESTER

08 EC 7313(A)FPGA ARCHITECTURE AND APPLICATIONS

Credits: 3-0-0: 3

Pre-requisites: Nil **Year: 2015**

Course Objectives:

- To impart the idea of programmable logic devices,FPGA's,FSM
- It also give the idea about system level design

Syllabus

Overview of programmable logic devices,FPGA'S,finite state machines,architectures,petrinets,system level design,EDAtool.Casestudies,design consideration using FPGA parallel adder cell

Course Outcome:

On successful completion of this subject, the student should be capable of

- Understanding about Programmable logic devices
- Understanding about system level design

Text Books:

1. Field Programmable Gate Array Technology - S. Trimberger, Edr, 1994, Kluwer Academic Publications.
2. Engineering Digital Design - RICHARD F.TINDER, 2nd Edition, Academic press.
3. Fundamentals of logic design-Charles H. Roth, 4th Edition Jaico Publishing House.

REFERENCE BOOKS:

1. Digital Design Using Field Programmable Gate Array, P.K. Chan & S. Mourad, 1994, Prentice Hall.
2. Field programmable gate array, S. Brown, R.J. Francis, J. Rose, Z.G. Vranesic, 2007, BS

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COURSE PLAN

08 EC 7313(A): FPGA ARCHITECTURE AND APPLICATIONS (L-T-P : 3-0-0) CREDITS:3		
MODULE S	**Contact hours**	**Sem.Exam Marks;%**
MODULE : 1 Programmable logic Devices: ROM, PLA, PAL, CPLD, FPGA Features, Architectures and Programming. Applications and Implementation of MSI circuits using Programmable logic Devices.	6	15
MODULE : 2 FPGAs: Field Programmable Gate Arrays- Logic blocks, routing architecture, design flow, technology mapping for FPGAs, Case studies Xilinx XC4000 & ALTERA's FLEX 8000/10000 FPGAs	6	15
FIRST INTERNAL TEST		
MODULE : 3 Introduction to advanced FPGAs: Xilinx Virtex and ALTERA Stratix. Finite State Machines (FSM): Top Down Design, State Transition Table, State assignments for FPGAs	6	15
MODULE : 4 Realization of state machine charts using PAL, Alternative realization for state machine charts using microprogramming, linked state machine, encoded state machine	6	15
SECOND INTERNAL TEST		
MODULE : 5 FSM Architectures: Architectures Centered around non registered PLDs, Design of state machines centered around shift registers, One_Hot state machine, Petrinets for state machines-Basic concepts and properties, Finite State Machine-Case study.	7	20
MODULE : 6 System Level Design: Controller, data path designing, Functional partition, Digital front end digital design tools for FPGAs. System level design using mentor graphics/Xilinx EDA tool (FPGA Advantage/Xilinx ISE), Design flow using FPGAs. Case studies: Design considerations using FPGAs of parallel adder cell, parallel adder sequential circuits, counters, multiplexers, parallel controllers.	8	20

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08 EC 7313(B)MIXED SIGNAL SYSTEM DESIGN

Credits: 3-0-0: 3
Pre-requisites: Nil **Year: 2015**

Course Objectives:

- To fundamentals concept about PN junction, bipolar devices etc
- It also give the idea about Digital and analog sub circuits

Syllabus

Introduction about basic active components, digital sub circuits, analog sub circuits, Data converters: DAC, ADC, oversampling data converters

Course Outcome:

On successful completion of this subject, the student should be capable of

- Analyze the Programmable logic devices
- Analyze the system level design

Text Books:

1. Gray Paul R, Meyer, Robert G, Analysis and Design of Analog Integrated Circuits, 3rd edition, John Wiley & Sons.
2. Jacob Baker, "CMOS Mixed-Signal circuit design", A John Willy & Sons, inc., publications, 2003.
3. Professor Bernhard Boser -"Analysis and Design of VLSI Analog-Digital Interface Integrated Circuits" "Addison Wisely publications"(1991).

REFERENCE BOOKS:

1. D A John, Ken Martin, Analog Integrated Circuit Design, 1st Edition, John Wiley
2. CMOS Analog Circuit Design, 2nd edition; by: Allen, Phillip E, Holberg , Douglas R, Oxford University Press, (Indian Edition
3. Ken Martin, Digital Integrated Circuit Design, John Wiley

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COURSE PLAN

08 EC 7313(B): MIXED SIGNAL SYSTEM DESIGN (L-T-P : 3-0-0) CREDITS:3		
MODULE S	**Contact hours**	**Sem.Exam Marks;%**
MODULE : 1 **Introduction:**PN Junctions, Bipolar Vs Unipolar Devices, MOS Transistor operation, MOS Transistor as a Switch, NMOS ,PMOS and CMOS Switches, CMOS Inverter AC and DC Characteristics, Analog Signal Processing, Example of Analog Mixed Signal Circuit Design	6	15
MODULE : 2 Example of Analog Mixed Signal Circuit Design **Digital Sub Circuits:** CMOS Logic implementation basics- Logic gates and Flip flops –Transmission Gates, TG based implementation of multiplexers, de-multiplexers.	6	15
FIRST INTERNAL TEST		
MODULE : 3 Encoders, decoders. Digital Circuits like ALU, Comparator, Parity generator, Timer, PWM,SRAM and DRAM, CAM, **Analog Sub circuits:** Ideal Operational Amplifier	6	15
MODULE : 4 Inverting and Non-inverting configuration Differential amplifier basics .VCO, PLL, Comparator characteristics, two stage open loop comparator	6	15
SECOND INTERNAL TEST		
MODULE : 5 Switched capacitor fundamentals, Switched capacitor amplifier **Data Converters: DAC** : Static &Dynamic Charatersitics,1 Bit DAC, String DAC, Fully Decoded DAC,PWM DAC, Current scaling, voltage scaling DACs	7	20
MODULE : 6 **ADC** : Static &Dynamic Characteristics, Nyquist Criteria , Sample & Hold Circuit, Quantization error, Concept of over sampling, Counting ADC, Tracking ADC, Successive approximation ADC, Flash ADC, Dual Slope ADC **Over sampling Data Converters** : Over sampling fundamentals, Delta –Sigma Converter basics,∑ Modulator	8	20

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08 EC 7323(A) SYSTEM VERILOG

Credits: 3-0-0: 3

Pre-requisites: Nil **Year: 2015**

Course Objectives:

- To impart the basics of introduction to functional verification languages
- Make a idea about object oriented programming

Syllabus

Introduction to functional verification languages, classes and objects ,inheritance, system verilog assertion, Basics of properties and sequences, coverage driven verification and functional coverage in SV

Course Outcome:

On successful completion of this subject, the student should be capable of

- Applying functional verification languages
- Applying the idea about system verilog

Text Books:

1. "System Verilog for Design" : A Guide to Using System Verilog for Hardware Design and Modeling Sutherland, Stuart, David mann, Simon, Flake, Peter2nd ed., 2006

2. "SystemVerilogforVerification": AGuideto LearningtheTestbench Language Features, Chris Spear, 2006

3. "Hardware Verification with System Verilog": An Object-Oriented Framework Mintz, Mike, Ekendahl, Robert 2007

REFERENCE BOOKS:

1. "Writing Test benches using System Verilog" Bergeron, Janick 2006,

2. "A Practical Guide for System Verilog Assertions" Meyyappan Ramanathan

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COURSE PLAN

08 EC 7323(A) SYSTEM VERILOG (L-T-P : 3-0-0) CREDITS:3		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE : 1 Introduction to functional verification languages, Introduction to System Verilog, System Verilog data types	6	15
MODULE : 2 System Verilog procedures, Interfaces and modports, System Verilog routines.	6	15
FIRST INTERNAL TEST		
MODULE : 3 Introduction to object oriented programming, Classes and Objects, Inheritance, Composition, Inheritance v/s composition,	6	15
MODULE : 4 Virtual methods. Parameterized classes, Virtual interface, Using OOP for verification, System Verilog Verification Constructs	6	15
SECOND INTERNAL TEST		
MODULE : 5 System Verilog Assertions: Introduction to assertion, Overview of properties and assertion, Basics of properties and sequences, Advanced properties and sequences, Assertions in design and formal verification, some guidelines in assertion writing.	7	20
MODULE : 6 Coverage Driven Verification and functional coverage in SV: Coverage Driven Verification, Coverage Metrics, Code Coverage, Introduction to functional coverage, Functional coverage constructs, Assertion Coverage, Coverage measurement, Coverage Analysis SV and C interfacing: Direct Programming Interface (DPI)	8	20

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08 EC 7323(C) VLSI SIGNAL PROCESSING

Credits: 3-0-0: 3

Pre-requisites: Nil **Year: 2015**

Course Objectives:

- To impart the fundamentals and overview of DSP concepts
- It give the description about of digital filters

Syllabus

An overview of DSP concepts, Algorithm for fast convolution, Pipeline interleaving in digital filters,State variable description of digital filters

Course Outcome:

On successful completion of this subject, the student should be capable of

- Analyze the DSP
- Applying the idea of digital filters

Text Books:

1. K.K. Parhi, VLSI Digital Signal Processing Systems, John-Wiley, 1999.
2. Pirsch, P., Architectures for Digital Signal Processing, Wiley, 1999.

REFERENCE BOOKS:

1. S. Allworth, "Introduction to Real-time Software Design", Springer-Verlag, 1984.
2. C. M. Krishna, K. Shin, "Real-time Systems", Mc-Graw Hill, 1997
3. Peter Marwedel, G. Goosens, "Code Generation for Embedded Processors", Kluwer Academic Publishers, 1995.

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COURSE PLAN

08 EC 7323(B) VLSI SIGNAL PROCESSING(L-T-P : 3-0-0) CREDITS:3		
MODULE S	**Contact hours**	**Sem.Exam Marks;%**
MODULE : 1 An overview of DSP concepts-Linear system theory- DFT, FFT- realization of digital filters- Typical DSP algorithms- DSP applications	6	15
MODULE : 2 Data flow graph representation of DSP algorithm.- Loop bound and iteration bound Retiming and its applications.	6	15
FIRST INTERNAL TEST		
MODULE : 3 Algorithms for fast convolution- Algorithmic strength reduction in filters and transforms- DCT and inverse DCT- Parallel FIR filters	6	15
MODULE : 4 Pipelining of FIR filters- Parallel processing- Pipelining and parallel processing for low power. Pipeline interleaving in digital filters	6	15
SECOND INTERNAL TEST		
MODULE : 5 Pipelining and parallel processing for IIR filters-Low power IIR filter design using pipelining and parallel processing- Pipelined adaptive digital filters.	7	20
MODULE : 6 State variable description of digital filters- Round off noise computation using state variable description- Scaling using slow-down, retiming and pipelining.	8	20

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Electrical and Electronics Engineering

Course No.	Course Name	L-T-P -Credits	Year of Introduction
EE201	CIRCUITS AND NETWORKS	3-1-0-4	2016

Prerequisite: Nil

Course Objectives:

To learn about various techniques available to solve various types of circuits and networks

To gain the capability to synthesize a circuit for a particular purpose.

Syllabus AC Circuit Analysis(Steady State AC Analysis), Network topology, Transient analysis,

Laplace transform– properties , Transformed circuits, Two port networks, Symmetrical two port reactive networks as filters, Network functions, Network Synthesis

Expected outcome.

Ability to solve any DC and AC circuits

Ability to apply graph theory in solving networks

Ability to apply Laplace Transform to find transient response

Ability to synthesize networks

Text Book:

1. Hayt and Kemmerly :Engineering Circuit Analysis, 8e, Mc Graw Hill Education , New Delhi,2013.
2. Sudhakar and Shyam Mohan- Circuits and Networks: Analysis and Synthesis, 5e, Mc Graw HillEducation,

Data Book (Approved for use in the examination): Nil

References:

1. Siskand C.S : Electrical Circuits ,McGrawHill
2. Joseph. A. Edminister: Theory and problems of Electric circuits,TMH
3. D Roy Chaudhuri: Networks and Systems, New AgePublishers
4. A . Chakrabarti : Circuit Theory (Analysis and Synthesis),Dhanpat Rai&Co
5. Valkenberg : Network Analysis ,Prentice Hall ofIndia
6. B.R. Gupta: Network Systems and Analysis, S.Chand & Companyltd

Course Plan

Module	Contents	Hours	End Sem. Exam Marks
I	Network theorems – Superposition theorem – Thevenin's theorem – Norton's theorem – Reciprocity Theorem – Maximum power transfer theorem – dc and ac steady state analysis – dependent and independent sources	9 hours	15%
II	Network topology – graph, tree, incidence matrix – properties of incidence matrix – fundamental cut sets – cut set matrix – tie sets – fundamental tie sets – tie set matrix – relationships among incidence matrix, cut set matrix & tie set matrix – Kirchoff's laws in terms of network topological matrices – formulation and solution of network equations using topological methods	9 hours	15%

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FIRST INTERNAL EXAMINATION			
III	Steady state and transient response – DC response & sinusoidal response of RL, RC and RLC series circuits	**9hours**	15%
IV	Application of Laplace transform in transient analysis – RL, RC and RLC circuits (Series and Parallel circuits) – step and sinusoidal response Transformed circuits – coupled circuits - dot convention - transform impedance/admittance of RLC circuits with mutual coupling – mesh analysis and node analysis of transformed circuits – solution of transformed circuits including mutually coupled circuits ins-domain	**10 hours**	15%
SECOND INTERNAL EXAMINATION			
V	Two port networks – Z, Y , h, T parameters – relationship between parameter sets – condition for symmetry & reciprocity – interconnections of two port networks – driving point and transfer immittance – T-π transformation.	**9hours**	20%
VI	Network functions–Network synthesis-positive real functions and Hurwitz polynomial-synthesis of one port network with two kinds of elements-Foster form I&II-Cauer form I&II.	**8hours**	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN (End semester exam)

Part A: 8 questions.

One question from each module of Module I - IV; and two each from Module V & VI. Student has to answer all questions. (8 x5)=40

Part B: 3 questions uniformly covering modules I&II

Student has to answer any 2 questions: (2 x 10)=20

Part C: 3 questions uniformly covering modules III&IV

Student has to answer any 2 questions: (2 x 10)=20

Part D: 3 questions uniformly covering modules V&VI

Student has to answer any 2 questions: (2 x 10) =20

Note: Each question can have maximum of 4 sub questions, if needed.

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Course No.	Course Name	L-T-P -Credits	Year of Introduction
EE203	ANALOG ELECTRONICS CIRCUITS	3-1-0-4	2016

Prerequisite : Nil

Course Objectives

- To impart an in depth knowledge in electronic semiconductor devices & circuits giving importance to the various aspects of design &analysis.
- To provide knowledge about different types amplifier & oscillator circuits and their design.
- To provide a thorough understanding of the operational amplifier circuits and their functions.

Prerequisites: Nil

Syllabus Diode clipping and clamping circuits and Zener voltage regulators, BJT biasing, AC Equivalent Circuit of BJT and CE amplifier analysis, Biasing of JFET and MOSFET, Frequency response of BJT and FET amplifiers, Power amplifiers using BJT, Feedback amplifiers &Oscillator Circuits

Operational Amplifier basics and OP-AMP Circuits, Wave form generation using Op-Amp, Multivibrators using Timer IC 555.

Expected outcome: Upon successful completion of the course the students will be able to

1. Design biasing scheme for transistorcircuits
2. Model BJT and FET amplifiercircuits
3. Choose a power amplifier with appropriate specifications for electronic circuitapplications
4. Design & analyse oscillator circuits using BJT
5. Choose Operational amplifier(OPAMP) for specific applications includingwaveform generation.
6. Design & implement analog circuits using OPAMPs

Text Book:

1. Malvino A. and D. J. Bates, Electronic Principles 7/e, Tata McGraw Hill,2010.
2. Boylestad R. L. and L. Nashelsky, Electronic Devices and Circuit Theory, 10/e,Pearson Education India,2009.
3. Choudhury R., Linear Integrated Circuits, New Age International Publishers.2008.

Data Book (Approved for use in the examination): Nil

References:

1. Floyd T. L., Fundamentals of Analog Circuits,, Pearson Education,2012.
2. Robert T. Paynterand John Clemons, Paynter's Introductory electronic devices &circuits, Prentice Hall Career & Technology, NewJersey.
3. Bell D. A., Electronic Devices and Circuits, Prentice Hall of India,2007.
4. Millman J. and C. C. Halkias, Integrated Electronics: Analog and Digital Circuits and Systems, Tata McGraw-Hill,2010.
5. Streetman B. G. and S. Banerjee, Solid State Electronic Devices, Pearson Education Asia, 2006.
6. Gayakward R. A., Op-Amps and Linear Integrated Circuits, PHI Learning Pvt. Ltd.,2012.

Course Plan			
Module	**Contents**	**Hours**	**Sem.ExamMarks**
I	**Diode Circuits**: Diode clipping circuits - Single level and two level clippers - Clamping circuits – Design of Zener Voltage Regulators. **Bipolar Junction Transistors** : Review of BJT characteristics- Operating point of a BJT – Factors affecting stability of Q point and DC Biasing – Biasing circuits: fixed bias, collector to base bias, voltage division bias and self bias. (Derivation of stability factors for Voltage Divider Biasing only) –Bias compensation using diode and thermistor. Low frequency equivalent circuit of BJT. Common Emitter amplifier - AC Equivalent Circuit – Role of coupling and emitter bypass capacitors – h parameter model of BJT -Amplifier gains and impedances calculations using h equivalentcircuit.	9 hours	15%
II	**Field Effect Transistors** : Review of JFET and MOSFET construction, working and characteristics- Biasing a JFET and MOSFET using voltage divider bias— CS and CD amplifiers – small signal models-FET as switch and voltage controlledresistance. **Frequency response of Amplifiers** : Miller's Theorem- BJT Internal Capacitances at high frequency operations- High frequency analysis of CE Amplifier using hybrid Pi Model -Low Frequency Response of Common Emitter amplifier — CE High frequency response-Gain bandwidth product- ——Low and High Frequency response of FET amplifiers	9 hours	15%
FIRST INTERNAL EXAMINATION			
III	**Multistage amplifiers** : Direct, RC, transformer coupled amplifiers – **Power amplifiers using BJT** : Class A, Class B and Class AB and class C- Conversion efficiency and distortion in power amplifiers. **Feedback Amplifiers-** Effect of positive and negative feedbacks- Basic feedback topologies and their properties	**8 hours**	15%
IV	**Oscillators** : Bark Hausen's criterion – RC oscillators (RC Phase shift oscillator and Wein Bridge oscillator) –LC oscillators (Hartley and Colpitt's)- Derivation of frequency of oscillation for the above mentioned oscillators- Crystal oscillator.	**8 hours**	15%

	Operational Amplifiers: Review of Operational Amplifier basics - Analysis of fundamental differential amplifier- Properties of ideal and practical Op-Amp - Gain, CMRR and Slew rate of IC 741 and LM 301– Drift and frequency compensation in OP Amps- Open loop and Closed loop Configurations-Concept of virtual short and its relation to negativefeedback		
	SECOND INTERNAL EXAMINATION		
V	**OP-AMP Circuits** : Review of inverting and non-inverting amplifier circuits- Summing and difference amplifiers, Differentiator and Integrator circuits-Logarithmic amplifier- Half Wave Precision rectifier - Instrumentation amplifier. Comparators: Zero crossing and voltage level detectors, Schmitt trigger.	8hours	20%
VI	**Wave form generation using Op-Amps**: Square, triangular and ramp generator circuits using Op-Amp - Effect of slew rate on waveform generation. **Timer 555 IC** : Internal diagram of 555 IC– Astable and Monostable multivibrators using 555 IC. **Oscillator circuits using Op-amps** : RC Phase shift oscillator, Wein Bridge oscillator, LC Oscillators- (Derivation not required) - Crystal oscillator.	8 hours	20%
	END SEMESTER EXAM		

QUESTION PAPER PATTERN (End semester exam)

Part A: 8 questions.

One question from each module of Module I - IV; and two each from Module V & VI.
Student has to answer all questions. (8 x5)=40

Part B: 3 questions uniformly covering modules I&II

Student has to answer any 2 questions: (2 x 10)=20

Part C: 3 questions uniformly covering modules III&IV

Student has to answer any 2 questions: (2 x 10)=20

Part D: 3 questions uniformly covering modules V&VI

Student has to answer any 2 questions: (2 x 10) =20

Note: Each question can have maximum of 4 sub questions, if needed.

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Course No.	Course Name	L-T-P -Credits	Year of Introduction
EE205	**DC MACHINES AND TRANSFORMERS**	**3-1-0-4**	**2016**

Prerequisite : Nil

Course Objectives

To give exposure to the students about the concepts of direct current machines and transformers, including their constructional details, principle of operation and performance analysis.

Syllabus:

Electromagnetic principles for Machines, electrodynamic equations and their solution, Magnetic Circuits for Machines, construction of DC machines, DC generators, DC motor, Transformers - single phase and three phase, Construction of single phase and three phase transformers, losses and efficiency, equivalent circuit, testing. Transformerconnections.

Expected outcome.

After the successful completion of this course, the students will be able to

1. identify dc generator types, and appreciate theirperformance
2. describe the principle of operation of dc motor and select appropriate motor types for differentapplications.
3. analyse the performance of different types of dcmotors
4. describe the principle of operation of single phasetransformers
5. analyse the performance of single phasetransformers
6. familiarize with the principle of operation and performance of three phaseransformers.

Text Book

1. Bimbra P. S., *Electrical Machinery*, 7/e, Khanna Publishers,2011.
2. Nagrath J. and D. P. Kothari, *Theory of AC Machines*, Tata McGraw Hill, 2006.

ReferenceBooks

1. Fitzgerald A. E., C. Kingsley and S. Umans, *Electric Machinery*, 5/e, McGraw Hill,1990.
2. Langsdorf M. N., *Theory of Alternating Current Machinery*, Tata McGraw Hill,2001.
3. Abhijith Chakrabarti, Sudipta Debnath, Electrical Machines, McGraw Hill Education,New Delhi2015.
4. Deshpande M. V., *Electrical Machines*, Prentice Hall India, New Delhi,2011.
5. Theodore Wilde, *Electrical Machines, Drives and Power System*, Pearson Ed. Asia2001.

Data Book (Approved for use in the examination): Nil

Course Plan

Module	Contents	Hours	Semester Exam Marks
I	Electromagnetic principles for Machines Electro dynamical equations and their solution – rotational motion system – mutually coupled coils – construction of DC machines – energy conversion in rotating electrical machines – eddy currents and eddy current losses – flux distribution curve in the airgap – armature windings – lap and wave windings – selection criteria – equalizer rings – dummy coils.	9 hours	15%
II	DC generators – EMF equation – methods of excitation – separately and self excited – shunt, series, compound – armature reaction – effects of armature reaction – demagnetizing & cross magnetizing ampere-turns – compensating windings – interpoles – commutation –methods to improve commutation – voltage build-up – no load	9 hours	15%

	characteristics – load characteristics – losses and efficiency – power flow diagram – parallel operation – applications of dc generators.		
FIRST INTERNAL EXAMINATION			
III	DC motor – principle of operation – back emf – classification – torque equation – losses and efficiency – power flow diagram – performance characteristics of shunt, series and compound motors – starting of dc motors – necessity and types of starters – speed control – methods of speed control – testing – Swinburne's test – Hopkinson's test – separation of losses – retardation test – applications of dcmotors.	9 hours	15%
IV	Transformers – principle of operation – types and construction, core type and shell type construction, dry type transformers, cooling of transformers – ideal transformer – transformation ratio – dot convention – polarity test – practical transformer–kVArating–equivalentcircuit–phasor diagram.	9 hours	15%
SECOND INTERNAL EXAMINATION			
V	Transformer losses and efficiency – voltage regulation – OC & SC test – Sumpner's test – all day efficiency Autotransformer – saving of copper – current rating and kVA rating of autotransformers, parallel operation of single phase transformers, necessary and desirable conditions ofparallel operation, on load and off load tap changers.	9 hours	20%
VI	3-phase transformer – 3-phase transformer connections – Δ-Δ, Y-Y , Δ-Y , Y-Δ, V-V – vector groupings Yy0, Dd0, Yd1, Yd11, Dy1, Dy11 – Scott connection – three winding transformer – tertiary winding – percentage and per unit impedance – parallel operation of three phase transformers.	9 hours	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN (End semester exam)

Part A: 8 questions.

One question from each module of Module I - IV; and two each from Module V & VI.
Student has to answer all questions. (8 x5)=40

Part B: 3 questions uniformly covering modules I&II
Student has to answer any 2 questions: (2 x 10)=20

Part C: 3 questions uniformly covering modules III&IV
Student has to answer any 2 questions: (2 x 10)=20

Part D: 3 questions uniformly covering modules V&VI
Student has to answer any 2 questions: (2 x 10) =20

Note: Each question can have maximum of 4 sub questions, if needed.

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Course No.	Course Name	L-T-P -Credits	Year of Introduction
EE207	COMPUTER PROGRAMMING	2-1-0-3	2016

Course Objectives

To impart knowledge about programming in C

To learn basics of PYTHON.

Syllabus Introduction to Programming, Basic elements of C, Control statements in C, Arrays and Strings, Functions, Storage classes ,Structures and Pointers, File Management in C, Introduction to Python

Expected outcome. 1. Ability to design programs using C language
2. Ability to develop simple programs using Python

Text Book:1)E. Balaguruswamy, *Programming in ANSI C*, Tata McGraw Hill, New Delhi
2) John V Guttag, Introduction to Computation and programming using Python, PHI Learning, New Delhi.

Data Book (Approved for use in the examination): Nil

References:

1. P. Norton, *Peter Norton's Introduction to Computers*, Tata McGraw Hill, NewDelhi
2. Byron S. Gottfried, Programming with C, Schaun Outlines –McGrawHill.
3. Ashok Kamthane, Programming with ANSI & Turbo C- Pearsoneducation
4. K.R Venugopal and S.R Prasad, Mastering C - Tata McGrawHill
5. Kelley, Al & Pohl, *A Book on C- Programming in C*, 4th Ed,, PearsonEducation

Course Plan

Module	Contents	Hours	Sem.ExamMarks
I	**Introduction to Programming**: Machine language, assembly language, and high level language. Compilers and assemblers. Flow chart and algorithm – Development of algorithms for simpleproblems. **Basic elements of C:** Structure of C program –Keywords, Identifiers, data types, Operators and expressions – Input and Output functions	5hours	15%
II	**Control statements in C:** *if, if-else, while, do-while and for statements, switch, break, continue, go to, and labels. Programming examples.*	7 hours	15%
FIRST INTERNAL EXAMINATION			
III	**Arrays and Strings**: Declaration, initialisation, processing arrays and strings– two dimensional and multidimensional arrays –application of arrays. Example programs.	7 hours	15%
IV	**Functions :** Functions – declaring, defining, and accessing functions –parameter passing methods – – passing arrays to functions , Recursion . **Storage classes** – extern, auto, register and static. Example programs.	7 hours	15%
SECOND INTERNAL EXAMINATION			

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V	**Structures** – declaration, definition and initialization of structures, unions **Pointers**: Concepts, declaration, initialization of pointer variables, Accessing a Variable through its Pointer Chain of Pointers, Pointer Expressions, Pointer Increments and Scale Factor, Pointers and Arrays, examples	**8 hours**	20%
VI	**File Management** – File operations, Input/Output Operations on Files, Random Access to Files ,File pointer. **Introduction to Python** :Basic Syntax, Operators, control statements, functions-examples.	**8hours**	20%
	END SEMESTER EXAM		

QUESTION PAPER PATTERN (End semester exam)

Part A: 8 questions.

One question from each module of Module I - IV; and two each from Module V & VI. Student has to answer all questions. (8 x5)=40

Part B: 3 questions uniformly covering modules I&II

Student has to answer any 2 questions: (2 x 10)=20

Part C: 3 questions uniformly covering modules III&IV

Student has to answer any 2 questions: (2 x 10)=20

Part D: 3 questions uniformly covering modules V&VI

Student has to answer any 2 questions: (2 x 10) =20

Note: Each question can have maximum of 4 sub questions, if needed.

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Course code	Course Name	L-T-P - Credits	Year of Introduction
EE301	POWER GENERATION, TRANSMISSION AND PROTECTION	3-1-0-4	2016

Prerequisite : Nil

Course Objectives

- To set a foundation on the fundamental concepts of Power System Generation,Transmission, Distribution and Protection.

Syllabus

Power Generation-conventional-hydrothermal, nuclear - non conventional solar and wind-economics of power generation-Power factor Improvement-Power transmission -line parameters -resistance- inductance and capacitance- Transmission line modelling- classifications -short line, medium line, long line-transmission line as two port network-parameters- derivation -Overhead lines- types of conductors-volume of conductors- Kelvin's law- Types of Towers-calculation of Sag and tension-
Insulators- types -corona-underground cables-H V DC transmission-Flexible A C transmission-
-need for protection-circuit breakers-protective relay types -Types of protection causes of over voltages -insulation coordination – Power Distribution system

Expected outcome .

The students will be able to

i. Know the basic aspects in the area of power generation, transmission, distribution and protection.

ii. Design power factor correction equipment, transmission line parameters, and decide upon the various protection schemes to be adopted in various cases.

Text Books:

1. D P Kothari and I Nagrath, "Power System Engineering," 2/e Tata McGraw Hills, 2008
2. Wadhwa, "Electrical Power system", Wiley Eastern Ltd. 2005

References:

1. A.Chakrabarti, ML.Soni, P.V.Gupta, V.S.Bhatnagar, "A text book of Power system Engineering" Dhanpat Rai, 2000
2. Grainer J.J, Stevenson W.D, "Power system Analysis", McGraw Hill
3. I.J.Nagarath & D.P. Kothari, "Power System Engineering", TMH Publication,
4. K.R Padiyar," FACTS Controllers for Transmission and Distribution" New Age International, New Delhi
5. Stevenson Jr. Elements of Power System Analysis, TMH
6. Sunil S Rao ,"Switch gear and Protection",Khanna Publishers

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	**Introduction: Typical layout of Power system Network** **Generation of Electric Power:** Overview of conventional (Hydro, Thermal and Nuclear) and Nonconventional Sources (Solar and Wind) (Block Diagram and Brief Description Only) **Economics of Generation:** Load factor, diversity factor, Load curve (Brief description only) Numerical Problems. Methods of power factor improvement using capacitors	9	15%
II	**Power Transmission** **Transmission Line Parameters:** Resistance, inductance and capacitance of 1-Φ, 2 wire lines-composite conductors	10	15%

	(Derivation Required). Inductance and capacitance of 3-Φ lines. Symmetrical and unsymmetrical spacing-transposition-double circuit lines-bundled conductors (Derivation Required) .Numerical Problems **Modelling of Transmission Lines**: Classification of lines-short lines-voltage regulation and efficiency-medium lines-nominal T and Π configurations-ABCD constants- long lines- rigorous solution- interpretation of long line equation-Ferranti effect.		
	FIRST INTERNAL EXAMINATION		
III	**Introduction of Overhead transmission and underground transmission** Conductors -types of conductors -copper, Aluminium and ACSR conductors -Volume of conductor required for various systems of transmission-Choice of transmission voltage, conductor size -Kelvin's law. Mechanical Characteristics of transmission lines – configuration-Types of Towers. Calculation of sag and tension-supports at equal and unequal heights -effect of wind and ice-sag template Insulators -Different types -Voltage distribution, grading and string efficiency of suspension insulators. Corona -disruptive critical voltage -visual critical voltage -power loss due to corona -Factors affecting corona - interference on communication lines.	9	15%
IV	Underground Cables -types of cables -insulation resistance -voltage stress -grading of cables -capacitance of single core and 3 -core cables -current rating. **HVDC Transmission:** Comparison between AC &DC Transmission ,Power flow equations and control, Types of DC links **Flexible AC Transmission systems:** Need and Benefits, SVC, Configuration of FC + TCR, Series compensation: Configuration of TCSC	8	15%
	SECOND INTERNAL EXAMINATION		
V	**Need for power system protection.** **Circuit breakers –** principle of operation- formation of arc-Arc quenching theory- Restriking Voltage-Recovery voltage, RRRV (Derivation Required). Interruption of Capacitive currents and current chopping (Brief Description Only). Types of Circuit Breakers: Air blast CB – Oil CB – SF6 CB – Vacuum CB – CB ratings.		20%

	Protective Relays- Zones of Protection, Essential Qualities-Classification of Relays -Electro mechanical, Static Relays, Microprocessor Based Relay. Electromechanical Relays-Attracted Armature, Induction disc, Thermal Relays (Brief Description only) Static Relays-Merits and Demerits, Basic components, Comparison and duality of Amplitude and Phase comparators. Static overcurrent, Differential, Distance Relays, Directional Relay-(principle and Block diagram only) Microprocessor Based Relay-Block diagram and flow chart of Over current Relay, Numerical Relay(Basics Only)	10	
VI	**Protection of alternator:** Stator inter turn, Earth fault Protection and Differential protection **Protection of transformers-** Percentage Differential Protection-Buchholz Relay **Protection of transmission lines**-Differential Protection-carrier current protection **Protection against over voltages**: Causes of over voltages - Surge diverters - Insulation co-ordination **Power distribution systems** –Radial and Ring Main Systems - DC and AC distribution: Types of distributors- bus bar arrangement -Concentrated and Uniform loading -Methods of solving distribution problems.	10	20%
END SEMESTER EXAM			

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QUESTION PAPER PATTERN:

Maximum Marks: 100 Exam Duration: 3Hourrs.

Part A: 8 compulsory questions.

One question from each module of Module I - IV; and two each from Module V & VI.

Student has to answer all questions. (8 x5)=40

Part B: 3 questions uniformly covering Modules I & II. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

Part C: 3 questions uniformly covering Modules III & IV. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

Part D: 3 questions uniformly covering Modules V & VI. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

Course code	Course Name	L-T-P - Credits	Year of Introduction
EE302	**ELECTROMAGNETICS**	**2-1-0-3**	**2016**

Prerequisite: Nil

Course Objectives

- To develop a conceptual basis of electrostatics, magnetostatics, electromagnetic waves
- To understand various engineering applications of electromagnetics

Syllabus

Introduction to vector calculus, Electrostatics, Electrical potential, energy density and their applications. Magneto statics, magnetic flux density, scalar and vector potential and its applications, Time varying electric and magnetic fields, Electromagnetic waves

Expected outcome .

The students will be able to:

i. Analyze fields and potentials due to static charges
ii. Explain the physical meaning of the differential equations for electrostatic and magnetic fields
iii. Understand how materials are affected by electric and magnetic fields
iv. Understand the relation between the fields under time varying situations
v. Understand principles of propagation of uniform plane waves.
vi. Be aware of electromagnetic interference and compatibility

Text Book:

1. Nannapeni Narayana Rao, "Elements of Engineering Electromagnetics", Prentice Hall India
2. Sadiku M. N. O, *Elements of Electromagnetics*, Oxford university Press, 2010

Data Book (Approved for use in the examination):

References:

1. Cheng D. K., Field and Wave Electromagnetic, Pearson Education, 2013.
2. Edminister J. A., Electromagnetics, Schaum Outline Series , Tata McGraw-Hill, 2006.
3. Gangadhar K. A. and P. M. Ramanathan , Electromagnetic field theory , Khanna Publishers, 2009.
4. Hayt W. H. and J. A. Buck , Engineering Electromagnetics, 8/e, McGraw-Hill, 2012.
5. Inan U. S. and A. S. Inan, Engineering Electromagnetics, Pearson Education, 2010.
6. John Krauss and Daniel A. Fleisch, Electromagnetics with Applications, McGraw-Hill, 5th edition
7. Murthy T. V. S. A, Electromagnetic field, S. Chand Ltd, 2008.
8. Premlet B., Electromagnetic theory with applications, Phasor Books, 2000.
9. S.C.Mahapatra and Sudipta Mahapatra ,Principles of Electromagnetics, McGraw-Hill, 2015

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	**STATIC ELECTRIC FIELDS:** Introduction to Co-ordinate System – Rectangular – Cylindrical and Spherical Co- ordinate System – Gradient of a Scalar field, Divergence of a Vector field and Curl of a Vector field- Their Physical interpretation. Divergence Theorem, Stokes' Theorem. Numerical problems	6	15%
II	Coulomb's Law, Electric field intensity. Field due to a line charge, Sheet Charge and Continuous Volume Charge distribution. Electric Flux and Flux Density; Gauss's law and its application. Electric Potential-The Potential Gradient. The Electric dipole. The Equipotential surfaces. Capacitance - capacitance of co-axial cable, two wire line. Poisson's and Laplace's equations	8	15%
	FIRST INTERNAL EXAMINATION		

III	STATIC MAGNETIC FIELD: Biot-Savart Law, Amperes Force Law.– Magnetic Field intensity due to a finite and infinite wire carrying a current–Magnetic field intensity on the axis of a circular and rectangular loop carrying a current –Magnetic vector potential, Magnetic flux Density and Ampere's circuital law and simple applications.	6	15%
IV	ELECTRIC AND MAGNETIC FIELDS IN MATERIALS–Electric Polarization-Nature of dielectric materials-Electrostatic energy and energy density–Boundary conditions for electric fields and magnetic fields–Conduction current and displacement current densities–continuity equation for current. Maxwell's Equation in Differential and integral form from Modified form of Ampere's circuital law, Faraday's Law and Gauss Law	8	15%
SECOND INTERNAL EXAMINATION			
V	TIME VARYING ELECTRIC AND MAGNETIC FIELDS:. Poynting Vector and Poynting Theorem – Power flow in a co-axial cable – Complex Average Poynting Vector. ELECTROMAGNETIC WAVES: Wave Equation from Maxwell's Equation – Uniform Plane Waves –Wave equation in Phasor form	7	20%
VI	Plane waves propagation in loss less and lossy dielectric medium and conducting medium. Plane wave in good conductor, surface resistance, Skin depth, Intrinsic Impedance and Propagation Constant in all medium. Phase and group velocity. Transmission lines: waves in transmission line –solution for loss less lines –characteristic impedance – VSWR – impedance matching. Introduction to Electromagnetic interference and compatibility.	7	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN:

Maximum Marks: 100 Exam Duration: 3Hourrs.

Part A: 8 compulsory questions.

One question from each module of Modules I - IV; and two each from Module V & VI.

Student has to answer all questions. (8 x5)=40

Part B: 3 questions uniformly covering Modules I & II. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

Part C: 3 questions uniformly covering Modules III & IV. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

Part D: 3 questions uniformly covering Modules V & VI. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

Course code	Course Name	L-T-P - Credits	Year of Introduction
EE303	Linear Control Systems	2-1-0-3	2016

Prerequisite: Nil

Course Objectives:

- To provide a strong foundation on the analytical and design techniques on classical control theory and modelling of dynamic systems

Syllabus :

Open loop-and closed loop control systems- Transfer function - Control system components-Steady stare error- static error coefficient- dynamic error coefficient-Stability Analysis- Root locus- Frequency domain analysis-Bode plot-polar plot-Nyquist stability criterion- Non-minimum phase system - transportation lag.

Expected outcome.

The students will have the ability to

i. develop mathematical models of various systems.

ii. analyse the stability aspects of linear time invariant systems.

Text Books:

1) Dorf R. C. and R. H. Bishop, Modern Control Systems, Pearson Education, 2011.
2) Nagarath I. J. and Gopal M., Control System Engineering, Wiley Eastern, 2008.
3) Nise N. S., Control Systems Engineering, 6/e, Wiley Eastern, 2010.
4) Ogata K., Modern Control Engineering, Prentice Hall of India, New Delhi, 2010.

References:

1) Gibson J. E., F. B. Tuteur and J. R. Ragazzini, Control System Components, Tata McGraw Hill, 2013
2) Gopal M., Control Systems Principles and Design, Tata McGraw Hill, 2008.
3) Imthias Ahamed T P, *Control Systems*, Phasor Books, 2016
4) Kuo B. C., Automatic Control Systems, Prentice Hall of India, New Delhi, 2002.

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Open loop-and closed loop control systems: Transfer function of LTI systems-Mechanical and Electromechanical systems – Force voltage and force current analogy - block diagram representation - block diagram reduction - signal flow graph - Mason's gain formula - characteristic equation.	8	15%
II	Control system components: DC and AC servo motors – synchro - gyroscope - stepper motor - Tacho generator. Time domain analysis of control systems: Transient and steady state responses - time domain specifications - first and second order systems - step responses of first and second order systems.	6	15%
FIRST INTERNAL EXAMINATION			
III	Error analysis - steady state error analysis - static error coefficient of type 0,1, 2 systems - Dynamic error coefficients. Concept of stability: Time response for various pole locations - stability of feedback system - Routh's stability criterion	7	15%
IV	Root locus - General rules for constructing Root loci – stability from root loci - effect of addition of poles and zeros.	7	15%
SECOND INTERNAL EXAMINATION			
	Frequency domain analysis: Frequency domain specifications- Analysis based on Bode plot - Log magnitude vs. phase plot,	7	20%

VI	Polar plot- Nyquist stability criterion-Nichols chart - Non-minimum phase system - transportation lag.	7	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN:

Maximum Marks: 100 Exam Duration: 3Hourrs.

Part A: 8 compulsory questions.

One question from each module of Modules I - IV; and two each from Module V & VI.

Student has to answer all questions. (8 x5)=40

Part B: 3 questions uniformly covering Modules I & II. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

Part C: 3 questions uniformly covering Modules III & IV. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

Part D: 3 questions uniformly covering Modules V & VI. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

Course code	Course Name	L-T-P -Credits	Year of Introduction
EE304	**Advanced Control Theory**	**3-1-0-4**	**2016**

Prerequisite: EE303 Linear control systems

Course Objectives:

- To provide a strong concept on the compensator design and on advanced control system analysis and design techniques
- To analyse the behaviour of discrete time systems and nonlinear control systems.

Syllabus:

Compensator design-Frequency domain approach-root locus method-Tuning of P, PI and PID controller-State space analysis of systems-state feedback controller design-sampled data control systems-Nonlinear systems-describing function-phase plane-Lyapunov method.

Expected outcome.

On successful completion, students will have the ability to

i. design compensators using classical techniques.
ii. analyse both linear and nonlinear system using state space methods.
iii. analyse the stability of discrete system and nonlinear system.

Text Book:

1. Hassan K Khalil, Nonlinear Systems, Prentice - Hall International (UK), 2002.
2. Kuo B.C, Analysis and Synthesis of Sampled Data Systems, Prentice Hall Publications.
3. Nagarath I. J. and Gopal M., Control System Engineering, Wiley Eastern, 2008.
4. Nise N. S., Control Systems Engineering, 6/e, Wiley Eastern, 2010.
5. Ogata K., Modern Control Engineering, Prentice Hall of India, New Delhi, 2010.

Data Book (Approved for use in the examination):

References:

1. Alberto Isidori, Nonlinear Control Systems, Springer Verlag, 1995.
2. Gibson J. E., F.B. Tuteur and J. R. Ragazzini, Control System Components, Tata McGraw Hill, 2013
3. Gopal M., Control Systems Principles and Design, Tata McGraw Hill, 2008.
4. Jean-Jacques E. Slotine & Weiping Li, Applied Nonlinear Control, Prentice-Hall., NJ, 1991.

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Types of controller- Feedforward-feedback-cascade-P, PI and PID. Compensator design: Realization of compensators – lag, lead and lag-lead -Design of compensator using bode plot.	7	15%
II	Compensator design: Realization of compensators – lag, lead and lag-lead. Design of compensator using rootlocus. Design of P, PI and PID controller using Ziegler-Nichols tuning method.	7	15%
FIRST INTERNAL EXAMINATION			
III	State space analysis of systems: Introduction to state concept - state equation of linear continuous time systems, matrix representation of state equations. Phase variable and canonical forms of state representation-controllable, observable, diagonal	7	15%

	and Jordan canonical forms- solution of time invariant autonomous systems, forced system-state transition matrix-relationship between state equations and transfer function. Properties of state transition matrix-Computation of state transition matrix using Laplace transform-Cayley-Hamilton method. Conversion from canonical form to phase variable form.		
IV	State feedback controller design: Controllability & observability. State feed-back design via pole placement technique. Sampled data control system: Pulse Transfer function-Stability of sampled data system -Routh Hurwitz criterion and Jury's test. Introduction to state-space representation of sampled data systems.	7	15%
SECOND INTERNAL EXAMINATION			
V	Nonlinear systems: Introduction - characteristics of nonlinear systems. Types of nonlinearities. Analysis through harmonic linearisation - Determination of describing function of nonlinearities (relay, dead zone and saturation only) - application of describing function for stability analysis of autonomous system with single nonlinearity.	7 hrs	20%
VI	Phase Plane Analysis: Concepts- Construction of phase trajectories for nonlinear systems and linear systems with static nonlinearities - Singular points – Classification of singular points. Definition of stability- asymptotic stability and instability Liapunov methods to stability of linear and nonlinear, continuous time systems.	7 hrs	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN:

Maximum Marks: 100 Exam Duration: 3Hourrs.

Part A: 8 compulsory questions.

One question from each module of Modules I - IV; and two each from Module V & VI.

Student has to answer all questions. (8 x5)=40

Part B: 3 questions uniformly covering Modules I & II. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

Part C: 3 questions uniformly covering Modules III & IV. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

Part D: 3 questions uniformly covering Modules V & VI. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

Course code	Course Name	L-T-P -Credits	Year of Introduction
EE305	Power Electronics	3-0-0-3	2016

Prerequisite: Nil

Course Objectives

- To get an overview of different types of power semiconductor devices and their switching characteristics
- To study the operation and characteristics of various types of power electronic converters

Syllabus :

Structure and characteristics of various power semiconductor devices – turn-on methods – controlled rectifiers – inverters – AC voltage controllers – cycloconverters – DC choppers and switching regulators

Expected outcome.

The students who successfully complete this course will be able to:

i. Choose appropriate power semiconductor device in converter circuits and develop their triggering circuits.
ii. Analyze various types of power electronic converters and apply different switching techniques.
iii. Select appropriate power converter for specific applications.
iv. Interpret and use datasheets of power semiconductor devices for design.

Text Book:

Muhammad H. Rashid, *Power Electronics Circuits, Devices and Applications*, Pearson Education

References:

1. Mohan N., T. M. Undeland and W. P. Robbins., Power Electronics, Converters, Applications & Design, Wiley-India
2. Krein P. T., Elements of Power Electronics, Oxford University Press, 1998.
3. P.S. Bimbhra, Power Electronics, Khanna Publishers, New Delhi
4. L. Umanand, Power Electronics – Essentials & Applications, Wiley-India
5. Singh M. D. and K. B. Khanchandani, *Power Electronics*, Tata McGraw Hill, New Delhi, 2008.

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	SCR-Structure, static characteristics & switching (turn-on & turn-off) characteristics - di/dt & dv/dt protection – turn-on methods of SCR - two transistor analogy - series and parallel connection of SCRs Structure and principle of operation of power diode, TRIAC, GTO, Power MOSFET & IGBT – Comparison	6	15%
II	**Gate triggering circuits** – R, RC, UJT triggering circuits – natural and forced commutation (concept only). Requirements of isolation and synchronisation in gate drive circuits- Opto and pulse transformer based isolation. **Controlled rectifiers** – half-wave controlled rectifier with R load – 1-phase fully controlled bridge rectifier with R, RL and RLE loads (continuous & discontinuous conduction) – output voltage	8	15%

	equation – 1-phase half controlled bridge rectifier with R, RL and RLE loads – displacement power factor – distortion factor.		
	FIRST INTERNAL EXAMINATION		
III	3-phase half-wave controlled rectifier with R load – 3-phase fully controlled & half-controlled converter with RLE load (continuous conduction, ripple free) – output voltage equation-waveforms for various triggering angles (no analysis) – 1-phase & 3-phase dual converter with & without circulating current – four-quadrant operation	7	15%
IV	**Inverters** – voltage source inverters– 1-phase half-bridge & full bridge inverter with R & RL loads – THD in output voltage – 3-phase bridge inverter with R load – 120° & 180° conduction mode – current source inverters.	7	15%
	SECOND INTERNAL EXAMINATION		
V	**Voltage control in inverters** – Pulse Width Modulation – single pulse width, multiple pulse width & sine PWM – modulation index & frequency modulation ratio. **AC voltage controllers** (ACVC) – 1-phase full-wave ACVC with R, & RL loads – waveforms – RMS output voltage, input power factor with R load – sequence control (two stage) with R load	7	20%
VI	**DC-DC converters** – step down and step up choppers – single-quadrant, two-quadrant & four quadrant chopper – pulse width modulation & current limit control in dc-dc converters. Switching regulators – buck, boost & buck-boost - continuous conduction mode only – waveforms – design of filter inductance & capacitance	7	20%
	END SEMESTER EXAM		

QUESTION PAPER PATTERN:

Maximum Marks: 100 Exam Duration: 3Hourrs.

Part A: 8 compulsory questions.

One question from each module of Module I - IV; and two each from Module V & VI.

Student has to answer all questions. (8 x5)=40

Part B: 3 questions uniformly covering Modules I & II. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

Part C: 3 questions uniformly covering Modules III & IV. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

Part D: 3 questions uniformly covering Modules V & VI. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

Course code	Course Name	L-T-P - Credits	Year of Introduction
EE306	**POWER SYSTEM ANALYSIS**	**3-0-0-3**	**2016**

Prerequisite: Nil

Course Objectives

- To enable the students to analyse power systems under normal and abnormal conditions.
- To understand the need for load flow analysis and different methods
- To understand power system modeling
- To understand the need for stability studies and their analysis

Syllabus

Per unit quantities - modeling of power system components - methods of analyzing faults in symmetrical and unsymmetrical case - load flow studies - Automatic Generation Control - Automatic voltage control – Economic load dispatch - Unit commitment - Power system stability - Solution of swing equation - Methods of improving stability limits

Expected outcome .

The students will be able to:

i. Analyse power systems under normal and abnormal conditions.
ii. Carry out load flow studies under normal and abnormal conditions

References:

1. Cotton H. and H. Barber, Transmission & Distribution of Electrical Energy, 3/e, Hodder and Stoughton, 1978.
2. Gupta B. R., *Power System Analysis and Design*, S. Chand, New Delhi, 2006.
3. Gupta J.B., Transmission *& Distribution of Electrical Power*, S.K. Kataria & Sons, 2009.
4. Hadi Saadat, *Power System Analysis*, 2/e, McGraw Hill, 2002.
5. Kothari D. P. and I. J. Nagrath, *Modern Power System Analysis*, 2/e, TMH, 2009.
6. Kundur P., *Power system Stability and Control*, McGraw Hill, 199
7. Soni, M.L., P. V. Gupta and U. S. Bhatnagar, *A Course in Electrical Power*, Dhanpat Rai & Sons, New Delhi, 1984.
8. Stevenson W. D., *Elements of Power System Analysis*, 4/e, McGraw Hill, 1982.
9. Uppal S. L. and S. Rao, *Electrical Power Systems*, Khanna Publishers, 2009.
10. Wadhwa C. L., *Electrical Power Systems*, 33/e, New Age International, 2004.
11. Weedy B. M., B. J. Cory, N. Jenkins, J. B. Ekanayake and G. Strbac, *Electric Power System*, John Wiley & Sons, 2012.

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Per unit quantities-single phase and three phase-selection of base quantities -advantages of per unit system –changing the base of per unit quantities-Simple problems.	2	15%
	Modelling of power system components - single line diagram – per unit quantities. Symmetrical components- sequence impedances and sequence networks of generators, transformers and transmission lines.	3	
II	Methods of analyzing faults in symmetrical and unsymmetrical case- effects of faults - Power system faults - symmetrical faults - short circuit MVA - current limiting reactors-	8	15%

	Unsymmetrical faults - single line to ground, line to line, double line to ground faults -consideration of prefault current-problems.		
FIRST INTERNAL EXAMINATION			
III	Load flow studies – Introduction-types-network model formulation - formation of bus impedance and admittance matrix, Gauss-Siedel (two iterations), Newton-Raphson (Qualitative analysis only) and Fast Decoupled method (two iterations) - principle of DC load flow.	8	15%
IV	Automatic Generation Control: Load frequency control: single area and two area systems - Automatic voltage control.	6	15%
SECOND INTERNAL EXAMINATION			
V	Economic Operation - Distribution of load between units within a plant - transmission loss as a function of plant generation - distribution of load between plants - Method of computing penalty factors and loss coefficients.	5	20%
	Unit commitment: Introduction — Constraints on unit commitments: Spinning reserve, Thermal unit constraints-Hydro constraints. -	2	
VI	Power system stability - steady state, dynamic and transient stability-power angle curve-steady state stability limit	3	20%
	Mechanics of angular motion-Swing equation – Solution of swing equation - Point by Point method - RK method - Equal area criterion application - Methods of improving stability limits.	5	
END SEMESTER EXAM			

QUESTION PAPER PATTERN:

Maximum Marks: 100 Exam Duration: 3Hourrs.

Part A: 8 compulsory questions.

One question from each module of Modules I - IV; and two each from Module V & VI.

Student has to answer all questions. (8 x5)=40

Part B: 3 questions uniformly covering Modules I & II. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

Part C: 3 questions uniformly covering Modules III & IV. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

Part D: 3 questions uniformly covering Modules V & VI. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

Course code	Course Name	L-T-P - Credits	Year of Introduction
EE307	**SIGNAL AND SYSTEMS**	**3-0-0-3**	**2016**

Prerequisite: Nil

Course Objectives

- To impart knowledge about the representation and properties of signal and systems and applications in engineering

Syllabus:

Classification of signals - Basic operations on signals- properties of systems- Convolution-Laplace transform-applications-Fourier series and Fourier transforms- properties- Discrete time systems-sampling- ZT-properties-applications- DFS-DFT-properties-Basics of Nonlinear systems

Expected Outcome:

After the completion of the course student will be able to:

i. Represent various signals and systems
ii. Analyse the continuous time system with Laplace transform
iii. Represent and analyse signals using Fourier representation
iv. Analyse the discrete time system using ZT
v. Analyse the DT systems with DFS
vi. Acquire basic knowledge in nonlinear systems

Text books:

1. Haykin S. & Veen B.V., Signals & Systems, John Wiley
2. Oppenheim A.V., Willsky A.S. & Nawab S.H., Signals and Systems, Tata McGraw Hill
3. Signals and Systems: I J Nagrarth- Tata McGraw Hill

References:

1. Bracewell R.N., Fourier Transform & Its Applications, McGraw Hill
2. Farooq Husain , Signals and Systems, Umesh pub.
3. Papoulis A., Fourier Integral & Its Applications, McGraw Hill
4. Taylor F.H., Principles of Signals & Systems, McGraw Hill

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Introduction to signals and systems - Classification of signals - Basic operations on signals – Elementary signals – Concept of system - Properties of systems - Stability, inevitability- time invariance- Linearity -Causality – Memory- Convolution- Impulse response- Representation of LTI systems - Differential equation representations of LTI systems	7	15%
II	Laplace transform analysis of systems - Relation between the transfer function and differential equation –Causality and stability - Inverse system - Determining the time domain and frequency response from poles and zeros	7	15%
FIRST INTERNAL EXAMINATION			
III	Fourier representation of continuous time signals –Fourier	7	15%

	Series-Harmonic analysis of common signals- Fourier transform - Existence –properties of FT- Energy spectral density and power spectral density - Frequency response of LTI systems -		
IV	Sampled data systems- Sampling process-sampling theorem-signal re construction- Zero order and First order hold circuits- Difference equation representations of LTI systems - Discrete form of special functions- Discrete convolution and its properties	7	15%
SECOND INTERNAL EXAMINATION			
V	Z Transform - Region of convergence- Properties of the Z transform – Inverse ZT-methods Z-transfer function- Analysis of difference equation of LTI systems – Basic idea on Stability and causality conditions-	7	20%
VI	Fourier representation of discrete time signals - Discrete Fourier series–properties- Frequency response of simple DT systems Basics of Non linear systems-types and properties Introduction to random signals and processes (concepts only)	7	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN:

Maximum Marks: 100 Exam Duration: 3Hourrs.

Part A: 8 compulsory questions.

One question from each module of Module I - IV; and two each from Module V & VI.

Student has to answer all questions. (8 x5)=40

Part B: 3 questions uniformly covering Modules I & II. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

Part C: 3 questions uniformly covering Modules III & IV. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

Part D: 3 questions uniformly covering Modules V & VI. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

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Course code	Course Name	L-T-P-Credits	Year of Introduction
EE308	**Electric Drives**	**3-0-0-3**	**2016**

Prerequisite: EE202 & EE205

Course Objectives

- To provide fundamental knowledge in dynamics and control of Electric Drives.
- To justify the selection of Drives for various applications.
- To familiarize the various semiconductor controlled drives employing various motors.

Syllabus

Fundamentals of dynamics and control of electric drives– separately excited dc motor drives using controlled rectifiers — chopper controlled dc drives – ac voltage controllers – three phase induction motor speed control – VSI and CSI fed induction motor drives – synchronous motor drives

Expected outcome.

The students will be able to select a drive for a particular application. They will familiarize with the various control techniques employed for controlling drives with ac and dc motors.

Text books

1. Bimal K. Bose "Modern power electronics and AC drives" Pearson Education, Asia 2003
2. Dubey G. K. "Power semiconductor control drives" Prentice Hall, Englewood Cliffs, New Jersey, 1989

References:

1. Dewan S.B. , G. R. Slemon, A. Strauvhen, "Power semiconductor drives", John Wiley and sons
2. Dr. P. S. Bimbra "Power electronics", Khanna publishers
3. J. M. D. Murphy "Thyristor control of AC drives"
4. N. K. De, P. K. Sen "Electric drives" Prentice Hall of India 2002
5. Ned Mohan, Tore m Undeland, William P Robbins, "Power electronics converters applications and design", John Wiley and Sons.
6. Pillai S. K. "A first course on electric drives", Wieley Eastern Ltd, New Delhi
7. Vedam Subrahmanyam, "Electric Drives", MC Graw Hill Education, New Delhi
8. W. Shepherd, L. N. Hulley and D. T. Liang, "Power Electronocs and motor control", Second Edition, Cambridge University Press, 1995.

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Introduction to electric drives – Block diagram – advantages of electric drives – Dynamics of motor load system, fundamental equations, and types of load – classification of load torque, four quadrant operation of drives. Steady state stability. Introduction to closed loop control of drives.	7	15%
II	DC motor drives- constant torque and constant power operation, separately excited dc motor drives using controlled rectifiers, single phase semi converter and single phase fully controlled converter drives. Three phase semi converter and fully controlled converter drives. Dual converters, applications of dual converter for speed control of DC motor. Closed loop control of separately excited dc motor drive. DC series motor drive for traction application.	7	15%
FIRST INTERNAL EXAMINATION			

III	Chopper controlled DC drives. Analysis of single quadrant chopper drives. Regenerative braking control. Two quadrant chopper drives. Four quadrant chopper drives. Cycloconverters for drive applications – different types – basic principle.	7	15%
IV	Three phase induction motor speed control. Using semiconductor devices. Stator voltage control – stator frequency control - Stator voltage and frequency control (v/f). Rotor chopper speed control - slip power recovery control schemes – sub synchronous and super synchronous speed variations.	7	15%
SECOND INTERNAL EXAMINATION			
V	Voltage source inverter fed induction motor drives, Current source inverter fed induction motor drives. Concept of space vector – Basic transformation in reference frame theory – field orientation principle.	7	20%
VI	Synchronous motor drives – introduction to v/f control. Permanent Magnet synchronous motor drives – different types – control requirements, converter circuits, modes of operation. Microcontroller based permanent magnet synchronous motor drives (schematic only).	7	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN:

Maximum Marks: 100 Exam Duration: 3Hourrs.

Part A: 8 compulsory questions.

One question from each module of Modules I - IV; and two each from Module V & VI.

Student has to answer all questions. (8 x5)=40

Part B: 3 questions uniformly covering Modules I & II. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

Part C: 3 questions uniformly covering Modules III & IV. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

Part D: 3 questions uniformly covering Modules V & VI. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

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Course code	Course Name	L-T-P - Credits	Year of Introduction
EE367	New and Renewable Energy Systems	3-0-0-3	2016

Prerequisite: Nil

Course Objectives:

- To give sufficient knowledge about the promising new and renewable sources of energy
- To equip students in working with projects and to take up research work in connected areas.

Syllabus:

Solar energy - Solar radiation measurements - Applications of solar energy - Energy from oceans-Tidal energy - Wind energy -Small Hydro Power (SHP) Stations- Biomass and bio-fuels - geothermal energy -Power from satellite stations - Hydrogen energy.

Expected Outcome:

- The students will be able to design and analyse the performance of small isolated renewable energy sources.

References:

1. A.A.M. Saigh (Ed): Solar Energy Engineering, Academic Press, 1977
2. Abbasi S. A. and N. Abbasi, Renewable Energy Sources and Their Environmental Impact, Prentice Hall of India, 2001..
3. Boyle G. (ed.), Renewable Energy - Power for Sustainable Future, Oxford University Press, 1996
4. Earnest J. and T. Wizelius, Wind Power Plants and Project Development, PHI Learning, 2011.
5. F. Kreith and J.F. Kreider: Principles of Solar Engineering, McGraw Hill, 1978
6. G.N. Tiwari: Solar Energy-Fundamentals, Design, Modelling and Applications, Narosa Publishers, 2002
7. J.A. Duffie and W.A. Beckman: Solar Energy Thermal Processes, J. Wiley, 1994
8. Johansson T. B., H. Kelly, A. K. N. Reddy and R. H. Williams, Renewable Energy – Sources for Fuel and Electricity, Earth scan Publications, London, 1993.
9. Khan B. H., Non-Conventional Energy Resources, Tata McGraw Hill, 2009.
10. Rao S. and B. B. Parulekar, Energy Technology, Khanna Publishers, 1999.
11. Sab S. L., Renewable and Novel Energy Sources, MI. Publications, 1995.
12. Sawhney G. S., Non-Conventional Energy Resources, PHI Learning, 2012.
13. Tiwari G. N., Solar Energy- Fundamentals, Design, Modelling and Applications, CRC Press, 2002.

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Introduction, Classification of Energy Resources; Conventional Energy Resources - Availability and their limitations; Non-Conventional Energy Resources – Classification, Advantages, Limitations; Comparison of Conventional and Non-Conventional Energy Resources; World Energy Scenario; Indian Energy Scenario. ENERGY STORAGE: Sizing and Necessity of Energy Storage.	5	15%
II	SOLAR THERMAL SYSTEMS: Introduction, Solar Constant, Basic Sun-Earth Angles, Measurement of Solar Radiation Data – Pyranometer and Pyrheliometer .Principle of Conversion of Solar Radiation into Heat, – Solar thermal collectors – General description	11	15%

	and characteristics – Flat plate collectors – Heat transfer processes – Solar concentrators (parabolic trough, parabolic dish, Central Tower Collector) –performance evaluation..		
FIRST INTERNAL EXAMINATION			
III	SOLAR ELECTRIC SYSTEMS: Solar Thermal Electric Power Generation –; Solar Photovoltaic – Solar Cell fundamentals, characteristics, classification, construction of module, panel and array. Solar PV Systems – stand-alone and grid connected; Applications – Street lighting, Domestic lighting and Solar Water pumping systems..	5	15%
IV	ENERGY FROM OCEAN: Tidal Energy – Principle of Tidal Power, Components of Tidal Power Plant (TPP), Classification of Tidal Power Plants, Advantages and Limitations of TPP. Ocean Thermal Energy Conversion (OTEC): Principle of OTEC system, Methods of OTEC power generation – Open Cycle (Claude cycle), Closed Cycle (Anderson cycle) and Hybrid cycle (block diagram description of OTEC); Site-selection criteria, Biofouling, Advantages & Limitations of OTEC.	7	15%
SECOND INTERNAL EXAMINATION			
V	WIND ENERGY: Introduction, Wind and its Properties, History of Wind Energy, Wind Energy Scenario – World and India. Basic principles of Wind Energy Conversion Systems (WECS), Classification of WECS, Parts of WECS, Derivation for Power in the wind, Electrical Power Output and Capacity Factor of WECS, Advantages and Disadvantages of WECS	7	20%
VI	BIOMASS ENERGY: Introduction, Photosynthesis process, Biomass fuels, Biomass conversion technologies, Urban waste to Energy Conversion, Biomass Gasification, Biomass to Ethanol Production, Biogas production from waste biomass, factors affecting biogas generation, types of biogas plants – KVIC and Janata model; Biomass program in India. Small hydro power: Classification as micro, mini and small hydro projects - Basic concepts and types of turbines - Design and selection considerations. EMERGING TECHNOLOGIES: Fuel Cell, Small Hydro Resources, Hydrogen Energy, alcohol energy, nuclear fusion and power from satellite stations.	7	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN:

Maximum Marks: 100 Exam Duration: 3Hourrs.

Part A: 8 compulsory questions. One question from each module of Module I - IV; and two each from Module V & VI. Student has to answer all questions. (8 x5)=40

Part B: 3 questions uniformly covering Modules I & II. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

Part C: 3 questions uniformly covering Modules III & IV. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

Part D: 3 questions uniformly covering Modules V & VI. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

EE14 701 POWER SYSTEM ANALYSIS

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objective

- *Development of a power system model*
- *Analysing the power system model under normal and abnormal conditions*

Module I (14 Hours)
Representation of power systems – one line diagrams, impedance and reactance diagrams, per unit and percent quantities , primitive networks , Y-bus matrix formulation by singular transformation and Direct determination, Z-bus matrices – Building algorithm.
Load flow studies: problem formulation, classification of buses, Gauss –Seidal method, Newton -Raphson method and fast decoupled load flow method

Module II (13Hours)
Economic load dispatch: system constraints, economic dispatch of thermal plants neglecting line losses, optimum load dispatch including transmission line losses,
Speed governing mechanism: speed governing of turbo generator, load sharing and governor characteristics, transfer function model of single area system, Load Frequency Control, Automatic Voltage Regulation, AGC (Basic concepts only)

Module III (13 Hours)
Short circuit studies : Faults on power systems , three phase to ground faults, SLG , DLG , LL faults, Sequence impedance and sequence networks, symmetrical component methods of analysis of unsymmetrical faults at the terminals of an unloaded generator, Faults on power systems, fault analysis using Z-bus, faults through impedance , short circuit capacity of a bus and circuit breaker rating

Module IV (12 Hours)
Power system stability studies: steady state, transient and dynamic stability, electrical stiffness, Swing equation, inertia constant , equal area criterion, Step by step method of solution of swing equation , factors affecting stability.
Multi machine stability analysis using forward Euler's method, electromechanical oscillations, sub-synchronous resonance.
Voltage stability problem, causes and improvement methods

Text Books

1. Stevenson Jr., *Elements of Power System Analysis*, TMH
2. I J Nagrath & D P Kothari, *Modern Power System Analysis*, TMH
3. C L Wadhwa, *Electric Power Systems*, New-Age International
4. J Wood, B F Woolenberg, *Power Generation, Operation and Control*, Wiley India
5. C W Taylor, *Power System Voltage Stability*, McGraw Hill Inc

Reference Books

1. S S Wadhera , *Power System Analysis and Stability*, Khanna Publishers
2. O I Elgerd, *Electric Energy System Theory- An introduction*, TMH
3. B R Gupta, *Power System Analysis and Design*, Wheeler publishing Company, New Delhi
4. Arthur R Bergen, Vijay Vittal, *Power System Analysis*, Pearson
5. Chakravarti & Halder, *Power System Analysis, Operation & Control*, PHI

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions 4 x 15 marks=60 marks

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

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EE14 703: ELECTRIC DRIVES

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives
- *Study the basic concepts of electrical drives*
- *Study the different types of DC & AC drives*
- *Study the different special electrical machine drives*

Module I (10 hours)
Concept of Electric Drives – parts of electric drives – review of different types of motors & power electronic converters - choice of electric drives - dynamics of electric drives – developed torque – components of load torque - types of load torque - four quadrant operation – Loads with rotational and translational motion – Steady state stability - load equalization

Module II (14 hours)
DC drives – DC motors and their performance – separately excited, shunt and series motors - starting – braking – regenerative braking, dynamic braking & plugging – speed control - methods of armature voltage control – 1-phase fully controlled & half controlled converter fed DC drives – continuous and discontinuous conduction - 3-phase fully controlled & half controlled rectifier fed dc drives – Four quadrant operation of dc drive using dual converter- Chopper fed dc drives- closed loop control scheme for control below and above base speed

Module III (14 hours)
3-phase induction motor drives – equivalent circuit - torque equation – starting - braking - regenerative braking, plugging, ac & dc dynamic braking - pole changing – stator voltage control - 3-phase AC voltage controller - stator frequency control – stator voltage & frequency control - 3-phase VSI fed induction motor using sine PWM - static rotor resistance control - slip power recovery scheme – static Kramer drive – static Scherbius drive – vector control – basic principle of vector control – comparison of vector control & V/f control

Module IV (14 hours)
Synchronous motor drives – cylindrical rotor motors - salient pole motors - reluctance motors - self-controlled synchronous motor drive - closed loop control of synchronous motor - permanent magnet ac motor drives – sinusoidal PMAC drives - brushless DC motor drives - stepper motor – variable reluctance, permanent magnet & hybrid type stepper motor - unipolar and bipolar drive circuits - switched reluctance motor (SRM) – operation and control requirements - modes of operation – closed loop speed control of SRM

Text Books
1. Gopal K. Dubey, *Fundamentals of Electrical Drives,* Narosa Publishing House, New Delhi
2. M. H. Rashid, *Power Electronics Circuits, Devices and Applications*, Pearson Education
3. Vedam Subrahmanyam, *Electric Drives, Concepts & Applications*, Tata McGraw Hill Education Pvt. Ltd, New Delhi

Reference Books
1. Sen P. C., *Thyristor DC Drives,* Tata McGraw Hill
2. B. K. Bose, *Modern Power Electronics and AC Drives*, PHI
3. Bose, *Power Electronics & Variable Frequency Drives*, Wiley-India
4. R. Krishnan, *Electric Motor Drives- Modelling, Analysis and control*, Pearson education
5. De & Sen, *Electric Drives*, PHI

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class
Note : One of the assignments shall be simulation/hardware implementation of DC or AC drives

University Examination Pattern

PART A: Analytical/problem solving SHORT questions — *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions 4 x 15 marks=60 marks

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

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EE14 704(B) ELECTRICAL MACHINE DESIGN

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objective
- *Design of electrical machines and transformers for the given specifications*

Module I (14 Hours)
DC Machines : Output equation – Main dimensions – Choice of specific electric and magnetic loadings – Choice of speed and number of poles – Design of armature conductors, slots and winding – Design of air-gap-Design of field system -Height of the field winding-Design procedure for shunt and series field windings-Design of commutator and brushes- interpoles and compensating winding – Carter's coefficient – Real and apparent flux density – Design examples.

Module II (14 Hours)
Transformers: Single phase and three phase power transformers – Output equation –Core and shell type - main dimensions – Choice of specific electric and magnetic loadings – Design of core- Core cross sections-Window dimensions-Over all dimensions- Design of windings-Number of turns and conductor size-cooling tank-plain walled and tank with cooling tubes – leakage reactance and equivalent circuit based on design data- Prediction of no load current-Mechanical forces on winding– Design examples – Design principles of current transformers – Temperature rise calculations – continuous and intermittent rating.

Module III (12 Hours)
Alternators: Salient pole and turbo alternators – Output equation – Main dimensions – choice of specific electric and magnetic loadings – choice of speed and number of poles –short circuit ratioand its effects- design of armature conductors, slots and winding – Design of air-gap, field system and damper winding – prediction of open circuit characteristics and regulation of the alternator based on design data – design examples

Module IV (12 Hours)
Induction machines: Output equation – Main dimensions – choice of specific electric and magnetic loadings –Design of stator-stator winding design- Different types of rotor-Design of squirrel cage rotor - rotor slots- calculation of rotor bar and end ring currents in cage rotor - Design of slip ring rotor-Design of airgap— calculation of equivalent circuit parameters and prediction of magnetizing current based on design data – Design examples

Text Books
1. Sawhney A. K., *Electrical Machine Design*, Dhanpath Rai & Sons.

Reference Books
1. Clayton & Hancock, *Performance and Design of DC Machines*, ELBS
2. Say M. G., *Performance and Design of AC Machines*, Pitman, ELBS
3. Deshpande, *Design & Testing of Electrical Machines*, PHI

Internal Continuous Assessment *(Maximum Marks-50)*
60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions — *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions 4 x 15 marks=60 marks

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

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EE14 705(B) HIGH VOLTAGE ENGINEERING

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives
- *To study the breakdown mechanism in electrical insulators*
- *To study the generation and measurement of high AC, DC and impulse voltages*
- *Testing of high voltage equipments*

Module I (13Hours)
Breakdown mechanisms in solids , liquids, vacuum , gases & gas mixtures- breakdown in uniform fields- breakdown in composite dielectrics - partial discharge , penning effect time tag &paschen's law. Townsends criterion

Module II (13 Hours)
Generation of High Voltages and Currents: D.C.Voltages : voltage doubler, cascade circuits, electrostatic machines, voltage stabilization. A.C. Voltages : Cascade transformers, series resonance circuits. Impulse Voltages : Single stage and multistage circuits, wave shaping, tripping and control of impulse generators, synchronization with oscilloscope, generation of switching surge voltage, generation of impulse currents

Module III (13 Hours)
Measurement of High Voltages and Currents : D.C.,A.C. and impulse voltages and currents, CRO, electrostatic generating and peak voltmeters, sphere gaps, factors affecting measurements, potential dividers(capacitive and resistive), series impedance ammeters, Ragowski coils, magnetic links, Hall effect generators, PT's (magnetic and capacitive types) and CT's.

Module IV (13 Hours)
Dielectric loss measurements:- Schering's bridge- inductively coupled ratio arm bridge.
Partial discharge measurement technologies - radio interference measurements.
Over voltage phenomenon - travelling waves- line equations, wave transmission, reflection & attenuation, lightning phenomenon - Switching surges - protection against surges - Testing of circuit breakers and generators.

Text Books
1. Naidu M. S. &Kamaraju V., *High Voltage Engineering,* Tata Mc Graw Hill
2. Kuffel and Abdulla M., *High Voltage Engineering,*Pergman Press

Reference Books
1. Bewley L. V. Lines, *Travelling Waves on Transmission,* Dover Publishers.
2. S.K. Singh, *Fundamentals of High Voltage Engineering*, Dhanpat Rai & Co.
3. Alston L. L., *H. V. Technology,* Oxford University Press
4. Dieter Kind, *An Introduction to HV*, Wiley Ltd.
5. C.L. Wadhwa, *High Voltage Engineering*, New Age International
6. B. Thaparet. Al., *Power System Transients and High Voltage Principles,* Capital Pub
7. *IEEE Standard Technique for High Voltage Testing*, IEEE John Wiley and Sons
8. *Indian Standards:*
   IS: 2070-1962 IS:2070- 1962
   IS: 2544- 1963 IS: 2079- 1962
   IS:2099-1962 IS:2026-1962
   IS:166-1962 IS:5959- 1970
   IS:1544-1964,1970 IS: 7098- 1973
   IS: 3070- 1965 IS:4004-1967
   IS:6209-1971 IS: 4950- 1968
   British Standards: B5: 3659, B5: 3070, B%: 2914- 1957
   IEC Publications: No. 99-1, Part1-1970

Internal Continuous Assessment *(Maximum Marks-50)*
60% - Tests (minimum 2) 30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc. 10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions — *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions 4 x 15 marks=60 marks

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

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EE14 801 ELECTRICAL SYSTEM DESIGN

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives
- *To impart the basic concepts of electrical installations for buildings*
- *To study the design and estimation of different electrical installations.*

Module I (13 hours)
General: Salient features of Indian Electricity Act 2003,Central Electricity Authority (Measures relating to Safety and Electricity supply) Regulations 2010, Role and scope of National Electric Code in the design of electrical installations, Graphical symbols, Safety in electrical work, accidents and treatment for electric shock.
Assessment of general characteristics of buildings, Classification of supply systems- TN, TT & IT systems,
Service Connection:- Receptions and distribution of main supply, sub-circuits, methods of internal wiring, Preparation of schematic and wiring diagram, Estimation of wiring materials used for a small residential building, Selection of switch gear for control and protection against overload, short circuit and earth fault, Neutral wire, Earth wire, pipe, rod and plate earthing, Testing of installation.

Module II (13 hours)
Electrical aspects of building services: Lighting- Qualities of good lighting schemes-Types of lighting schemes-Different types of lamps - Polar curves - Maintenance factor - Absorption factor - Reflection factor - Coefficient of utilization (COU) - Calculation of COU based on room index, Norms for comfort lighting - shielding angle, General rules for interior lighting - office building lighting –design of industrial lighting - hospital lighting - Design of interior lighting by average illumination - Design of street lighting - flood lighting.
Ventilation – Electrical aspects of air conditioning and Heating services, Calculation of tonnage capacity and motor power
Module III (13 hours)
Connected Load, Selection of LT Cables - Types and Testing of LT cables, Design of LT panels, Design, Layout and schematic diagram of electrical installations in High Rise Building (HRB) - Design of main switch board and distribution boards considering electrical services of building (including lift and escalator) and standby generating units, Selection of switch gear for control and protection (ACB, MCCB,VCB etc.), Power factor improvement, APFC.
Electrical design concepts of 1) Hospitals, 2) Cinema Theatre
Module IV (13 hours)
Design, layout and schematic diagram of substations (using transformers up to 630kVA) availing supply at 11 kV - Standard values of voltage and frequency – Selection of switch gear for control and protection (MCCB, ACB, VCB, SF_6 CB etc.), Selection of HT & LT cables - Types and Testing of HT cables, Design of Earthing System:- Measurement of Earth resistance using Earth Megger - soil resistivity - Types of earth electrodes - design of pipe earthing, rod earthing and plate earthing - Earth buses and Earth wires, grounding of electronic equipments, Concept of Earth mat, Shielding of Electric systems, Lightning protection - Materials, Shapes and Sizes of Lightning conductors - Joints and bonds - Isolation and bonding – Testing

Reference Books

1. National Electric Code (India)
2. Indian Electricity Act 2003, Central Electricity Authority (Measures relating to Safety and Electricity supply) Regulations 2010.
3. IEC standards, IS Codes, National Building Code, Bureau of Indian Standard Publications, Cinema Regulation (Rules)
4. K.B. Raina & S.K. Battacharya, *Electrical System Design, Estimation & Costing*, New Age international (P) Limited publishers
5. Gupta J.B., *Electrical Installation, Estimation & Costing*, S. K. Kataria & Sons
6. V. K. Jain & Amitabh Bajaj, *Design of Electrical Installations*, Lakshmi Publications Pvt. Ltd
7. ABB Switchgear Manual

Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions *8x 5 marks=40 marks*

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions 4 x 15 marks=60 marks

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

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Course code	Course Name	L-T-P-Credits	Year of Introduction
CS308	Software Engineering and Project Management	3-0-0-3	2016

Pre-requisite: Nil

Course Objectives

- To introduce the fundamental concepts of software engineering.
- To build an understanding on various phases of software development.
- To introduce various software process models.

Syllabus

Introduction to software engineering, Software process models, Software development phases, Requirement analysis, Planning, Design, Coding, Testing, Maintenance.

Expected Outcome

The students will be able to

i. Identify suitable life cycle models to be used.
ii. Analyze a problem and identify and define the computing requirements to the problem.
iii. Translate a requirement specification to a design using an appropriate software engineering methodology.
iv. Formulate appropriate testing strategy for the given software system.
v. Develop software projects based on current technology, by managing resources economically and keeping ethical values.

References

1. Ian Sommerville, Software Engineering, University of Lancaster, Pearson Education, Seventh edition, 2004.
2. K. K.Aggarwal and Yogesh Singh, Software Engineering, New age International Publishers, Second edition, 2005.
3. Roger S. Pressman, Software Engineering : A practitioner's approach, McGraw Hill publication, Eighth edition, 2014
4. S.A. Kelkar, Software Project Management: A concise study, PHI, Third edition, 2012.
5. Walker Royce, Software Project Management : A unified frame work, Pearson Education, 1998

COURSE PLAN

Module	Contents	Hours	End Sem. Exam Marks
I	Introduction to software engineering- scope of software	07	15%

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Course code	Course Name	L-T-P - Credits	Year of Introduction
CS368	**Web Technologies**	**3-0-0-3**	**2016**

Prerequisite: Nil

Course Objectives

- To impart the design, development and implementation of Dynamic Web Pages.
- To develop programs for Web using Scripting Languages.
- To give an introduction to Data Interchange formats in Web.

Syllabus

Basics of Internet and World Wide Web, HTML and XHTML, Cascading Style Sheets, Frameworks, Basics of JavaScript, JQuery, Introduction to XML and JSON, Overview of PHP

Expected Outcome

The student will be able to

i. Understand different components in web technology and to know about CGI and CMS.
ii. Develop interactive Web pages using HTML/XHTML.
iii. Present a professional document using Cascaded Style Sheets.
iv. Construct websites for user interactions using JavaScript and JQuery.
v. Know the different information interchange formats like XML and JSON.
vi. Develop Web applications using PHP.

Text Books

1. P. J. Deitel, H.M. Deitel, Internet &World Wide Web How To Program, 4/e, Pearson International Edition 2010.
2. Robert W Sebesta, Programming the World Wide Web, 7/e, Pearson Education Inc., 2014

References

1. Bear Bibeault and Yehuda Katz, jQuery in Action, Second Edition, Manning Publications.[Chapter 1]
   Black Book, Kogent Learning Solutions Inc. 2009.
2. Bob Boiko, Content Management Bible, 2nd Edition, Wiley Publishers. [Chapter 1, 2]
3. Chris Bates, Web Programming Building Internet Applications, 3/e, Wiley India Edition 2009.
4. Dream Tech, Web Technologies: HTML, JS, PHP, Java, JSP, ASP.NET, XML, AJAX,
5. Jeffrey C Jackson, Web Technologies A Computer Science Perspective, Pearson Education Inc. 2009.
6. Lindsay Bassett, Introduction to JavaScript Object Notation: A To-the-Point Guide to JSON 1st Edition, O'Reilly.[Chapter 1,2,3,4]
7. Matthew MacDonald, WordPress: The Missing Manual, 2nd Edition, O'Reilly Media. [Chapter 1]

Web Resources

1. www.w3.org/CGI/
2. old.tree.ro/en/strategy-white-papers/content-management-systems.pdf
3. httpd.apache.org/download.cgi
4. https://alistapart.com/article/frameworks
5. http://getbootstrap.com/css/
6. https://www.w3.org/TR/WD-DOM/introduction.html

Course Plan

Module	Contents	Hours	End Sem. Exam Marks

	Substitution Techniques, Caesar Cipher, Mono alphabetic Cipher, Play fair cipher, Hill cipher, Poly alphabetic Cipher, one time pad	4	
IV	Transposition techniques ,Block Ciphers, Data encryption Standards, DES Encryption, DES decryption	3	15%
	Differential and Linear Crypt analysis Advanced Encryption standard	2	
	The AES Cipher, substitute bytes transformation, Shift row transformation, Mix Column transformation.	2	
SECOND INTERNAL EXAM			
V	Public key cryptosystem, Application for Public key cryptosystem requirements	2	20%
	RSA algorithm, Key management, Distribution of public key, public key certificates, Distribution of secret keys.	5	
VI	Intruders: Intrusion techniques, Intrusion detection, Statistical anomaly detection, Rule based intrusion detection, Distributed intrusion detection, Honey pot, Intrusion detection exchange format.	5	20%
	Password management: Password protection, password selection strategies.	2	
END SEMESTER EXAM			

Question Paper Pattern

The question paper shall consist of three parts. Part A covers modules I and II, Part B covers modules III and IV, and Part C covers modules V and VI. Each part has three questions uniformly covering the two modules and each question can have maximum four subdivisions. In each part, any two questions are to be answered. Mark patterns are as per the syllabus with 50% for theory and 50% for logical/numerical problems, derivation and proof.

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III	Microwave Network Analysis – Equivalent voltages and currents, Impedance and Admittance matrices, Scattering matrix, The transmission matrix.	3	15%
	Signal flow graphs. Impedance matching and tuning – Matching with lumped elements, Single stub tuning, Double stub tuning. Quarter wave transformer, Theory of small reflections.	4	
IV	Microwave filters – Periodic structures – Analysis of infinite periodic structures and terminated periodic structures, Filter design by image parameter method – Constant k, m-derived and composite. Filter design by insertion loss method. Filter transformation and implementation.	7	15%
	SECOND INTERNAL EXAM		
V	Introduction to MICSs:-Technology of hybrid MICs, monolithic MICs. Comparison of both MICs.	4	20%
	Planar transmission lines such as stripline, microstrip line, and slotline.	3	
VI	Distributed and lumped elements of integrated circuits - capacitors, inductors, resistors, terminations, attenuators, resonators and discontinuities.	5	20%
	Diode control devices – switches, attenuators, limiters. Diode phase shifter. Circulators and isolators.	2	
	EN[illegible]		

Question Paper Pattern

The question paper shall consist of three parts. Part A covers modules I and II, Part B covers modules III and IV, and Part C covers modules V and VI. Each part has three questions uniformly covering the two modules and each question can have maximum four subdivisions. In each part, any two questions are to be answered. Mark patterns are as per the syllabus with 70% for theory and 30% for logical/numerical problems, derivation and proof.

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Mechanical Engineering

Course No.	Course Name	L-T-P-Credits	Year of Introduction
ME204	THERMAL ENGINEERING	3-1-0-4	2016

Prerequisite: ME205 Thermodynamics

Course Objectives:

1. To acquire knowledge on the working of steam turbines, IC engines and gas turbines
2. To introduce the combustion process in IC engines
3. To understand air pollution from IC engines and its remedies.

Syllabus

Steam engineering, boilers, steam nozzles, steam turbines, internal combustion engines, performance testing of IC Engines, fuels and fuel combustion, air pollution from IC engines and remedies, combustion in I.C. engines, gas turbines

Expected outcome: At the end of the course the students will be able to

1. Integrate the concepts, laws and methodologies from the course in thermodynamics into analysis of cyclic processes
2. To apply the thermodynamic concepts into various thermal application like IC engines, steam turbines, compressors.

Text Books:

1. Rudramoorthy , Thermal Engineering, McGraw Hill Education India,2003
2. R.K Rajput, Thermal Engineering, Laxmi publications,2010

References Books:

1. V. Ganesan, Fundamentals of IC engines, Tata McGraw-Hill,2002
2. T.D. Eastop and A McConkey, Applied thermodynamics for engineering technology, Pearson education,1996
3. J.B.Heywood, I.C engine fundamentals. McGraw-Hill,2011
4. Gill, P.W., Smith, JR., J.H., and Ziurys, E.J Fundamentals of internal combustion engines Oxford and IBH,1959
5. Rathore, Thermal Engineering, McGraw Hill Education India, 2010

Steam Tables

6. R.S.Khurmi, Steam table with Mollier chart,S.Chand,2008

Course Plan			
Module	**Contents**	**Hours**	**Sem. Exam Marks**
I	Steam engineering- T- S diagram, Mollier chart, Steam cycles- Rankine cycle, Modified Rankine cycle, Relative efficiency, Improvement in steam cycles-Reheat, Regenerative and Binary vapor cycle Steam Boilers: Types of boilers –Cochran boiler, Babcock and Wilcox boiler, Benson boiler, La Mont boiler, Loeffler boiler, Velox boiler, Boiler Mountings and Accessories Steam nozzles:-Types of nozzle- Velocity of steam, mass flow rate, critical pressure ratio and its significance, effect of friction, super saturated flow	8	15%
II	Steam turbines: classification, compounding of turbines-pressure velocity variation, velocity diagrams, work done, efficiency, condition for maximum efficiency, multistage turbines-condition line, stage efficiency. Steam turbine performance-reheat factor, degree of reaction, cycles with reheating and regenerative heating, governing of turbines	8	15%
FIRST INTERNAL EXAM			
III	Internal combustion engines: classification of I.C. Engines- four stroke and two stroke I.C. Engines, Comparison of four stroke and two stroke Engine. Wankel Engine, Air standard cycle-Carnot cycle, Otto cycle; Diesel cycle, dual combustion cycle, comparison of Otto, diesel and dual combustion cycles. Stirling and Ericsson cycles, air standard efficiency, specific work output, work ratio, Actual cycle analysis, deviation of actual engine cycle from ideal cycle. Rotary engines, Stratified charge engine , super charging of SI and CI Engines – turbo charging. Variable specific heats.	10	15%
IV	Performance Testing of I C Engines: Indicator diagram, mean effective pressure. Torque, Engine power- BHP, IHP. Engine efficiency-mechanical efficiency, volumetric efficiency, thermal efficiency and relative efficiency, Specific fuel consumption. Testing of I C engines-Morse test, Heat balance test and Retardation test Fuels and fuel combustion: flash point and fire point, calorific value, Fuels for SI and CI engine, Important qualities of SI and CI engine fuels, Rating of SI engine and CI engine fuels, Dopes, Additives, Gaseous fuels, LPG, CNG, Biogas, Producer gas. Analysis of fuel combustion-A/F ratio, equivalence ratio, minimum quantity of air, flue gas analysis, excess air.	10	15%
SECOND INTERNAL EXAM			
V	Air pollution from I.C. Engine and its remedies: Pollutants from S.I. and C.I. Engines, Methods of emission control, alternative fuels for I.C. Engines; the blending of fuels, Bio fuels. Combustion in I.C. Engines: Combustion phenomena in S.I. engines; Ignition limits, stages of combustion in S.I. Engines, Ignition lag, velocity of flame propagation, auto ignition, detonation; effects of engine variables on detonation; theories of detonation, octane rating of fuels;	10	20%

	pre-ignition; S.I. engine combustion chambers. Stages of combustion in C.I. Engines; delay period; variables affecting delay period; knock in C.I. engines, Cetane rating; C.I. engine combustion chambers.		
VI	Gas turbines: classification, Thermodynamic analysis of gas turbine cycles-open , closed and semi closed cycle; ideal working cycle- Brayton cycle-P-v and T-s diagram, thermal efficiency. Effect of compressor and turbine efficiencies. Optimum pressure ratio for maximum specific work output with and without considering machine efficiencies. Comparison of gas turbine and IC engines, Analysis of open cycle gas turbine, Improvements of the basic gas turbine cycles-regeneration, intercooling and reheating-cycle efficiency and work output-Condition for minimum compressor work and maximum turbine work. Combustion chambers for gas turbines. pressure loss in combustion process and stability loop.	10	20%
END SEMESTER EXAM			

Question Paper Pattern

Total marks: 100, Time: 3 hrs

The question paper should consist of three parts

Part A

4 questions uniformly covering modules I and II. Each question carries 10 marks

Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part B

4 questions uniformly covering modules III and IV. Each question carries 10 marks

Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part C

6 questions uniformly covering modules V and VI. Each question carries 10 marks

Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

Note: In all parts, each question can have a maximum of four sub questions, if needed.

Course No.	Course Name	L-T-P-Credits	Year of Introduction
ME206	FLUID MACHINERY	2-1-0-3	2016

Prerequisite: ME203 Mechanics of Fluids

Course Objectives:

1. To acquire knowledge on hydraulic machines such as pumps and turbines
2. To understand the working of air compressors and do the analysis

Syllabus

Impact of jets, Hydraulic Turbines, Rotary motion of liquids, Rotodynamic pumps, Positive displacement pumps, , Compressors

Expected outcome: At the end of the course the students will be able to

1. Discuss the characteristics of centrifugal pump and reciprocating pumps
2. Calculate forces and work done by a jet on fixed or moving plate and curved plates
3. Know the working of turbines and select the type of turbine for an application.
4. Do the analysis of air compressors and select the suitable one for a specific application

Text Books:

1. Som, Introduction to Fluid Mechanics and Fluid Machines ,McGraw Hill Education India 2011
2. Bansal R. K., A Textbook of Fluid Mechanics and Hydraulic Machines, Laxmi Publications,2005.

Reference Books:

1. Cengel Y. A. and J. M. Cimbala, Fluid Mechanics, Tata McGraw Hill, 2013
2. Yahya S. M, Fans, Blower and Compressor, Tata McGraw Hill, 2005.
3. Shepherd D. G, Principles of Turbo Machinery, Macmillan, 1969.
4. Stepanoff A. J, Centrifugal and Axial Flow Pumps, John Wiley & Sons, 1991.
5. Rajput R. K, Fluid Mechanics and Hydraulic Machines, S. Chand & Co.,2006.
6. Subramanya, Fluid mechanics and hydraulic machines, 1e McGraw Hill Education India,2010

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Course Plan			
Module	**Contents**	**Hours**	**Sem. Exam Marks**
I	Impact of jets: Introduction to hydrodynamic thrust of jet on a fixed and moving surface (flat and curve),– Series of vanes - work done and efficiency Hydraulic Turbines : Impulse and Reaction Turbines – Degree of reaction – Pelton Wheel – Constructional features - Velocity triangles – Euler's equation – Speed ratio, jet ratio and work done , losses and efficiencies, design of Pelton wheel – Inward and outward flow reaction turbines- Francis Turbine – Constructional features – Velocity triangles, work done and efficiencies.	7	15%
II	Axial flow turbine (Kaplan) Constructional features – Velocity triangles- work done and efficiencies – Characteristic curves of turbines – theory of draft tubes – surge tanks – Cavitation in turbines – Governing of turbines – Specific speed of turbine , Type Number– Characteristic curves, scale Laws – Unit speed – Unit discharge and unit power.	7	15%
FIRST INTERNAL EXAM			
III	Rotary motion of liquids – free, forced and spiral vortex flows Rotodynamic pumps- centrifugal pump impeller types,-velocity triangles-manometric head- work, efficiency and losses, H-Q characteristic, typical flow system characteristics, operating point of a pump. Cavitation in centrifugal pumps- NPSH required and available- Type number-Pumps in series and parallel operations. Performance characteristics- Specific speed-Shape numbers – Impeller shapes based on shape numbers.	7	15%
IV	Positive displacement pumps- reciprocating pump – Single acting and double acting- slip, negative slip and work required and efficiency- indicator diagram- acceleration head - effect of acceleration and friction on indicator diagram – speed calculation- Air vessels and their purposes, saving in work done to air vessels multi cylinder pumps. Multistage pumps-selection of pumps-pumping devices-hydraulic ram, Accumulator, Intensifier, Jet pumps, gear pumps, vane pump and lobe pump.	7	15%
SECOND INTERNAL EXAM			
V	Compressors: classification of compressors, reciprocating compressor-single stage compressor, equation for work with and without clearance volume, efficiencies, multistage compressor, intercooler, free air delivered (FAD)	7	20%
VI	Centrifugal compressor-working, velocity diagram, work done, power required, width of blades of impeller and diffuser, isentropic efficiency, slip factor and pressure coefficient, surging and chocking. Axial flow compressors:- working, velocity diagram, degree of reaction, performance. Roots blower, vane compressor, screw compressor.	7	20%
END SEMESTER EXAM			

Question Paper Pattern

Total marks: 100, Time: 3 hrs

The question paper should consist of three parts

Part A

4 questions uniformly covering modules I and II. Each question carries 10 marks

Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part B

4 questions uniformly covering modules III and IV. Each question carries 10 marks

Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part C

6 questions uniformly covering modules V and VI. Each question carries 10 marks

Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

Note: In all parts, each question can have a maximum of four sub questions, if needed.

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Course No.	Course Name	L-T-P-Credits	Year of Introduction
ME220	**MANUFACTURING TECHNOLOGY**	**3-0-0-3**	**2016**

Prerequisite: Nil

Course Objectives:-

1. To give an exposure to different techniques of casting and molds required.
2. To provide an exposure to different rolling processes and different rolled products
3. To familiarize with different forging methods, cautions to be adopted in die design.
4. To give an introduction to various work and tool holding devices used in manufacturing.
5. To introduce to the bending, shearing and drawing processes of sheet metal working and allied machines,
6. To give an understanding of welding metallurgy and weldability and to introduce various metal joining techniques.

SYLLABUS

Casting –patterns - Cores – Gating – Risering – Defects in Castings - Rolling –Defects in Rolled parts- forging – Coining – Heading – Piercing –Die Design– Extrusion Process– Extrusion Defects – Drawing Process -Principles of Location –Principles of Clamping – Types of Clamp -Sheet metal characteristics –Deep drawing –Spinning –Definition of Welding – Weldability – Solidification of Weld Metal – Heat Affected Zone – Welding Defects - Gas Welding -Arc Welding - Ultrasonic Welding – Friction Welding – Resistance Welding — Brazing- Soldering.

Expected outcomes: At the end of the course the students will be able to

1. Acquire knowledge in various casting processes and technology related to them.
2. Understand the rolling passes required for getting required shapes of rolled products.
3. Discuss important aspects of forging techniques
4. Discuss sheet metal working processes and their applications to produce various shapes and products.
5. Acquire knowledge in various types of welding processes.

Text books:-

1. Amitabha Ghosh and Ashok Kumar Mallick, Manufacturing Science Affiliated East West Press Ltd, New Delhi, 2002
2. S.Kalpakjian and Steven R Schimid, Manufacturing Engineering and Technology, Pearson.2001

Reference books:-

1. RAO, Manufacturing Technology-Vol 2 3e, McGraw Hill Education India, 2013
2. RAO, Manutacturing Technology-Vol 1 4e, McGraw Hill Education India, 2013
3. Cyril Donaldson and George H LeCain, Tool Design,TMH
4. Handbook of Fixture Design – ASTME
5. Campbell J. S., Principles of Manufacturing Materials and Processes, Tata McGraw Hill, 1999
6. P.R Beeley, Foundry Technology, Elsevier, 2001
7. Richard W. Heine, Carl R. Loper, Philip C. Rosenthal, Principles of Metal Casting,

Tata McGraw-Hill Education, 2001
8. Paul Degarma E and Ronald A. Kosher ,Materials and Processes in Manufacturing, Wiley,20111
9. P. N. Rao,Manufacturing Technology Foundry, Forming and Welding, Tata McGraw-Hill Education,2011
10. HMT Production Technology, 1e McGraw Hill,2001

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Course Plan

Module	Contents	Hours	Semester Examination Marks
I	Sand Casting – Sand Molds-Types of Molding Sands and Testing	1	15%
	Type of patterns - Pattern Materials	1	
	Cores –Types and applications –Sand Molding Machines	1	
	Gating System – Risering	1	
	Shell Mold Casting – Ceramic Mold Casting	1	
	Investment Casting – Vacuum Casting – Slush Casting	1	
	Pressure Casting – Die Casting – Centrifugal Casting	1	
	Design Considerations based on Various Shapes - Defects in Castings – simple problems in casting	1	
II	Principles of Rolling –Types of rolling mills, Mechanics of Flat Rolling	1	15%
	Roll Force and Power Requirement - Neutral Point	1	
	Hot and Cold Rolling	1	
	Defects in Rolled Plates - Rolling Mills	1	
	Ring Rolling – Thread Rolling	1	
	Applications- Rolling of tubes, wheels, axles and I-beams	1	
FIRST INTERNAL EXAM			
III	Classification of forging – Forging methods – Forging under sticking condition	1	15%
	Precision Forging – Coining – Heading – Piercing	1	
	Die Design:- Preshaping, Design Features, Draft Angles – Die Materials and Lubrication	1	
	Forging Machines – Forging Defects and tests	1	
	Extrusion Process - Hot Extrusion – Cold Extrusion	1	
	Impact Extrusion – Extrusion Defects – Drawing Process, wire drawing process	1	

IV	Principles Location - Degrees of Freedom, 3-2-1 principle of locating	1	15%
	Locating from Planes - Locating from Circular Surfaces	1	
	Concentric Locating - Principles of Clamping	1	
	Types of Clamps - Strap Clamps Slide Clamps - Swing Clamps - Hinge Clamps	1	
	Vacuum Clamping - Magnetic Clamping	1	
SECOND INTERNAL EXAM			
V	Sheet metal characteristics – Typical shearing	1	20%
	Bending Sheet and Plate – Spingback - Bending Force	1	
	Press Brake Forming - Tube Bending	1	
	Stretch Forming - Deep Drawing	1	
	Rubber forming - Spinning Shear Spinning - Tube Spinning	1	
	Definition of Welding - Weldability – Solidification of the Weld Metal	1	
	Heat Affected Zone – correlation of strength of welded joint with structure - Welding Defects	1	
VI	Gas Welding: – Flame Characteristics	1	20%
	Equipment, fluxes and filler rods	1	
	Arc Welding – Applications and Equipment	1	
	Electrodes	1	
	Shielded Metal Arc Welding – Submerged Arc Welding	1	
	GTAW – Plasma Arc Welding	1	
	Ultrasonic Welding – Friction Welding	1	
	Resistance Spot Welding	1	
	Resistance Seam Welding – Stud Welding – Percussion Welding - simple problems in welding	1	
	Brazing:- Filler Metals, Methods - Soldering:- Techniques, Types of Solders and Fluxes	1	
END SEMESTER EXAM			

Question Paper Pattern

Total marks: 100, Time: 3 hrs

The question paper should consist of three parts

Part A

4 questions uniformly covering modules I and II. Each question carries 10 marks

Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part B

4 questions uniformly covering modules III and IV. Each question carries 10 marks

Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part C

6 questions uniformly covering modules V and VI. Each question carries 10 marks

Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

Note: In all parts, each question can have a maximum of four sub questions, if needed.

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Course code	Course Name	L-T-P-Credits	Year of Introduction
ME304	DYNAMICS OF MACHINERY	2-1-0-3	2016

Prerequisite: ME301 Mechanics of Machinery

Course Objectives:

- To impart knowledge on force analysis of machinery, balancing of rotating and reciprocating masses, Gyroscopes, Energy fluctuation in Machines.
- To introduce the fundamentals in vibration, vibration analysis of single degree of freedom systems.
- To understand the physical significance and design of vibration systems with desired conditions

Syllabus

Force analysis of machinery - static and dynamic force analysis of plane motion mechanisms. Flywheel analysis - static and dynamic balancing - balancing of rotating masses, gyroscopic couples. Vibrations – free vibrations of single degree freedom systems, damping, forced vibration, torsional vibration.

Expected outcome:

The students will be able to

1. Develop the design and practical problem solving skills in the area of mechanisms
2. Understand the basics of vibration and apply the concepts in design problems of mechanisms.

Text Books:

1. Ballaney P.L. Theory of Machines, Khanna Publishers,1994
2. S. S. Rattan. Theory of Machines, Tata McGraw Hill, 2009
3. V. P. Singh. Theory of Machines, Dhanpat Rai,2013

References :

1. E. Wilson. P. Sadler, Kinematics and Dynamics of Machinery, Pearson Education, 2003
2. Ghosh. A. K. Malik, Theory of Mechanisms and Machines, Affiliated East West Press, 2003
3. H. Myszka. Machines and Mechanisms Applied Kinematic Analysis, Pearson Education, 4e, 2012
4. Holowenko. Dynamics of Machinery, John Wiley, 1995
5. J. E. Shigley. J. J. Uicker, Theory of Machines and Mechanisms, McGraw Hill,1995
6. W. T. Thompson. Theory of vibration, Prentice Hall,1997

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Course Plan			
Module	**Contents**	**Hours**	**End Sem. Exam Marks**
I	Introduction to force analysis in mechanisms - static force analysis (four bar linkages only) - graphical methods	4	15%
	Matrix methods - method of virtual work - analysis with sliding and pin friction	3	
II	Dynamic force analysis: Inertia force and inertia torque. D'Alemberts principle, analysis of mechanisms (four bar linkages only), equivalent dynamical systems	4	15%
	Force Analysis of spur- helical - bevel and worm gearing	3	
FIRST INTERNAL EXAM			
III	Flywheel analysis - balancing - static and dynamic balancing - balancing of masses rotating in several planes	4	15%
	Balancing of reciprocating masses - balancing of multi-cylinder in line engines - V engines - balancing of machines	3	
IV	Gyroscope – gyroscopic couples	3	15%
	Gyroscopic action on vehicles-two wheelers, four wheelers, air planes and ships. Stability of an automobile – stability of a two wheel vehicle –Stabilization of ship.	4	
SECOND INTERNAL EXAM			
V	Introduction to vibrations – free vibrations of single degree freedom systems – energy Method	2	20%
	Undamped and damped free vibrations – viscous damping – critical damping - logarithmic decrement - Coulomb damping – harmonically excited vibrations	3	
	Response of an undamped and damped system – beat phenomenon - transmissibility	2	
VI	Whirling of shafts – critical speed - free torsional vibrations – self excitation and stability analysis - vibration control - vibration isolation – vibration absorbers	4	20%
	Introduction to multi-degree freedom systems - vibration measurement - accelerometer – seismometer – vibration exciters	3	
END SEMESTER EXAM			

Question Paper Pattern

Maximum marks: 100 **Time: 3 hrs**

The question paper should consist of three parts

Part A
There should be 2 questions each from module I and II
Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part B
There should be 2 questions each from module III and IV
Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part C
There should be 3 questions each from module V and VI
Each question carries 10 marks
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

Note: Each question can have a maximum of four sub questions, if needed.

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Course code	Course Name	L-T-P-Credits	Year of Introduction
ME306	ADVANCED MANUFACTURING TECHNOLOGY	3-0-0-3	2016

Pre requisite: ME 220 Manufacturing Technology, ME303 Machine Tools and Digital Manufacturing

Course Objectives

1. To introduce machining principles and processes in the manufacturing of precision components and products that use conventional and nonconventional technologies.
2. To give basic understanding of the machining capabilities, limitations, and productivity of advanced manufacturing processes.
3. To describe how PLC's operate and how they control automated equipment and systems
4. To demonstrate tool path simulations with CNC powered equipment
5. To introduce CNC programming

Syllabus:-

Powder Metallurgy- Programmable Logic Controllers- CNC- non-traditional and micro machining process - high velocity forming of metals-material additional process.

Expected outcome:

The students will be able to

i. Become conversant with the non- traditional machining process and to appreciate the effect of process parameters on the surface integrity aspects during the non- traditional machining process.
ii. Appreciate the use of an EDM as a non traditional method of machining complex and hard materials.
iii. Prescribe a laser materials processing technique suitable for a given product with material, size, precision, and surface quality requirements.
iv. Program and operate a CNC mill and lathe.
v. Select the tool material and machining process parameters.

Text books/References

1. ASTME, High velocity forming of metals, PHI, 1968.
2. Davies K and Austin E.R, Developments in high speed metal forming, the machinery publishing Co, 1970.
3. Ibrahim Zeid, R Sivasubrahmanian CAD/CAM: Theory & Practice, McGraw Hill Education, 2009
4. Jain V.K., Introduction to Micromachining, Narosa publishers,2014
5. M.P. Groover, E.M. Zimmers, Jr. CAD/CAM; Computer Aided Design and Manufacturing, Prentice Hall of India, 1987
6. Petruzella Frank.D., Programmable logic controllers,McGraw Hill,2016
7. Yoram Koren, Computer control of manufacturing systems, TMH,2006

Course Plan			
Module	Contents	Hours	End Sem. Exam. Marks
I	Introduction: Need and comparison between traditional, non-traditional and micro & nano machining process.	1	15%
	Powder Metallurgy: Need of P/M - Powder Production methods:- Atomization, electrolysis, Reduction of oxides, Carbonyls (Process parameters, characteristics of powder produced in each method).	1	
	Powder characteristics: properties of fine powder, size, size distribution, shape, compressibility, purity etc.	1	
	Mixing – Compaction:- techniques, pressure distribution, HIP & CIP.	1	
	Mechanism of sintering, driving force for pore shirking, solid and liquid phase sintering - Impregnation and Infiltration Advantages, disadvantages and specific applications of P/M.	1	
	Programmable Logic Controllers (PLC): need – relays - logic ladder program –timers, simple problems only.	1	
	Point to point, straight cut and contouring positioning - incremental and absolute systems – open loop and closed loop systems - control loops in contouring systems: principle of operation.	1	
II	DDA integrator:-Principle of operation, exponential deceleration –liner, circular and complete interpolator.	1	15%
	NC part programming: part programming fundamentals - manual programming –	1	
	NC coordinate systems and axes — sequence number, preparatory functions, dimension words, speed word, feed world, tool world, miscellaneous functions –	1	
	Computer aided part programming:– CNC languages – APT language structure: geometry commands, motion	1	
	commands, postprocessor commands, compilation control commands	1	
	Programming exercises: simple problems on turning and drilling etc - machining centers- 5 axis machining (***At least one programming exercise must be included in the end semester University examination).***	2	
	FIRST INTERNAL EXAMINATION		

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Mechatronics Engineering

Course code	Course Name	L-T-P - Credits	Year of Introduction
MR409	Micro Electro Mechanical Systems	3-0-0-3	2016

Prerequisite : NIL

Course Objectives

- To impart knowledge in micro machining techniques and Micro Electro Mechanical systems

Syllabus

Micro electro mechanical system – micro fabrication – microsystems and miniaturization- Materials for MEMS - Microsystems packaging- Micro Manufacturing Techniques - Micro-fabrication special machining - Theory of micromachining- Binder less wheel-Free form optics – Micro sensors: acoustic – Micro actuation - MEMS with micro actuators - Laws of scaling- Applications of MEMS - Future of MEMS

Expected outcome.

On completion of the course the student will be able to understand

i. the technology for fabrication of MEMS
ii. the behavior of materials used in MEMS
iii. the applications of MEMS

Text Books:

1. Tai-Ran Hsu MEMS & Microsytems Design and Manufacture, Tata McGraw-Hill publishing company Ltd.
2. N. Maluf, *an Introduction to Microelectro Mechanical Systems Engineering*, Artech House, 2000.

References:

1. V.C.Venaktesh , Precision Engineering, Tata McGraw-Hill Publishing Company Limited
2. Madou M.J., *Fundamentals of micro fabrication*, CRC Press, 1997.
3. Chang Liu, *Foundation of MEMS*, Illinois ECE Series, Pearson Prentice Hall 2006.

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Micro electro mechanical system: MEMS and microsystems – evolution of microfabrication – microsystems and miniaturization- Materials for MEMS - Microsystems packaging.	7	15%
II	Micro Manufacturing Techniques: Photolithography- chemical Vapour Deposition – Physical Vapour Deposition- Etching Processes-Bulk micro manufacturing- surface micro manufacturing- LIGA process.	7	15%
FIRST INTERNAL EXAMINATION			

III	Micro-fabrication special machining: Laser beam micro machining- Electrical Discharge Machining- Ultrasonic Machining- Electro chemical Machining- Electron beam machining. Clean room-New Materials	7	15%
IV	Mechanical micromachining: Theory of micromachining-Chip formation-size effect in micromachining-microturning-micromilling- microdrilling- Precision Grinding : Partial ductile mode grinding- Binderless wheel-Free form optics.	7	15%
SECOND INTERNAL EXAMINATION			
V	Microsensors:acoustic- biomedical- chemical- optical- pressure-thermal- Microactuation : actuation using thermal forces- shape memory alloys- piezo electric crystals-electrostatic forces. MEMS with micro actuators: microgrippers - micromotors-microvalves-micropumps.	7	20%
VI	Laws of scaling- Applications of MEMS in various industries : Automobile- defence- healthcare- Aerospace- industry- Future of MEMS	7	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN

Maximum Marks : 100 Exam Duration:3 hours

PART A: FIVE MARK QUESTIONS

8 compulsory questions –1 question each from first four modules and 2 questions each from last two modules (8 x 5= 40 marks)

PART B: 10 MARK QUESTIONS

5 questions uniformly covering the first four modules. Each question can have maximum of three sub questions, if needed. Student has to answer any 3 questions

(3 x10 = 30 marks)

PART C: 15 MARK QUESTIONS

4 questions uniformly covering the last two modules. Each question can have maximum of four sub questions, if needed. Student has to answer any two questions

(2 x15 = 30 marks)

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Course code	Course Name	L-T-P - Credits	Year of Introduction
MR304	Digital Image Processing and Machine Vision	3-0-0-3	2016

Prerequisite : NIL

Course Objectives

- To give the fundamentals of image processing and mathematical transforms necessary for image processing.
- To familiarise the image enhancement techniques.
- To know image restoration and image compression procedures.
- To provide the concept of image segmentation and image representation techniques.

Syllabus

Elements of visual perception – Image sampling and quantization- Basic relationship between pixels – Basic geometric transformations- FFT – Separable Image Transforms -Walsh – Hadamard – DCT- Haar-Spatial Domain methods: Basic grey level transformation – Histogram equalization – Image subtraction – Image averaging –Spatial filtering: Smoothing- sharpening filters –Frequency domain filters- Homomorphic filtering- Model of Image Degradation/restoration process – Noise models – Inverse filtering –Least mean square filtering – Constrained least mean square filtering – Blind image restoration – Pseudo inverse-Lossless compression: Variable length coding - predictive coding-DPCM. Lossy Compression: Transform coding – Wavelet coding – Basics of Image compression standards: JPEG- MPEG- Edge detection – Thresholding - Region Based segmentation – Boundary representation: chain codes– Boundary segments – boundary descriptors: Simple descriptors-Fourier descriptors - Regional descriptors –Simple descriptors- Texture.- Machine Vision- sensing- low and higher level vision- image acquisition and digitization- cameras- CCD- CID- CPD- illumination and types- image processing and analysis- feature extraction- applications.

Expected outcome

On completion of the course the student will be able to understand

- Basic concepts of digital image processing
- Various steps involved in digital image processing
- Techniques involved in machine vision

Text Books:

1.. Rafel C.Gonzalez and Richard E.Woods. Digital Image Processing, Addison Wesley, 1993.
2. Anil K. Jain, Fundamentals of Digital Image Processing, Prentice Hall of India, 1997
3. Vernon D, Machine Vision – Automated Visual Inspection and Robot Vision, Prentice Hall, International Ltd., 1991
4. Ramesh Jain, Rangachar Kasturi, Brain G. Schunk, Machine Vision, McGraw Hill International Editions, Computer Science Series.

References:

1. William K. Pratt, Digital Image Processing, John Wiley, NY, 1987.
2. Sid Ahmed M.A., Image Processing Theory, Algorithms and Architectures, McGraw Hill, 1995.

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Elements of visual perception – Image sampling and quantization- Basic relationship between pixels – Basic	7	15%

	geometric transformations-Introduction to Fourier Transform Properties of 2D Fourier Transform – Separable Image Transforms –Walsh – Discrete Cosine Transform- Haar		
II	Spatial Domain methods: Basic grey level transformation – Histogram equalization – Image subtraction – Image averaging –Spatial filtering: Smoothing- sharpening filters –Frequency domain filters: Smoothing – Sharpening filters – Homomorphic filtering.	7	15%
FIRST INTERNAL EXAMINATION			
III	Model of Image Degradation/restoration process – Noise models – Inverse filtering –Least mean square filtering – Constrained least mean square filtering – Blind image restoration – Pseudo inverse	7	15%
IV	Lossless compression: Variable length coding – LZW coding – Bit plane coding- predictive coding-DPCM. Lossy Compression: Wavelet coding-Digital Image Watermarking. – Basics of Image compression standards: JPEG- MPEG	7	15%
SECOND INTERNAL EXAMINATION			
V	Edge detection – Thresholding - Region Based segmentation – Boundary representation: chain codes– Boundary segments – boundary descriptors: Simple descriptors-Fourier descriptors - Regional descriptors –Simple descriptors- Texture.	7	20%
VI	Machine Vision- sensing- low and higher level vision- image acquisition and digitization- cameras- CCD- CID- CPD- illumination and types- image processing and analysis- feature extraction- applications.	7	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN

Maximum Marks : 100 Exam Duration:3 hours

PART A: FIVE MARK QUESTIONS

8 compulsory questions –1 question each from first four modules and 2 questions each from last two modules (8 x 5= 40 marks)

PART B: 10 MARK QUESTIONS

5 questions uniformly covering the first four modules. Each question can have maximum of three sub questions, if needed. Student has to answer any 3 questions (3 x10 = 30 marks)

PART C: 15 MARK QUESTIONS

4 questions uniformly covering the last two modules. Each question can have maximum of four sub questions, if needed. Student has to answer any two questions

(2 x15 = 30 marks)

Course code	Course Name	L-T-P - Credits	Year of Introduction
MR466	Special Electrical Machines and Applications	3-0-0:3	2016

Prerequisite : NIL

Course Objectives

- To impart knowledge on the working of special electrical machines and their applications in mechatronics systems.
- To impart knowledge on the characteristics of stepper motors, synchronous motors, PMDC motors and switched reluctance motors.

Syllabus

Introduction to special machines- Stepper motors- Working principle and its types- Characteristics of stepper motors- Switched reluctance motors- construction and working of SRM- Synchronous reluctance motors- construction- working- characteristics- Permanent magnet brushless dc motors- single phase induction motors- universal motors- servomotors and its application.

Expected outcome .

- The students will get knowledge on the construction , working and characteristics of of stepper motors, synchronous motors, PMDC motors and switched reluctance motors, servo motors and single phase induction motors.

Text Book:

1. Miller T J E, Switched Reluctance Motor and Their Control, Clarendon Press, Oxford,1993.
2. Miller T J E, Brushless Permanent Magnet and Reluctance Motor Drives, Clarendon Press,Oxford,1989.
3. B K Bose, Modern Power Electronics & AC drives, Pearson, 2002.
4. Athani V.V. "stepper motors – Fundamentals, Applications &Design" New Age International

References:

1. Kenjo T, Sugawara A, Stepping Motors and Their Microprocessor Control, Clarendon Press, Oxford, 1994.
2. Kenjo T, Power Electronics for the Microprocessor Age, Oxford University Press, 1990.
3. Ali Emadi (Ed), Handbook of Automotive Power Electronics and Motor Drives, CRC Press, 2005.
4. R Krishnan, Electric Motor Drives – Modeling, Analysis and Control, PHI, 2003.
5. H A Toliyat, S Campbell, DSP Based Electro Mechanical Motion Control, CRC Press, 2004.Tamil Nadu 1999.
6. Arumugam & Premkumar, Electric Circuit Theory, Khanna Publishers. 2002

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Stepper Motors - Constructional features- principle of operation- modes of excitation- Types- single phase stepping motors- torque production in variable Reluctance (VR) stepping motor- Dynamic characteristics- Application of stepper motors in mechatronics systems	7	15%

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II	Switched Reluctance Motors - Constructional features- principle of operation- Torque equation- Power controllers- Characteristics and control- Applications	7	15%
FIRST INTERNAL EXAMINATION			
III	Synchronous Reluctance Motors-Constructional features: axial and radial air gap Motors- Operating principle- reluctance torque – Phasor diagram- motor characteristics- Applications	7	15%
IV	Permanent Magnet Brushless DC Motors - Commutation in DC motors-- Difference between mechanical and electronic commutators- Hall sensors- Optical sensors- Multiphase Brushless motor- Square wave permanent magnet brushless motor drives- - Torque and emf equation- Torque speed characteristics- Controllers- Microprocessor based controller- Sensor less control	7	15%
SECOND INTERNAL EXAMINATION			
V	Permanent Magnet Synchronous Motors - Principle of operation- EMF- power input and torque expressions- Phasor diagram- Power controllers- Torque speed characteristics- Self Control- Vector control- Current control schemes- Sensor less control	7	20%
VI	**SPECIAL MACHINES / APPLICATIONS** Working principle of single phase induction motor – capacitor start & capacitor run motors – Universal motor – servomotor – Applications of Servo motors in Mechatronics.	7	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN

Maximum Marks : 100 Exam Duration:3 hours

PART A: FIVE MARK QUESTIONS

8 compulsory questions –1 question each from first four modules and 2 questions each from last two modules (8 x 5= 40 marks)

PART B: 10 MARK QUESTIONS

5 questions uniformly covering the first four modules. Each question can have maximum of three sub questions, if needed. Student has to answer any 3 questions (3 x10 = 30 marks)

PART C: 15 MARK QUESTIONS

4 questions uniformly covering the last two modules. Each question can have maximum of four sub questions, if needed. Student has to answer any two questions

(2 x15 = 30 marks))

Course code	Course Name	L-T-P - Credits	Year of Introduction
EC209	Analog Electronics	3-1-0-4	2016

Prerequisites :Nil

Course Objectives

- To familiarize basic electronic elements and their characteristics
- To develop understanding about BJT and FET circuits
- To understand the concept of power amplifier and differential amplifiers

Syllabus

Diode: Diode as a circuit element-diode clipping circuits-clamping circuits-voltage regulators-BJT: Operating point of a BJT-thermal runaway-h parameter model of a BJT-frequency response of amplifiers-FET: Construction and characteristics of JFET and MOSFET-Feedback: - Concepts – negative and positive feedback-Power Amplifiers- Class A, B, AB, C, D & S power amplifier-Differential Amplifiers:- The BJT differential pair- Large and small signal operation-MOS differential amplifier- Large and small signal operation-UJT- 555 Timer IC, PLL.

Expected outcome.

- Will get knowledge on electronic elements and their characteristics.

Text Book:

1. Allen Mottershead, *Electronic Devices and Circuits: An Introduction*, Prentice Hall of India.
2. V. Boylestad and Nashelsky, *Electronic Devices and Circuits*, Pearson Education
3. Ramakant A Gayakwad, *Op- Amps and Linear Integrated Circuits*, Prentice Hall of India

References:

1. Schilling and Belove, Electronic Circuits, McGraw Hill
2. Theodore F. Bogart Jr., Electronic Devices and Circuits,
3. Coughlin and Driscoll, Operational amplifiers and Linear Integrated Circuits,
4. K. R. Botkar, Integrated Circuits, Khanna Publishers
5. Somanathan Nair, Linear Integrated Circuits – Analsysis, Design & Application, Wiley-India

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	**Diode:** Diode as a circuit element - load line - piecewise linear model – single-phase half wave and full wave rectifier circuits – voltage regulation - ripple factor - rectifier efficiency - bridge rectifier - rectifier filters - diode clipping circuits - single level and two level clippers - clamping circuits –Zener diodes - Zener voltage regulators.	9	15%
II	**BJT:** Operating point of a BJT – DC biasing - bias stability - thermal runaway - AC Concepts –role of capacitors in amplifiers – common emitter AC equivalent circuit - amplifier gain and impedance calculations- h parameter model of a BJT –cascaded amplifiers, frequency response of amplifiers	9	15%

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FIRST INTERNAL EXAMINATION			
III	**FET** Construction and characteristics of JFET and MOSFET, biasing a JFET and MOSFET, JFET and MOSFET small signal model - CS and CD amplifiers. feedback: - Concepts – negative and positive feedback feedback -feedback connection types - practical feedback circuits	9	15%
IV	**Power Amplifiers** Class A, B, AB, C, D & S power amplifiers - harmonic distortion efficiency -wide band amplifier - broad banding techniques - low frequency and high frequency compensation -cascode amplifier - broad banding using inductive loads - Darlington pairs.	10	15%
SECOND INTERNAL EXAMINATION			
V	**OSCILLATORS & MULTI VIBRATORS** Classification of oscillators – Barkhausen criteria- operation and analysis of RC phase shift – Hartely and Colpitts oscillators – Multi vibrators – astable, mono stable and bi stable multi vibrators	9	20%
VI	UJT-construction –working-UJT oscillator-UPS-brief overview of online UPS &off line UPS-SMPS-operation **Timer IC 555**: Functional diagram- astable and monostable modes **Phase Locked Loops**: Principles – building blocks of PLL-VCO-lock and capture ranges - capture process - frequency multiplication using PLL	10	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN

Maximum Marks : 100 Exam Duration:3 hours

PART A: FIVE MARK QUESTIONS

8 compulsory questions –1 question each from first four modules and 2 questions each from last two modules (8 x 5= 40 marks)

PART B: 10 MARK QUESTIONS

5 questions uniformly covering the first four modules. Each question can have maximum of three sub questions, if needed. Student has to answer any 3 questions

(3 x10 = 30 marks)

PART C: 15 MARK QUESTIONS

4 questions uniformly covering the last two modules. Each question can have maximum of four sub questions, if needed. Student has to answer any two questions

(2 x15 = 30 marks)

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Course code	Course Name	L-T-P - Credits	Year of Introduction
MR303	Microprocessors and Microcontrollers	3-0-0--3	2016

Prerequisite : NIL

Course Objectives

- To study the Architecture of microprocessor 8086 & microcontroller 8051
- To study the addressing modes & instruction set of 8086 & 8051.
- To introduce the need & use of Interrupt structure 8086 & 8051.

Syllabus

Architecture of Intel 8086 processor – Pin description –8086 configurations: Minimum mode and Maximum mode –Timing diagrams – DMA-8086 Addressing modes – Instruction set- Programmable Peripheral interface (8255) – Mode 0,1,2 operations- Interval timer application 8253- programmable interrupt controller 8259- Programmable communication Interface (8251)- DMA Controller 8237-Introduction to embedded controllers- architectures- introduction to 8051-8051 family architecture of 8051 -pin details- port operation- memory organization- SFRs- programming in assembly - assembler directives- addressing modes- instruction set- timer and counter operations- interrupts- serial communication- introduction to hardware interfacing- programmable I/O 8255- external memory- seven segment display- LCD- stepper motor- DAC- ADC- matrix keyboard .

Expected outcome .

Student will gain knowledge on microprocessor and microcontrollers based system design

Text Book:

1. A.K. Roy, K.M. Bhurchandi, *Advanced Microprocessors and Peripherals* McGraw- Hill International

2. Muhammad Ali Mazidi, Janice Gillipse Mazidi, Rolin D. Mckinlay, *"8051 Microcontroller and Embedded Systems Using Assembly and C"* Pearson Education, 2010

References:

1. Douglas V Hall, *Microprocessors And Interfacing Programming and Hardware* Tata McGraw-Hill

2. N.Senthil Kumar, M.Saravanan, S.Jeevananthan, „Microprocessors and Microcontrollers", Oxford,2013.

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	**Architecture of 8086** Architecture of Intel 8086 processor – Pin description –8086 configurations: Minimum mode and Maximum mode –system bus timing - Timing diagrams – Interrupts: Interrupt mechanism – Types and priority – Interrupt vector table-DMA.	8	15%
II	**Programming 8086** 8086 Addressing modes – Instruction set – Data transfer Instructions – String Instructions – Logical Instructions – Arithmetic Instructions – transfer control Instructions – Processor control instructions- Arithmetic operations- Code conversion- searching –Sorting	6	15%

FIRST INTERNAL EXAMINATION			
III	**8086 interface** Programmable Peripheral interface (8255) – Mode 0,1,2 operations- Interval timer application 8253- programmable interrupt controller 8259- Programmable communication Interface (8251)- DMA Controller 8237.	8	15%
IV	**Architecture of 8051** Overview of 8051 microcontrollers – Architecture – Assembly programming –data types and directives –flag bits – register banks and stack.	6	15%
SECOND INTERNAL EXAMINATION			
V	**Programming 8051** 8051Addressing modes – Instruction set -loop and Jump instructions – call instructions – Arithmetic and Logic instructions and simple programs – 8051 interrupts – programming timer interrupts.	7	20%
VI	**8051 interface** Interfacing of microcontroller – External memory interfacing- LCD and Keyboard interfacing – Parallel and serial ADC interfacing – DAC interfacing – Interfacing 8255 - Stepper motor control – DC motor interfacing.	7	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN

Maximum Marks : 100 Exam Duration:3 hours

PART A: FIVE MARK QUESTIONS

8 compulsory questions –1 question each from first four modules and 2 questions each from last two modules

(8 x 5= 40 marks)

PART B: 10 MARK QUESTIONS

5 questions uniformly covering the first four modules. Each question can have maximum of three sub questions, if needed. Student has to answer any 3 questions

(3 x10 = 30 marks)

PART C: 15 MARK QUESTIONS

4 questions uniformly covering the last two modules. Each question can have maximum of four sub questions, if needed. Student has to answer any two questions

(2 x15 = 30 marks)

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Course code	Course Name	L-T-P - Credits	Year of Introduction
MR463	Bio Mechatronics	3-0-0-3	2016

Prerequisite : NIL

Course Objectives

The course enables the students to:

- understand types of sensors used in biomedical applications.
- be familiar with various equipment in bio-medical applications and the techniques of diagnosis

Syllabus

Cell structure – electrode – electrolyte interface- electrode potential- electrodes for their measurement- ECG- EEG- EMG -Basic transducer principles – Bio & Nano sensors - Input isolation- – instrument power supply- Telemetry principles – Bio telemetry-Electrocardiograph measurements – blood pressure measurement – blood flow measurement – phonocardiography – vector cardiography - Heart lung machine – artificial ventilator – Anesthetic machine – Basic ideas of CT scanner – MRI and ultrasonic scanner – Bio-telemetry – laser equipment and application – cardiac pacemaker – DC – defibrillator patient safety - electrical shock hazards- Centralized patient monitoring system- computers in medicine – basis of signal conversion and digital filtering data reduction technique – time and frequency domain technique – ECG Analysis

Expected outcome

The students will

i. gain knowledge in medical measurements.
ii. be able to select appropriate equipments for medical applications.
iii. have knowledge on diagnosis and analysis capabilities of biomedical equipments.

Text Books:

Arumugam M., "Bio Medical Instrumentation", Anuradha agencies Pub., 2002.

References:

1. Khandpur, R.S., "Handbook of Biomedical Instrumentation", TMH, 1989.
2. Geddes L.A., and Baker, L.E., Principles of Applied Bio-medical Instrumentation, 3rd Edition, John Wiley and Sons, 1995.
3. Cromwell, Weibell and Pfeiffer, Biomedical Instrumentation and Measurements, 2nd Edition, Prentice Hall of India, 1999.
4. Tompkins W.J., Biomedical Digital Signal Processing, Prentice Hall of India, 1998.

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Cell structure – electrode – electrolyte interface- electrode potential- resting and action potential – electrodes for their measurement- ECG- EEG- EMG – machine description – methods of measurement – three equipment failures and trouble shooting	7	15%
II	Basic transducer principles Types – source of bioelectric potentials – resistive- inductive- capacitive- fiber-optic- photoelectric and chemical transducers – their description and feature applicable for biomedical instrumentation – Bio & Nano sensors & application	7	15%

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FIRST INTERNAL EXAMINATION			
III	Input isolation- DC amplifier- power amplifier- and differential amplifier – feedback- op-Amp-electrometer amplifier- carrier Amplifier – instrument power supply- Oscillagraphic – galvanometric - X-Y- magnetic recorder- storage oscilloscopes – electron microscope – PMMC writing systems – Telemetry principles – Bio telemetry	7	15%
IV	Electrocardiograph measurements – blood pressure measurement: by ultrasonic method – plethysonography – blood flow measurement by electromagnetic flow meter cardiac output measurement by dilution method – phonocardiography – vector cardiography	7	15%
SECOND INTERNAL EXAMINATION			
V	Heart lung machine – artificial ventilator – Anesthetic machine – Basic ideas of CT scanner – MRI and ultrasonic scanner – Bio-telemetry – laser equipment and application – cardiac pacemaker – DC – defibrillator patient safety - electrical shock hazards- Centralized patient monitoring system	7	20%
VI	Introduction – computers in medicine – basis of signal conversion and digital filtering data reduction technique – time and frequency domain technique – ECG Analysis	7	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN

Maximum Marks : 100 Exam Duration:3 hours

PART A: FIVE MARK QUESTIONS

8 compulsory questions –1 question each from first four modules and 2 questions each from last two modules (8 x 5= 40 marks)

PART B: 10 MARK QUESTIONS

5 questions uniformly covering the first four modules. Each question can have maximum of three sub questions, if needed. Student has to answer any 3 questions (3 x10 = 30 marks)

PART C: 15 MARK QUESTIONS

4 questions uniformly covering the last two modules. Each question can have maximum of four sub questions, if needed. Student has to answer any two questions (2 x15 = 30 marks)

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Master of Computer Applications

2017-18

Course code	Course Name	L-T-P - Credits	Year of Introduction
RLMCA107	Principles of Management	3-1-0-4	2016

Course Objectives

- To develop ability to critically analyze and evaluate a variety of management practices.
- To understand and apply a variety of management and organisational theories in practice.
- To be able to mirror existing practices or to generate their own innovative management competencies, required for today's complex and global workplace.

Syllabus

Definition, functions of a management, managerial skills and roles, basics of decision making process. Early contributors and their contributions to the field of management. Planning, Organizing, Staffing and HRD functions, Directing and Controlling form the core content of this course.

Expected Outcome

The students will be able to

i. understand management as a process
ii. critically analyse and evaluate management theories and practices
iii. plan and make decisions for organisations
iv. do staffing and related HRD functions
v. be aware about quality standards
vi. understand the marketing basics

References

1. Gary Dessler, Biju Varkkey, "Human Resourse Management", Pearson Education India, 14th Edition.
2. Harold Koontz and Heinz Weihrich, "Essentials of Management", McGraw Hill Education, 10th Edition (2015).
3. L M Prasad, "Principles of Management", Sultan Chand & Sons, 8th Edition (2010)
4. L M Prasad, "Principles of Management", Sultan Chand & Sons, 8th Edition (2010)
5. Peter F Drucker, "The Practice of Management", Butterworth-Heinemann publication, 2nd Edition (2007)
6. Philip Kotler, "Marketing Management", Pearson Education India, 15th Edition.
7. R N Gupta, "Principles of Management", S. Chand & Company Ltd., (2010)
8. Robbins and Coulter, Management, Pearson Education 13th Edition, 2016,
9. Tripathi, "Principles of Management", McGraw Hill Education, 5th Edition (2012)

Suggested MOOCs

1. Management Functions: http://nptel.ac.in/courses/122108038/
2. Leadership: http://nptel.ac.in/courses/110105033/33

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	**Introduction to Management**: Basic Managerial Concepts, Levels of management, Managerial Skills, Managerial roles Decision Making- Concept, types of decision, decision making process. Management functions- Planning, Organising, Staffing, Directing and Controlling.	7	15%
II	**Early Contributions in Management**: Management thought - Classical approach, scientific management, contributions of Taylor, Gilbreths, Fayol's 14 principles of management.	10	15%

	Human relation approach - contribution of Elton Mayo Systems approach - organization as an open system and Contingency approach.		
FIRST INTERNAL EXAMINATION			
III	**Planning:** Nature and importance of planning, types of plans - Steps in planning, Levels of planning - The Planning Process - MBO definition and process, SWOT Analysis, importance.	9	15%
IV	**Organising :** Nature of organizing, Departmentation - need and importance, span of control in management, factors affecting span of management. Organisation structure - Formal and informal, Types of organization structure line, line and staff, functional, divisional, project, matrix, free form, virtual. Delegation of authority, Steps in delegation and Principles of delegation	10	15%
V	**Staffing and related HRD Functions:** meaning, nature, staffing process, Job analysis and manpower planning, job description and job specification, Recruitment & selection, selection process, tests and interviews. Training and development - concept and methods, Performance appraisal- concept and methods.	10	20%
SECOND INTERNAL EXAMINATION			
VI	**Directing and Controlling:** Supervision, Motivation - significance, motivational theories - Maslow's need hierarchy. Basic control process - control as a feedback system. Quality engineering, quality control, control chart (basic concepts), Introduction to ISO 9000 and 14000 standards, TQM, Six Sigma concepts, Bench marking, Introduction to marketing, marketing mix, Product Life cycle.	10	20%
END SEMESTER EXAM			
QUESTION PAPER PATTERN			

There will be two parts in the Question paper - **Part A and Part B.**

Part A will have 8 short answer questions of 3 marks each (8 X 3 M = 24 M). There will be no choice questions.

Part B will have 6 essay questions one from each module of 6 marks each, with an alternative choice question from the same module (6 x 6M=36M). The maximum number of sub part questions in **Part B** to be limited to 2.

The total marks assigned to questions in Part A (Short answer) and Part B (Essay) together from a single module will not exceed the marks assigned to that module specified in the course plan.

Course code	Course Name	L-T-P - Credits	Year of Introduction
RLMCA104	**Data Structures**	**3-1-0-4**	**2016**

Course Objectives

- To provide an insight into data structures such as arrays linked lists, stacks, queues, trees and graphs.
- To provide an understanding of searching and sorting methods.

Syllabus

Data structures: Definitions, Concept and Overview of data structures - Analysis of Algorithm-Asymptotic Complexity of an algorithm.

Arrays, Operations on Arrays, Applications - Linked List, Applications of Linked Lists, Stacks and Queues: Stack Operations, Applications of Stacks, Queues - Operations on Queues, Different Types of Queues, Applications of Queues - Trees, Binary Trees, Traversals, BST, Introduction to AVL trees.

Graphs: Traversals, Minimum Spanning Trees and shortest path algorithms

Internal and External sorting techniques – selection, bubble, insertion, merge sorting, partition exchange sorting, heap sort, Counting Sort, Searching - External sorting – sorting with disks, sorting with tapes

Expected Outcome

- The students will be able to choose appropriate data structure for solving problems considering resource constraints such as time and space.

References

1. A N Kamthane , "Introduction to Data Structures in C", Pearson Education (2005)
2. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman "Data structures and Algorithms", Fourth Edition, Pearson Education (2009)
3. G A V Pai , "Data Structures and Algorithms: Concepts, Techniques and Applications", 2nd Edition, Tata McGraw-Hill (2008)
4. J. P. Tremblay , P. G. Sorenson, "An Introduction to Data Structures with applications", 2nd Edn, McGraw Hill, Inc. New York, NY, USA.
5. Samanta, "Classic Data Structures", 2nd Edition, PHI.
6. Seymour Lipschutz, "Data Structures", 6th Edition, 9th Reprint 2008, Tata McGraw-Hill
7. Thomas H. Corman, Charles E. Leiserson and Ronald L. Rivest., "Introduction to Algorithms", 3rd Edition, Prentice Hall of India.

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Data structures: Definitions, Overview of data structures- Analysis of Algorithm-Asymptotic Complexity of an algorithm. Arrays: Definition, Terminology, One dimensional Array, Two dimensional array, Multidimensional array, Representation of Arrays in Memory, Operations on Arrays, Applications of Arrays, Sparse Matrices Manipulation.	7	10%
II	Stack-Introduction, Representation of a Stack, Operations on Stacks, Applications of Stacks - Evaluation of Arithmetic expressions – Recursion and Iteration	9	15%
	FIRST INTERNAL EXAMINATION		

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III	Queues-Introduction, Representation of a queue -Operations on Queues, Circular Queues, Deque, Priority Queue, Applications of Queues.	9	15%
IV	Linked List - Singly Linked Lists, Circular Linked Lists, Doubly Linked Lists - Applications of Linked Lists-Polynomial Representation-Linked stacks and Queues.	10	20%
V	Trees, Binary Trees, Representation and Traversals, BST and operations –Introduction to AVL trees. Graphs: Definitions and Basic Terminologies, Representations of Graphs, Traversals, Minimum Spanning Tree and shortest path algorithms	10	20%
SECOND INTERNAL EXAMINATION			
VI	Internal sorting – selection, bubble, insertion, merge sorting, and partition exchange sorting, heap sort, Counting Sort. Time Complexities- comparisons. Searching – linear search, binary search.	10	20%
END SEMESTER EXAM			
QUESTION PAPER PATTERN			

There will be two parts in the Question paper - **Part A and Part B.**
Part A will have 8 short answer questions of 3 marks each (8 X 3 M = 24 M). There will be no choice questions.
Part B will have 6 essay questions one from each module of 6 marks each, with an alternative choice question from the same module (6 x 6M=36M). The maximum number of sub part questions in **Part B** to be limited to 2.
The total marks assigned to questions in Part A (Short answer) and Part B (Essay) together from a single module will not exceed the marks assigned to that module specified in the course plan.

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Course code	Course Name	L-T-P - Credits	Year of Introduction
RLMCA112	**Computer Organization & Architectures**	**3-1-0-4**	**2016**

Course Objectives

- To introduce computer architecture and organization, with a special focus on the basic principles underlying micro-processor design.
- To explore the interaction of hardware and software, and consider the efficient use of hardware to achieve high performance.

Syllabus

Basic Structure of digital computer, Instructions and instruction sequencing, addressing modes. Basic I/O operations, stacks, subroutines. Basic processing unit – sequencing of control signals – Hardwired control and microprogrammed control. Pipelining – basic concepts only. I/O organization – Interrupts, DMA. Interface circuits. Memory organization – Cache memory. Virtual memory - paging and segmentation. RAID, Introduction to HDL.

Expected Outcome

- The students will acquire knowledge about the design and organization of components in computing systems.

References

1. Hamachar, Vranesic & Zaky, "Computer Organization" (5th Ed), McGraw Hill.
2. **http://ece.umd.edu/~manoj/350/notes/book.pdf**
3. J. Hennessy and D. Patterson, "Computer Architecture, A quantitative approach", 5^{th} Edition, Elsevier
4. Miles Murdocca, Vincent Heuring, "Computer Architecture and Organization, an integrated approach", (2007 Ed), Wiley.
5. Nisan & Schocken, "The Elements of Computing Systems" MIT Press (2008)
6. P. Pal Chaudhuri, "Computer Organization and Design", (2008 Ed) PHI.
7. Sameer Palnitkar, "Verilog HDL", 2^{nd} Edition (2003), Prentice Hall.
8. Tanen Baum and Austin, "Structured Computer Organisation", 6^{th} Edition, Pearson.
9. William Stallings, "Computer Organisation and Architecture, Designing for performance", Pearson Education (9th Edition or 2014 Indian Sub continent Edition).

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Basic Structure of digital computer - functional units - basic operational concepts – bus structures - software. Memory locations and addresses – Instructions and instruction sequencing – basic instruction types – Instruction execution and straight line sequencing – branching.	10	15%
II	Addressing modes, assembly language. Basic I/O operations, stacks, subroutines – nesting and processor stack – parameter passing.	10	15%
FIRST INTERNAL EXAMINATION			
III	Basic processing unit – fundamental concepts - execution of a complete instruction – multiple bus organization - sequencing of control signals – Hardwired control and microprogrammed control.	10	20%
IV	Pipelining – basic concepts only. I/O organization – Accessing I/O devices, Interrupts – handling - use of interrupts in operating systems, DMA. Interface circuits – parallel port – serial port. Standard I/O interfaces – PCI - SCSI and USB in brief.	8	15%

V	Memory organization – basic concepts, semiconductor RAM memories - memory system considerations – semiconductor ROM memories - speed, size and cost. Memory design using decoders.	8	15%
SECOND INTERNAL EXAMINATION			
VI	Cache memory – mapping functions – replacement algorithms, multiple module memories and interleaving. Virtual memory – paging and segmentation, RAID. *Programming assignments may be given in any HDL like Verilog or VHDL to create gate level OR Dataflow OR Behavioral level models of gates, multiplexer, adders, flip-flops, registers, latches, etc. Open source Verilog HDL like iverilog can be used. The Purpose of the assignment is to introduce the students to HDL for VLSI Design including Processor design. No detailed teaching of HDL is necessary. The students can be given a basic tutorial write up on gate level modelling.*	10	20%
END SEMESTER EXAM			
QUESTION PAPER PATTERN			
There will be two parts in the Question paper - **Part A and Part B**. **Part A** will have 8 short answer questions of 3 marks each (8 X 3 M = 24 M). There will be no choice questions. **Part B** will have 6 essay questions one from each module of 6 marks each, with an alternative choice question from the same module (6 x 6M=36M). The maximum number of sub part questions in **Part B** to be limited to 2. The total marks assigned to questions in Part A (Short answer) and Part B (Essay) together from a single module will not exceed the marks assigned to that module specified in the course plan.			

Course code	Course Name	L-T-P - Credits	Year of Introduction
RLMCA207	**Design and Analysis of Algorithms**	**3-1-0-4**	**2016**

Course Objectives

- To familiarize with algorithm design strategies.
- To learn to analyse and measure the performance of algorithms

Syllabus

Introduction to Algorithm Analysis, Divide and Conquer Method, Greedy Strategy, Dynamic Programming, Algorithm Design by State Space Trees – Backtracking - Branch and Bound, Introduction to Computational Complexity.

Expected Outcome

i. Given a problem, the student will be able to design algorithms.
ii. Given an algorithm, he/she will be able to analyse it and produce an estimate of its time and space requirements.

References

1. A. Levitin, "Introduction to the Design & Analysis of Algorithms", Pearson Education, 3rd Edition (2008).
2. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, "Fundamentals of Computer Algorithms", Orient Longman, Universities Press, 2nd Edition (2008)
3. Harsh Bhasin, "Algorithms Design and Analysis", Oxford University Press, 1st Edition (2015).
4. Rajesh K.Shukla, "Analysis and Design of Algorithms, A Beginner's Approach", Wiley (2015)
5. Richard Neapolitan , Kumarss Naimipour, "Foundations Of Algorithms ",Jones and Bartlett Publishers, Inc, 4th Edition (2011).
6. Sara Baase , Allen Van Gelder , "Computer Algorithms: Introduction to Design and Analysis", Pearson India, 3rd Edition (2002).
7. Thomas H. Cormen, et al., "Introduction to Algorithms", Prentice Hall, 3rd Edition (2010)

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Introduction to Algorithm Analysis : Algorithm and its properties - Apriory and Aposterior analysis of algorithms - Time and Space Complexity- Elementary Operation and Complexity Estimation of Simple Algorithms - Asymptotic notations and their properties - Common Complexity functions - Recurrence Relations - Solution of Recurrence Relations - Iteration Method - Recurrence Tree Method - Master's Theorem (Proof not required)	10	15%
II	Divide and Conquer Method : Control Abstraction for Divide and Conquer- 2- way Merge Sort , Quick sort, Binary Search, Finding Maximum and minimum, Divide and Conquer Matrix Multiplication.	9	15%
FIRST INTERNAL EXAMINATION			
III	Greedy Strategy: - Control Abstraction for Greedy Strategy - The Fractional Knapsack Problem - Prims' and Kruskal's Algorithms for Minimal Spanning Tree - Job Sequencing Problem.	8	15%
IV	Dynamic Programming : Control Abstraction for Dynamic Programming - The Principle of Optimal Substructure - All Pair	8	15%

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	Shortest Path Problem - Travelling Sales Person Problem, Divide and Conquer vs Dynamic Programming.		
V	Algorithm Design by State Space Trees: State Space - Bounding Functions – Examples. Backtracking: Control Abstraction for Backtracking - The N-Queen's Problem, Sum of Subset Problem. Branch and Bound: Depth First, Breadth First and Best First Branch and Bound strategies and their control abstractions - The N^2-1 Puzzle Problem	10	25%
SECOND INTERNAL EXAMINATION			
VI	Introduction to Computational Complexity: Tractable and Intractable Problems - Complexity Classes- P and NP Classes - SAT and 3-SAT Problems - NP-Hard and NP-Complete Classes – Study of NP complete problems - Travelling Sales Person Problem - Knapsack Problem - Clique Problem, Vertex Cover Problem. ***Note: Only general concepts required to be covered. No proof required. Only elementary treatment is required.***	10	15%
END SEMESTER EXAM			
QUESTION PAPER PATTERN			

There will be two parts in the Question paper - **Part A and Part B**.
Part A will have 8 short answer questions of 3 marks each (8 X 3 M = 24 M). There will be no choice questions.
Part B will have 6 essay questions one from each module of 6 marks each, with an alternative choice question from the same module (6 x 6M=36M). The maximum number of sub part questions in **Part B** to be limited to 2.
The total marks assigned to questions in Part A (Short answer) and Part B (Essay) together from a single module will not exceed the marks assigned to that module specified in the course plan.

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Course code	Course Name	L-T-P - Credits	Year of Introduction
RLMCA204	**Big Data Technologies**	**3-1-0-4**	**2016**

Course Objectives

- To understand the concept of Big data
- To understand HADOOP
- To understand the Big Data concerns: Storage and Analysis

Syllabus

Introduction to Big Data Platform, Big Data Storage Concepts, Big Data Processing Concepts, Introduction to Hadoop Ecosystem, Understanding Map Reduce Fundamentals, Big Data Storage Technology, Big Data Analysis Techniques

Expected Outcome

The students will

i. Be able to work with big data platform.
ii. Understand Hadoop and develop its applications on Big Data.

References

1. Chandrakant Naikodi, "Managing Big Data", Vikas Publishing, 2015
2. DreamTech Editorial Services, "Big Data", Dreamtech Press, 2015 Edition.
3. Michael Frampton, "Big Data Made Easy: A Working Guide to the Complete Hadoop Toolset", Apress, 2014
4. Michael Manoochehri, "Data Just Right", Pearson education, 2015.
5. Thomas Erl ,"Big Data Fundamentals Concepts, Drivers and Techniques", Pearson Education First Edition,2016
6. Vijay Srinivas Agneeswaran, "Big Data Analytics beyond HADOOP", Pearson Education(2015)

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Introduction to Big Data Platform – History of Data Management- Structuring Big data - Elements of Big Data, Big data stack - Big data Analytics - Introducing Technologies for handling Big Data: Distributed and Parallel Computing for Big Data - Cloud Computing and Big Data	8	15%
II	Big Data Storage Concepts- Clusters - File Systems and Distributed File Systems- NoSQL – Sharding – Replication – Sharding and Replication – CAP Theorem – ACID – BASE Big Data Processing Concepts- Parallel Data Processing – Distributed Data Processing – Hadoop – Processing in Batch Mode – Processing in Real time Mode	8	20%
FIRST INTERNAL EXAMINATION			
III	Introduction to Hadoop Ecosystem - Hadoop Distributed File System-HDFS Architecture - Features of HDFS - Map Reduce- Features of Map Reduce- Hadoop Yarn - HBase- Hive – Sqoop – ZooKeeper – Flume – Oozie. *Note : Lab Assignments and hands on training to be given in labs.*	10	15%
IV	Understanding Map Reduce Fundamentals- Map Reduce Framework- Exploring Features of Map Reduce- Working of Map Reduce- Exploring Map and Reduce Functions- Techniques	9	15%

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	to optimize Map Reduce- Hardware/ Network Topology- Synchronization- File System- Uses of Map Reduce ***Note: provide practical assignments on familiarizing HADOOP environment.***		
V	Big Data Storage Technology – On-Disk Storage Devices – Distributed File Systems, RDBMS Databases, NoSQL Databases, NewSQL Databases – In-Memory Storage Devices: In-Memory Data Grids, In-Memory Databases.	9	20%
SECOND INTERNAL EXAMINATION			
VI	Introduction to Big Data Analysis Techniques- Quantitative Analysis – Qualitative Analysis – Data Mining - Statistical Analysis - Machine Learning – Semantic Analysis – Visual Analysis	9	15%
END SEMESTER EXAM			
QUESTION PAPER PATTERN			

There will be two parts in the Question paper - **Part A and Part B**

Part A will have 8 short answer questions of 3 marks each (8 X 3 M = 24 M). There will be no choice questions.

Part B will have 6 essay questions one from each module of 6 marks each, with an alternative choice question from the same module (6 x 6M=36M). The maximum number of sub part questions in **Part B** to be limited to 2.

The total marks assigned to questions in Part A (Short answer) and Part B (Essay) together from a single module will not exceed the marks assigned to that module specified in the course plan.

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SEMESTER - 4

MCA10 401 CRYPTOGRAPHY AND NETWORK SECURITY

Objectives

- *To introduce the principles and practices of cryptography and network security.*
- *To discuss algorithms and schemes to handle the security issues.*
- *To introduce web security .*

Module I: (13 hrs)
Divisibility: gcd and lcm, prime numbers, fundamental theorem of arithmetic, Gauss function , *Congruence*: properties-complete and reduced residue systems-Fermat's theorem- Euler function. *Congruence in one unknown*: Congruence in First degree- Chinese remainder theorem

Module II: (10 hrs)
Introduction to cryptography: services, mechanisms and attacks- The OSI security architecture- A model for network security, *Classical Encryption Techniques*: Symmetric cipher model-Substitution techniques-transposition techniques-Rotor machine- steganography, *Modern Techniques:* Simplified DES- DES- block cipher principles- cryptanalysis- block cipher design principles.

Module III: (10 hrs)
Algorithms - Triple DES- IDEA- blowfish. *Confidentiality*: placement of encryption function- traffic confidentiality- key distribution- random number generation. *Public key encryption* : RSA algorithm- key management and exchange- elliptic curve cryptography.

Module IV: (9 hrs)
Message Authentication: requirements- functions and codes- hash functions- security of hash functions and MACS. *Hash Algorithms:* MD5 message digest algorithm- secure hash algorithm. *Digital Signatures*: authentication protocols- digital signature standard. *Authentication Applications:* Kerberos.

Module V: (10 Hrs)
Electronic Mail Security : Pretty Good Privacy – S/MIME , *Web Security*: SSL and Transport Layer Security- Secure electronic transaction, *Firewalls:* Design Principles- Trusted Systems

Text Books:
1. C.Y Hsiung , Elementary Theory of Numbers, Allied Publishers (World Scientific), New Delhi, 1992 (Module I)
2. W. Stallings, Cryptography and Network Security , Principles and Practices, 2/e, Pearson education Asia, 1999 (Module II, III, IV, V)

References:

1. Niven and H.S .Zuckerman, An introduction to the Theory of Numbers, 3/e, John Wiley and Sons, NewYork, 1992
2. B. Schiner, Applied Cryptography: Protocols, Algorithms, and Source code in C, 2/e, John Wiley and Sons, NewYork, 1996

Sessional work assessment

Assignments	2x10 = 20

Tests	2x15 = 30	
Total marks	= 50	

University examination pattern

Seven questions covering all the five modules .Each carries 20 marks and each question should have minimum of two parts. There should be a minimum of one question from each module. There should not be more than 2 questions from any module. The student has to answer any five full questions for scoring full marks.

MCA10 402 SOFTWARE ARCHITECTURE AND PROJECT MANAGEMENT

Objectives

- *To impart the basic concepts of software architecture and design patterns.*
- *To develop an understanding about development of complex software systems in a methodical manner.*

Module I (13 hrs)

Software Architecture - Foundations - Software architecture in the context of the overall software life cycle - Architectural Styles - CASE study of Architectures Designing, Describing, and Using Software Architecture - IS2000: The Advanced Imaging Solution - Global Analysis - Conceptual Architecture View - Module Architecture View - Styles of the Module Viewtype - Execution Architecture View, Code Architecture - View. Component-and-Connector Viewtype - Styles of Component-and-Connector Viewtype - Allocation Viewtype and Styles - Documenting Software Interfaces, Documenting Behavior - Building the Documentation Package.

Module II (11 hrs)

Archetypes and Archetype Patterns, Model Driven Architecture with Archetype Patterns. Literate Modeling, Archetype Pattern. , Customer Relationship Management (CRM) Archetype Pattern, Product Archetype Pattern, Quantity Archetype Pattern, Rule Archetype Pattern. Design Patterns, Creational Patterns. Patterns for

Organization of Work, Access Control Patterns, Service Variation Patterns, Service Extension Patterns

Module III (13 hrs)

Object Management Patterns Adaptation Patterns, Communication Patterns, Architectural Patterns, Structural Patterns, Patterns for Distribution, Patterns for Interactive Systems Adaptable Systems, Frameworks and Patterns, Analysis Patterns Patterns for Concurrent and Networked Objects, Patterns for Resource Management, Pattern Languages, Patterns for Distributed Computing.

Module IV (7 hrs)

Defining EAI, Data-Level EAI, Application Interface-Level EAI., Method- Level EAI., User Interface-Level EAI, The EAI Process - An Introduction to EAI and Middleware, Transactional Middleware and EAI, RPCs, Messaging, and EAI, Distributed Objects and EAI, Database-

Oriented Middleware and EAI, Java Middleware and EAI, Implementing and Integrating Packaged Applications

Module V (8 Hrs)

The General Idea, XML and EAI, Message Brokers—The Preferred EAI Engine, Process Automation and EAI. Layering, Organizing Domain Logic, Mapping to Relational Databases, Web Presentation, Domain Logic Patterns, Data Source Architectural Patterns, Object-Relational Behavioral Patterns, Object-Relational Structural Patterns, Object-Relational Metadata Mapping Patterns, Web Presentation Patterns, Distribution Patterns, Offline Concurrency Patterns.

Reference Books

1. Ian Gorton Springer, *Essential Software Architecture*, 1st edition, 2006.
2. Bob Hughes, Mike Cotterell, *Software Project Management, 4th edition*, Tata McGraw Hill, 2006.
3. Christine Hofmeister, Robert Nord, Deli Soni , *Applied Software Architecture*, Addison-Wesley Professional; 1st edition, 1999.
4. Erich Gamma, Richard Helm, Ralph Johnson, John Vlissides, *Design Patterns: Elements of Reusable Object-Oriented Software*, Addison-Wesley Professional; 1st edition.
5. Martin Fowler, *Patterns of Enterprise Application Architecture*, Addison- Wesley Professional, 2003.

Sessional work assessment	
Assignments	2x10 = 20
Tests	2x15 = 30
Total marks	= 50

University examination pattern

Seven questions covering all the five modules .Each carries 20 marks and each question should have minimum of two parts. There should be a minimum of one question from each module. There should not be more than 2 questions from any module. The student has to answer any five full questions for scoring full marks.

MCA10 403 WEB PROGRAMMING

Objectives:

- To impart the concepts of web programming techniques.
- To understand how a web program can be developed.

Module I (10 hrs)

Internet and WWW, Creating Web Graphics, HTML, Paintshop, Photoshop, FrontPage, Introduction to XHTML, Cascading Style Sheets.

Module II (12 hrs)

Introduction to Scripting, JavaScript: Control Statements, Functions, Arrays, Objects, Dynamic HTML: Object Model and Collections, Filters and Transitions, Data Binding with Tabular Data Control

Module III (10 hrs)

Building Interactive Animations, Extensible Markup Language (XML), Web Servers, Database: SQL, MySQL, DBI

Module IV (10 hrs)

Active server pages, CGI and, PHP. (concept only)

Module V (10 hrs)

Introduction to JSP – use – compared to ASP and Servlets – Architecture – JSP environment – using tags – declaration tag – expression tag – directive tag – scriptlet tag – action tag – implicit object – session tracking.

Reference Books

1. H. M. Deitel, P. J. Deitel and T. R. Nieto, Internet and World Wide Web: How To Program, Pearson Education, 2000.
2. Harvey Deitel, Paul Deitel, Tem Nieto, Complete Internet & World Wide Web Programming Training Course, Student Edition, 2/e, Prentice Hall , 2002

Sessional work assessment	
Assignments	2x10 = 20
Tests	2x15 = 30
Total marks	= 50

University examination pattern

Seven questions covering all the five modules .Each carries 20 marks and each question should have minimum of two parts. There should be a minimum of one question from each module. There should not be more than 2 questions from any module. The student has to answer any five full questions for scoring full marks.

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of backward pass- determination of float and slack times determination of critical path- simulation of complete network- merits of simulation of stochastic networks.

TEXTBOOK

1. Deon N, *System Simulation And Digital Computer*, Prentice Hall of India.

Reference:

1. Gordan G, *System Simulation* , Prentice Hall of India.
2. Law A M and Ketton W D, *Simulation Modeling and Analysis*, McGraw Hill.

Sessional work assessment

Assignments	2x10 = 20
Tests	2x15 = 30
Total marks	= 50

University examination pattern

Seven questions covering all the five modules .Each carries 20 marks and each question should have minimum of two parts. There should be a minimum of one question from each module. There should not be more than 2 questions from any module. The student has to answer any five full questions for scoring full marks.

MCA10 405 C EMBEDDED SYSTEMS

Objectives

- *To teach students about architecture, hardware and software elements, programming models and practices and tools for embedded system design and implementation.*
- *To focus on the hardware and real time operating systems used for the embedded systems design.*

Module I (14 hrs)

Embedded systems: Overview, Design challenges-Optimising design metrics, Common design metrics- Processor technology-General purpose processors, Single purpose processors and Application specific processors. IC technology: Full-custom/VLSI, Semi-custom ASIC, Compilation/Synthesis, libraries/IP, Test/Verification, Custom Single-purpose processors: Hardware-Combinational Logic, Transistors and logic gates, Basic combinational and Sequential logic design, Custom single purpose processor design and optimisation. General-purpose processors: Software: Basic architecture, Datapath, Control unit, Memory, Instruction execution, Pipelining, Superscalar and VLIW architectures, Instruction set, Program and data memory space, Registers, I/O, Interrupts, Operating Systems, Development environment, Design flow and tools, Testing and debugging. Application-specific instruction-set processors, Microcontrollers, Digital signal processors. Standard single-purpose processors: Peripherals- some examples such as Timers, counters, Analog-digital converters, etc.

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Module II (7 hrs)

Memory: Write-ability and storage permanence. Common memory types, Composing memories, memory hierarchy and cache - Cache mapping techniques: replacement, write techniques, Cache impact on system performance, Advanced RAM, the basic DRAM, types of DRAMS, DRAM integration problem, Memory management unit (MMU)

Module III (7 hrs)

Interfacing: Basic protocol concepts, Microprocessor interfacing: I/O addressing, interrupts, DMA, Arbitration methods, Multi-level bus architectures, Advanced communication principles, Parallel, Serial and Wireless communication, Error detection and correction, Bus standards and protocols.

An example: Digital camera - User's perspective, Designer's perspective, Specification, Informal functional specification, Non-functional specification, Executable specification Design, Implementation alternatives

Module IV(13 hrs)

State machine and concurrent process models: Models vs. languages, text vs. graphics, A basic state machine model: finite-state machines, FSM with datapath model FSMD, Hierarchical/Concurrent state machine model (HCFSM) and the State charts language, Program-state machine model (PSM),The role of an appropriate model and language

Concurrent process model: Concurrent processes, create, terminate suspend, resume and join, Interprocss Communication and synchronization methods and their implementation Case studies : Windows CE, QNX

Module V (11 hrs)

Design technology: Automation-The parallel evolution of compilation and synthesis, Synthesis levels, Logic synthesis, Two-level and, Multi-level logic minimization, FSM synthesis, Technology mapping, Integration logic synthesis and physical design, Register-transfer synthesis, Behavioural synthesis, System synthesis and hardware/software codesign, Intellectual property cores, New challenges posed by cores to processor providers and users.

Text Books

1. Frank Vahid and Tony Givargis, Embedded System Design: A Unified Hardware/Software Introduction, Wiley, 2002.

Reference Books

1. Jack Ganssle, The Art of Designing Embedded Systems, 2nd ed., Elsevier, 2008.
2. Raj Kamal, Embedded systems - architecture, programming and design, Tata McGraw Hill, 2007.
3. Steve Heath, Embedded Systems Design, 2nd ed., Elsevier, 2006.
4. Tammy Noergaard, Embedded Systems Architecture: A Comprehensive Guide for Engineers and Programmers, Elsevier, 2008.
5. A.N.Sloss, D. Symes, and C. Wright, ARM System Developer's Guide: Designing and Optimizing System Software, Morgan Kaufmann Publishers/Elsevier, 2008.

Sessional work assessment	
Assignments	2x10 = 20
Tests	2x15 = 30
Total marks	= 50

SEMESTER - 5

MCA10 501 COMPUTER GRAPHICS AND MULTIMEDIA

Objectives

- *To teach the fundamentals of computer graphics including algorithms for drawing 2D and 3D primitives, object transformations and the like.*
- *To understand the overview of multimedia systems and various data compression techniques.*

Module I: (11 hrs)

Introduction to Computer Graphics, Basic raster graphics algorithms for drawing 2D primitives: scan converting lines, circles, ellipses - filling polygons - clipping lines, circles, ellipses, polygons - generating representation of transformations

Module II: (11 hrs)

Homogenous coordinates and matrix techniques: Interaction hardware - basic interaction tasks - user interface software.3D graphics: viewing in 3D - projections - basics of solid modeling - 3D transformations.

Module III: (8 hrs)

Introduction to multimedia : Media and Data Streams - properties of a Multimedia systems - Building Blocks : Audio : Basic sound concepts - Music - Speech - MIDI versus Digital Audio - Audio file formats - sound for the web

Module IV: (8 hrs)

Images and Graphics: Basic concepts - Computer image processing. Video and Animation: Basic concepts - Animation techniques - Animation for the web.

Module IV: (14 hrs)

Data compression : Storage space and coding requirements - classification of coding compression techniques - Basic compression techniques like JPEG, H.261, MPEG and DVI.

Text Books

1. Foley J D, Van Dam A, Feineer S K & Hughes J F, Computer Graphis Principles and Practices, Addison Wesley
2. Ralf Steinmetz & Klara Nahrstedt Multimedia: Computing: Communications and Applications, Pearson Education

Reference:

1. Rogers D. F, *Procedural Elements for Computer Graphics,* McGraw Hill.
2. Newmann W and Sproull R. F, *Principles of Intractive Computer Graphics,* McGraw Hill.

3. Hearn D and Backer P.M, *Computer Graphics*, Prentice Hall India.
4. Koegel Buford J.F, *Multimedia System*, Addison Wesely.
5. Vaughan T, *Multimedia : Making it work*, McGraw Hill.

Sessional work assessment

Assignments	2x10 = 20
Tests	2x15 = 30
Total marks	= 50

University examination pattern

Seven questions covering all the five modules .Each carries 20 marks and each question should have minimum of two parts. There should be a minimum of one question from each module. There should not be more than 2 questions from any module. The student has to answer any five full questions for scoring full marks.

MCA10 502 WIRELESS COMMUNICATION

Objectives:

- *This introductory course is intended to introduce the basics of wireless and mobile networks in the context of the recent trends in this area and their proliferation in day to day life. Local Area Network (LAN), Wide area Network (WAN) and Inter networking are dealt with.*

Module I (8 hrs)

Introduction, wireless transmission - frequencies for radio transmission - signals - antennas - signal propagation - multiplexing - modulation - spread spectrum - cellular systems - medium access control - specialized MAC - SDMA - FDMA - TDMA - aloha - CSMA - collision avoidance - polling - CDMA - comparison of S/T/F/CDMA

Module II (10 hrs)

Telecommunication systems - mobile services - system architecture - radio interface - protocols - localization and calling - handover - security - new data services - satellite systems- GPS-broadcast systems - digital audio broadcasting - digital video broadcasting, WDM Optical networks.

Module III (12 hrs)

Mobile network layer - mobile IP - packet delivery - registration - tunneling and encapsulation - optimizations - reverse tunneling - dynamic host configuration protocol-Mobile Transport Layer-TCP-Indirect TCP-Snooping TCP-Mobile TCP-retransmission-recovery-transaction oriented TACP

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Module IV (12 hrs)

Wireless LAN-Infra red Vs radio transmission -infra structure and adhoc networks-IEEE 802.11 b/a/g-bluetooth-IEEE 802.16,adhoc networks - routing - algorithms - metrics

Module V (10 hrs)

WAP-Design and principles of operations,WAP architecture Overview-WAP model-WAP architecture components-WAE overview-WWW model-WAE model-WTA architecture overview-Wireless session protocol specifications-Wireless transaction protocol specification-Wireless transport layer security specification-Wireless datagram protocol-wireless control message protocol specification.

TEXT BOOKS

1. Schiller J.***Mobile Communications, 2/e***, Pearson Education, 2003.
2. Gray.S.Rogers,John Edwards ***An Introduction to Wireless Technology***,Pearson Education

References

1. C.Siva Ram Murthy, ***Ad Hoc Wireless Networks: Architectures and Protocols***, Pearson Education, 2004.
2. Singhal et.al S., ***The Wireless Application Protocol***, Addison Wesley
3. C. Siva Ram Murthy, ***WDM Optical Networks: Concepts, Design, and Algorithms***, Pearson Education.

Sessional work assessment	
Assignments	2x10 = 20
Tests	2x15 = 30
Total marks	= 50

University examination pattern

Seven questions covering all the five modules .Each carries 20 marks and each question should have minimum of two parts. There should be a minimum of one question from each module. There should not be more than 2 questions from any module. The student has to answer any five full questions for scoring full marks.

MCA10 503 OBJECT ORIENTED MODELING AND DESIGN

Objectives:

- To give concepts of OOPs UML and Architecture diagrams

Module 1 (6 hrs)

Overview of object-oriented systems, objects, attributes, encapsulation, class hierarchy, polymorphism, inheritance, messages, history of object orientation.

Module 2 (12 hrs)

Introduction to UML, basic expression of classes, attributes, and operations, Class diagrams: generalization and association constructs, composition and aggregation. Use case diagrams, Object interaction diagrams: collaboration diagrams, sequence diagrams, asynchronous messages and concurrent execution. State diagrams: basic state diagrams, nested states, concurrent states and synchronisation, transient states. Activity diagrams

Module 3 (6 hrs)

Architecture diagrams : packages, deployment diagrams for hardware artifacts and software constructs . Interface diagrams: window-layout and window-navigation diagrams.