NEHRU COLLEGE OF ENGINEERING AND RESEARCH CENTRE

(Accredited by NAAC, Approved by AICTE New Delhi, Affiliated to APJKTU)

Pampady, Thiruvilwamala(PO), Thrissur(DT), Kerala 680 588

DEPARTMENT OF MECHATRONICS

SYLLABUS BOOK FOR STUDENTS

CALICUT UNIVERSITY 2009 SCHEME

VISION OF THE INSTITUTION

To mould our youngsters into Millennium Leaders not only in Technological and Scientific Fields but also to nurture and strengthen the innate goodness and human nature in them, to equip them to face the future challenges in technological break troughs and information explosions and deliver the bounties of frontier knowledge for the benefit of humankind in general and the down-trodden and underprivileged in particular as envisaged by our great Prime Minister Pandit Jawaharlal Nehru

MISSION OF THE INSTITUTION

To build a strong Centre of Excellence in Learning and Research in Engineering and Frontier Technology, to facilitate students to learn and imbibe discipline, culture and spirituality, besides encouraging them to assimilate the latest technological knowhow and to render a helping hand to the under privileged, thereby acquiring happiness and imparting the same to others without any reservation whatsoever and to facilitate the College to emerge into a magnificent and mighty launching pad to turn out technological giants, dedicated research scientists and intellectual leaders of the society who could prepare the country for a quantum jump in all fields of Science and Technology

ABOUT DEPARTMENT

♦ Established in: 2013

♦ Course offered: B.Tech Mechatronics Engineering

♦ Approved by AICTE New Delhi and Accredited by NAAC

♦ Affiliated to the University of Dr. A P J Abdul Kalam Technological University.

DEPARTMENT VISION

To develop professionally ethical and socially responsible Mechatronics engineers to serve the humanity through quality professional education.

DEPARTMENT MISSION

MD 1: The department is committed to impart the right blend of knowledge and quality education to create professionally ethical and socially responsible graduates.

MD 2: The department is committed to impart the awareness to meet the current challenges in technology.

MD 3: Establish state-of-the-art laboratories to promote practical knowledge of mechatronics to meet the needs of the society.

PROGRAMME EDUCATIONAL OBJECTIVES

PEO1: Graduates shall have the ability to work in multidisciplinary environment with good professional and commitment.

PEO2: Graduates shall have the ability to solve the complex engineering problems by applying electrical, mechanical, electronics and computer knowledge and engage in lifelong learning in their profession.

PEO3: Graduates shall have the ability to lead and contribute in a team entrusted with professional social and ethical responsibilities.

PEO4: Graduates shall have ability to acquire scientific and engineering fundamentals necessary for higher studies and research.

SCHEME AND SYLLABI

FOR

THIRD TO EIGHT SEMESTERS

OF

BACHELOR OF TECHNOLOGY

IN

MECHATRONICS ENGINEERING

FROM 2009 ADMISSION ONWARDS

CALICUT UNIVERSITY (P.O), THENHIPALAM

SEMESTER III

SCHEME OF III SEMESTER B.Tech COURSE

Code	Subject	Hours/ Week			Marks		Duration of End Semester Examination	Credits
		L	T	P/D	Internal	End Semester		
EN09 301	Engineering Mathematics III	3	1	0	30	70	3	**4**
EN09 302	Humanities and Communication Skills	2	1	0	30	70	3	**3**
MT09 303	Thermodynamics and Heat Transfer	4	1	0	30	70	3	**5**
MT09 304	Computer Assisted Machine Drawing	1	0	3	30	70	3	**4**
MT09 305	Electrical Technology	3	1	0	30	70	3	**4**
MT09 306	Electronic Devices and Circuits	3	1	0	30	70	3	**4**
MT09 307 (P)	Electrical Technology Lab	0	0	3	50	50	3	**2**
MT09 308 (P)	Electronic Devices and Circuits Lab	0	0	3	50	50	3	**2**
	TOTAL	16	5	9				**28**

EN09 301: ENGINEERING MATHEMATICS III
(Common for all branches)

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

Objective
This course provides a quick overview of the concepts and results in complex analysis that may be useful in engineering. Also it gives an introduction to linear algebra and Fourier transform which are wealth of ideas and results with wide area of application.

Module I: Functions of a Complex Variable (13 hours)
Functions of a Complex Variable – Limit – Continuity – Derivative of a Complex function – Analytic functions – Cauchy-Riemann Equations – Laplace equation – Harmonic Functions – Conformal Mapping – Examples: Zn, sinz, cosz, sinhz, coshz, (z+1/Z)– Mobius Transformation.

Module II: Functions of a Complex Variable (14 hours)
Definition of Line integral in the complex plane – Cauchy's integral theorem (Proof of existence of indefinite integral to be omitted) – Independence of path – Cauchy's integral formula – Derivatives of analytic functions (Proof not required) – Taylor series – Laurent series – Singularities and Zeros – Residues – Residue Integration method – Residues and Residue theorem – Evaluation of real integrals.

Module III: Linear Algebra (13 hours) - Proofs not required
Vector spaces – Definition, Examples – Subspaces – Linear Span – Linear Independence – Linear Dependence – Basis – Dimension – Ordered Basis – Coordinate Vectors – Transition Matrix – Orthogonal and Orthonormal Sets – Orthogonal and Orthonormal Basis – Gram-Schmidt orthogonolisation process – Inner product spaces –Examples.

Module IV: Fourier Transforms (14 hours)
Fourier Integral theorem (Proof not required) – Fourier Sine and Cosine integral representations – Fourier Transforms – Fourier Sine and Cosine Transforms – Properties of Fourier Transforms.

Text Books
Module I:
Erwin Kreysig, Advanced Engineering Mathematics, 8e, John Wiley and Sons, Inc.
Sections: 12.3, 12.4, 12.5, 12.6, 12.7, 12.9
Module II:
Erwin Kreysig, Advanced Engineering Mathematics, 8e, John Wiley and Sons, Inc.
Sections: 13.1, 13.2, 13.3, 13.4, 14.4, 15.1, 15.2, 15.3, 15.4
Module III:
Bernaed Kolman, David R Hill, Introductory Linear Algebra, An Applied First Course, Pearson Education.
Sections: 6.1, 6.2, 6.3, 6.4, 6.7, 6.8, Appendix.B.1
Module IV:
Wylie C.R and L.C. Barrett, Advanced Engineering Mathematics, McGraw Hill.
Sections: 9.1, 9.3, 9.5

Reference books

1. H S Kasana, Complex Variables, Theory and Applications, 2e, Prentice Hall of India.
2. John M Howie, Complex Analysis, Springer International Edition.
3. Shahnaz bathul, Text book of Engineering Mathematics, Special functions and Complex Variables, Prentice Hall of India.
4. Gerald Dennis Mahan, Applied mathematics, Springer International Edition.
5. David Towers, Guide to Linear Algebra, MacMillan Mathematical Guides.
6. Howard Anton, Chris Rorres, Elementary Linear Algebra, Applications Version, 9e, John Wiley and Sons.
7. Anthony Croft, Robert Davison, Martin Hargreaves, Engineering Mathematics, 3e, Pearson Education.
8. H Parthasarathy, Engineering Mathematics, A Project & Problem based approach, Ane Books India.
9. B V Ramana, Higher Engineering Mathematics, McGrawHill.
10. Sarveswara Rao Koneru, Engineering Mathematics, Universities Press.
11. J K Sharma, Business Mathematics, Theory and Applications, Ane Books India.
12. John bird, Higher Engineering Mathematics, Elsevier, Newnes.
13. M Chandra Mohan, Vargheese Philip, Engineering Mathematics-Vol. I, II, III & IV., Sanguine Technical Publishers.

14. N Bali, M Goyal, C Watkins, Advanced Engineering Mathematics, A Computer Approach, 7e, Infinity Science Press, Fire Wall Media.
15. V R Lakshmy Gorty, Advanced Engineering Mathematics-Vol. I, II., Ane Books India.
16. Sastry S.S., Advanced Engineering Mathematics-Vol. I and II., Prentice Hall of India.
17. Lary C Andrews, Bhimsen K Shivamoggi, Integral Transforms for Engineers, Prentice Hall of India.

Internal Continuous Assessment *(Maximum Marks-30)*

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: Short answer questions (one/two sentences)   *5 x 2 marks=10 marks*
        All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.
PART B: Analytical/Problem solving questions   *4 x 5 marks=20marks*
        Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.
PART C: Descriptive/Analytical/Problem solving questions   *4 x 10 marks=40 marks*
        Two questions from each module with choice to answer one question.
                                                                        Maximum Total Marks: 70

EN09 302 HUMANITIES AND COMMUNICATION SKILLS
(Common for all branches)

Teaching scheme   Credits: 3
2 hours lectures and 1hour lab per week

Objectives

- *To identify the most critical issues that confronted particular periods and locations in history;*
- *To identify stages in the development of science and technology;*
- *to understand the purpose and process of communication;*
- *to produce documents reflecting different types of communication such as technical descriptions, proposals ,and reports;*
- *To develop a positive attitude and self-confidence in the workplace; and*
- *To develop appropriate social and business ethics.*

Module I (08 hours)
Humanities, Science and Technology: Importance of humanities to technology, education and society- Impact of science and technology on the development of moderncivilization.
Contributions of ancient civilization: Chinese, Indian, Egyptian and Greek.
Cultural, Industrial, Transportation and Communication revolutions.
Advances in modern India: Achievements in information, communication and space technologies.

Module II (10 hours)

Concept of communication: The speaker/writer and the listener/reader, medium of communication, barriers to communication, accuracy, brevity, clarity and appropriateness

Reading comprehension: Reading at various speeds, different kinds of text for different purposes, reading between lines.

Listening comprehension: Comprehending material delivered at fast speed and spoken material, intelligent listening in interviews

Speaking: Achieving desired clarity and fluency, manipulating paralinguistic features of speaking, task oriented, interpersonal, informal and semi formal speaking, making a short classroom presentation.

Group discussion: Use of persuasive strategies, being polite and firm, handling questions and taking in criticisms on self, turn-taking strategies and effective intervention, use of body language.

Module III (10 hours)

Written Communication : Note making and taking, summarizing, notes and memos, developing notes into text, organization of ideas, cohesion and coherence, paragraph writing, ordering information in space and time, description and argument, comparison and contrast, narrating events chronologically. Writing a rough draft, editing, proof reading, final draft and styling text.

Technical report writing: Synopsis writing, formats for reports. Introductory report, Progress report, Incident report, Feasibility report, Marketing report, Field report and Laboratory test report

Project report: Reference work, General objective, specific objective, introduction, body, illustrations using graphs, tables, charts, diagrams and flow charts. Conclusion and references

Preparation of leaflets, brochure and C.V.

Module IV (08 hours)

Human relations and Professional ethics: Art of dealing with people, empathy and sympathy, hearing and listening. Tension and stress, Methods to handle stress

Responsibilities and rights of engineers- collegiality and loyalty – Respect for authority – Confidentiality – conflicts of interest – Professional rights, Rights of information, Social responsibility

Senses of ethics – variety of moral issues – Moral dilemma – Moral autonomy – Attributes of an ethical personality – right action – self interest

Reference Books

1. Meenakshi Raman and Sangeeta Sharma, Technical Communication- Principles and Practice Oxford University press, 2006
2. Jayashree Suresh and B S Raghavan, Professional Ethics, S Chand and Company Ltd, 2005
3. Subrayappa, History of Science in India, National Academy of Science, India
4. R C Bhatia, Business Communication, Ane Books Pvt. Ltd, 2009
5. Sunita Mishra and C Muralikrishna, Communicatin Skils for Engineers, Pearson Education, 2007.
6. Jovan van Emden and Lucinda Becker, Effective Communication for Arts and Humanities Students, Palgrave macmillam, 2009
7. W C Dampier, History of Science, Cambridge University Press
8. Vesilind, Engineering, Ethics and the Environment, Cambridge University Press
9. Larson E, History of Inventions, Thompson Press India Ltd.
10. Bernal J.D, Science in History, Penguin Books Ltd
11. Encyclopedia Britannica, History of Science, History of Technology
12. Brownoski J, Science and Human Values, Harper and Row

13. Schrodinger, Nature and Greeks and Science and Humanism, Cambridge University Press

---

Internal Continuous Assessment *(Maximum Marks-30)*

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: Short answer questions (one/two sentences)   *5 x 2 marks=10 marks*
      All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.
PART B: Analytical/Problem solving questions   *4 x 5 marks=20marks*
      Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.
PART C: Descriptive/Analytical/Problem solving questions   *4 x 10 marks=40 marks*
      Two questions from each module with choice to answer one question.
Maximum Total Marks: 70

MT09 303 THERMODYNAMICS AND HEAT TRANSFER

Teaching scheme   **Credits:** 5
4 hours lecture and 1 hour tutorial per week

Objectives
- *To know and apply the basic concepts of first law second law of Thermo Dynamics.*
- *To make aware of the basic principles of IC engines, Gas Turbines and various modes of Heat Transfer.*

Module I (18 hours)
BASIC CONCEPTS & FIRST LAW OF THERMODYNAMICS
Working substance - system - ideal gas laws - perfect gas - property - state, process, path and cycle - Equilibrium - Zeroth law of Thermodynamics - point and path functions - Quasi static process, reversible and irreversible processes. First law of thermodynamics:- Energy – first law - specific heat - internal energy and Enthalpy - Energy changes in non-flow processes - The flow equation.
SECOND LAW OF THERMODYNAMICS
Kelvin - Plank and Clausius statements, Basic concepts of Heat Engines and Heat pumps (efficiency and COP) - Corollaries of II Law - Absolute temperature scale, Entropy, Entropy change for a perfect gas, principle of entropy increase, Clausius inequaility.

Module II (18 hours)
I.C. ENGINES
Classifications - Four stroke SI & CI engines, Two stroke SI & CI engines, Power developed by engines, Factors deciding power output, specific weight and specific volume, indicated and brake thermal efficiencies, mechanical efficiency, specific fuel consumption, Performance curves. Heat Balance - Comparison of two stroke and four stroke engines, SI and CI engines. Application of SI & CI engines.

Module III (18 hours)
STEAM AND GAS TURBINES
Steam Turbines : Types of steam turbines, condensing, non condensing, multi cylinder turbines. Properties of steam - steam tables/ Mollier chart, Ranking cycle - Simple problems, Concept of Reheat and regeneration.
Gas Turbine : Open and Closed cycle, Applications. Flow through stages, degree of reaction - Single stage - reaction impulse - their blade profiles, velocity triangles, specific work, loses and efficiencies. Simple Problems - Multi stage turbines - reaction (Parson) impulse - Pr Compounded and Velocity compounded - Their merits and demerits.

Module IV (18 hours)
HEAT TRANSFER
Modes of heat transfer
Conduction: Steady state heat conduction - Heat conduction through a plane wall, composite wall, hollow cylinder and composite cylinders - overall heat transfer coefficient
Convection: Heat transfer by convection - Emperical relations
Radiation: Laws of radiations - Concept of block body- Radiant Heat transfer between two surfaces.

Text Books
1. Rajput R K, *Thermal Engineering*, Lakshmi Publications 2001
2. Ballaney P L, *Thermal Engineering*, Khanna Publishers, 1986.

Reference Books
1. Holman J. P., *Thermodynamics*, McGraw Hill.1988.
2. Nag P. K., *Engineering Thermodynamics*, Tata McGraw Hill, 1995.
3. Pandya N. C & Shah C. S., *Elements of Heat Engines*, Charoter Pulishers, 1986.
4. Ganesan V., *Internal Combustion Engines*, Tata McGraw Hill
5. Ganesan V., *Gas Turbines*, Tata McGraw Hill
6. Mathur, Mehta, *Thermodynamics and Heat Power Engineering*, Vol. I & II

Internal Continuous Assessment *(Maximum Marks-30)*

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

MT09 304 COMPUTER ASSISTED MACHINE DRAWING

(Common for ME & AM Branches)

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

Objectives
- *To impart the fundamental concepts of machine drawing.*
- *To develop primary knowledge of working drawings.*
- *To produce orthographic drawing of different machine parts.*
- *To develop skill to produce assembly drawings.*
- *To develop skill to produce detailed drawings of machines parts from assembly drawing.*
- *To develop skill to produce drawings by using any standard CAD software.*

Module 0: (6 Hours).
Preparation of working Drawings with specification using any popular drafting software.

Module I (12 hours - 1 Printout, 2 Drawing sheets)
Preparation of Sketch & working drawings for:

a) Joints: Sleeve and cotter joints, knuckle joints, Socket and spigot joints, Flanged hydraulic joints, Lap and butt joint, Zigzag and chain structure.

b) Couplings and pulleys: Solid and split muff couplings, Universal coupling, Flat pulleys, Stepped cone pulleys.

Module II (12 Hrs. - 1 Printouts, 2 Drawing sheets)
Preparation of Sketch & working drawings for:
a) Tolerances and Fits -Hole system and shaft system of tolerances, Indication of dimensional tolerances and fits on simple machine parts - Geometrical tolerances, Indication of geometrical tolerances on simple machine parts, Indication of surface finish on drawings - Preparation of shop floor drawings of simple machine parts.

b) Bearings - Solid journal bearings, Plummer block and footstep bearings.

Module III (24 Hrs. - 3 Printouts, 6 Drawing sheets)

 Preparation of Sketch & assembly drawings for :
- Stuffing boxes - cross heads, Eccentrics, Petrol Engine connecting rod - Piston assembly - Screws jacks - Machine Vices – Tailstock – Crane hook.

- Steam stop valve - Spring loaded safety valve – Blow-off-cock - Gate valve- Glob valve- Ball valve- Non return valve.

.**Text Book**

1. P.I.Vargheese, *Machine Drawing,* VIP Publishers, Thrissur

Reference Books

1. KL Narayana, P.Kanniah, Venketa Reddy - *Machine Drawing*, New Age International Ltd. New Delhi.
2. K.R.Gopalakrisima - *Machine Drawing*, Subhash publications, Bangalore.
3. K.L.Narayana, P.Kannaiah, K.Venkata Reddy - *Machine drawing*, New Age International Limited
4. ET Weston - *Automobile Engineering Drawing*
5. N.D. Bhatt and Panchal, *Machine Drawing,* Charator Publishing House.
6. Gautam Pohit & Gautam Ghosh, *Machine Drawing with AUTO CAD*, Pearson Education, New Delhi.
7. N.D.Junnarkar, *Machine Drawing,* Pearson Education, New Delhi.

Internal Continuous Assessment *(Maximum Marks-30)*

Printouts (Best 5)   05x02 = 10
Drawing Sheets (Best 8)   08x01 = 08
Tests (Best 2)   02x05 = 10
Attendance and Regularity   = 02
Total   = 30

University Examination Pattern
Question I: Two questions of 15 marks each from (a) and (b) sections of Module I.
Question II: Two questions of 20 marks each from (a) and (b) sections of Module II.
Question III: Two questions of 35 marks each from (a) and (b) sections of Module III.

Total = 70 marks

MT09 305 ELECTRICAL TECHNOLOGY

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

Objectives
- *To enable a thorough knowledge of the working principle and characteristics of all electrical machines.*
- *To introduce special types of electrical machines and its applications in mechatronics system design*

Module I (14 hours)
DC MACHINES

Review of constructional details – Working principle of DC generator – EMF equation – No load & load characteristics of shunt generator – working principle of DC motor – back emf – equations for torque & power – characteristics of shunt, series & compound motors – Necessity of starters – speed control (quantitative treatment only) – power stages – efficiency.

Module II (12 hours)
TRANSFORMERS
Review of transformers – Real transformer – windingresistance and leakage reactance – 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.

Module III (15 hours)
INDUCTION MOTORS & ALTERNATORS
Production of rotating magnetic field – torque equation, torque – slip characteristics – power stages and efficiency – simple problems – starters & methods of speed control (quantitative treatment only).Working principle of single phase induction motor – capacitor start & capacitor run motors.

Review of alternators – distribution and chording factor – emf equation – armature reaction – phasor diagram – voltage regulation – predetermination of voltage regulation by EMF method

Module IV(13 Hours)
SPECIAL MACHINES / APPLICATIONS
Permanent Magnet Brushless DC Motors -Universal motor – stepper motor – servomotor(Quantitative treatment only) - Selection of motors with justifications for the following services,
*Machine tools *Washing machine *Cranes *WetGrinder *Steel mills * Mixie *Hoist *Electric traction

---

Text Books
1. Theraja B.L., Theraja A.K. *A Text Book of Electrical Technology*, Vol.II "AC & DC Machines", publication division of Nirja construction & development (p) Ltd., New Delhi, 1994.
2. P .S. Bhimbra, Electrical Machinery, Khanna Publishers

Reference Books
1. K. Murukesh Kumar, DC machines and Transformers, Vikas Publishing house Pvt Ltd.
2. B.k Bose,,Modern power electronics and ac drives,Pearson,2002.
3. Athani V.V. "stepper motors –Fundamentals, Applications &Design" New Age International.

Internal Continuous Assessment *(Maximum Marks-30)*

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: Short answer questions (one/two sentences)   *5 x 2 marks=10 marks*
        All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.
PART B: Analytical/Problem solving questions   *4 x 5 marks=20marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: Descriptive/Analytical/Problem solving questions   *4 x 10 marks=40 marks*

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

Maximum Total Marks: 70

MT09 306 ELECTRONIC DEVICES AND CIRCUITS

Teaching scheme   **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objectives
- *To understand the fundamental concepts*
- *To logically analyse any electronic circuit.*
- *To have knowledge about the amplifiers, Oscillators and Power supplies*
- *To apply the logic in any application.*

Module I (14 hours)
SEMICONDUCTORS & DIODES

Semiconductor fundamentals –Energy Band diagram – Intrinsic and Extrinsic Semiconductors- Working and description of a PN diode– Varactor Diode –Avalanche and Zener Breakdown – Zener diode –PIN diode – Photo diode – Photo voltaic cell – Light emitting diode – Liquid crystal display – Light dependant resistor.

Module II (13 hours)
TRANSISTORS

Principle of transistor action – Cut off, Active and saturation regions of a transistor – CE,CB,CC Configurations –Transistor as a switch – Use of a heat sink – Constructional features of a field effect transistor – theory of operation–MOSFET –Working and V-I Charecteristics – Depletion and enhancement types –Working and V-I characteristics of UJT – SCR

Module III (14 hours)
AMPLIFIERS

Classification of amplifiers– Distortion in amplifiers– frequency response of an amplifier– operation and analysis of class A Power amplifier– push-pull amplifier–Class B amplifier, class C amplifiers –single tuned and double tuned amplifier stagger tuned amplifier

OSCILLATORS & MULTI VIBRATORS

Classification of oscillators – Barkhausen criterion operation and analysis of RC phase shift – Hartely and colpitts oscillators – Multivibrators – astable, monostable and bistable multivibrators

Module IV (13 hours)
RECTIFIERS & POWER SUPPLIES

Single –phase, half-wave and full-wave rectifiers – Bridge rectifiers – Ripple factor, rectification efficiency, Transformer utilisation factor and regulation – Performance characteristics of rectifiers with filters – Regulated power supply– switched mode power supplies.

Text Books
1. Millman and Halkias, *Electronic devices and Circuits*, Tata McGraw Hill

International, Edition 1994.
2. G.K.Mithal, *Electronic Devices and Circuits*, Khanna Publishers, 1999.

Reference Books
1. Salivahanan *Electronic devices and Circuits*, Tata McGraw Hill International.
2. David A.Bell, *Electron Devices and Circuits*, Prentice Hall Of India, 3rd Edition, 1995.
3. Thomas L. Floyd , *Electron Devices*, Charles & Messil Publications, 1989.
4. Boylestad & Nashelsky, *Electronic Devices & Circuit Theory*, Eighth edition, Prentice Hall of India(P) Ltd., 2003.
5. Sedha.R.S., *A Text Book of Applied Electronics*, Sultan chand Publishers,1999.

Internal Continuous Assessment *(Maximum Marks-30)*

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: Short answer questions (one/two sentences)   *5 x 2 marks=10 marks*
        All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.
PART B: Analytical/Problem solving questions   *4 x 5 marks=20marks*
        Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.
PART C: Descriptive/Analytical/Problem solving questions   *4 x 10 marks=40 marks*
        Two questions from each module with choice to answer one question.
                                        Maximum Total Marks: 70

MT09 307(P) ELECTRICL TECHNOLOGY LAB

Teaching scheme   **Credits:** 2
3 hours practical per week

Objectives
- *To Study the, operation, performance and characteristics of different dc machines.*
- *T o conduct various tests on different ac machines and transformers and to study the performance.*

List of Experiments

1. Determination of V –I characteristics of (a) wirewound rheostat and (b) incandescent Lamps in series & parallel .
2. Brake test on3 phase squirrel cage &slip ring induction motors
3. V oltage regulation of alternator
4. OC &SC test on single phase transformer
5. Power measurement in 3 phase balanced circuits
6. Load test on DC shunt motor
7. Load test on DC series motor

8. Speed control of DC shunt motor
9. Open circuit characteristics of DC generator.
10. Swinburne's test and separation of losses in DC machine.
11. Load test on single phase transformer
12. Speed control ofinductionmotor by variable frequency method

---

Reference Books
1. Theraja B.L., Theraja A.K. *A Text Book of Electrical Technology*, Vol.II "AC & DC Machines", publication division of Nirja construction & development (p) Ltd., New Delhi, 1994.
2. Sudhakar, A. and Shyam Mojan, S.P. *Circuits and Networks Analysis and Synthesis*, Tata McGraw Hill Publishing Co. Ltd, New Delhi, 1994.

Internal Continuous Assessment *(Maximum Marks-30)*

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 *(Maximum Marks-100)*

70% - Procedure, conducting experiment, results, tabulation, and inference (70 marks)
20%- Viva voce (20 marks)

10%- Fair Record (10 marks)

MT 09 308(P) ELECTRONIC DEVICES AND CIRCUITS LABORATORY

Teaching scheme   **Credits:** 2
3 hours practical per week

Objectives
- *To strengthen the knowledge in the field of electronic devices through lab experiments.*
- *To equip the students to carry out independent experiments, and to train them on electronic circuits*

List of Experiments

1. V-I characteristic of PN & zener diode and series voltage regulator
2. Characteristics BJT, CE & CB – mode
3. Characteristics of JFET
4. Characteristic of SCR & UJT
5. Hartly oscillators & Colpilt's oscillators
6. Astable Multivibrator
7. Monostable, Bistable, multivibrator

8. Single Phase Half Wave Rectifier & Full Wave Rectifier
9. Bridge Rectifier.

Reference Books
1. Millman and Halkias, *Electronic devices and Circuits*, Tata McGraw Hill International, Edition 1994.
2. G.K.Mithal, *Electronic Devices and Circuits*, Khanna Publishers, 1999.

Internal Continuous Assessment *(Maximum Marks-30)*

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 *(Maximum Marks-100)*

70% -   Procedure, conducting experiment, results, tabulation, and inference (70 marks)
20%-   Viva voce (20 marks)

10%-   Fair Record (10 marks)

SEMESTER IV

SCHEME OF IV SEMESTER B.Tech COURSE

Code	Subject	Hours/Week			Marks		Duration of End Semester examination	Credits
		L	T	P/D	Internal	End Semester		
MT09 401	Mathematics for Mechatronic Systems	3	1	0	30	70	3	**4**
EN09 402	Environmental Science	2	1	0	30	70	3	**3**
MT09 403	Metrology and instrumentation	3	1	0	30	70	3	**4**
MT09 404	Mechanics of Solids and Fluids	4	1	0	30	70	3	**5**
MT09 405	Metallurgy & Material Science	3	1	0	30	70	3	**4**
MT09 406	Linear Integrated Circuits and Digital Systems	3	1	0	30	70	3	**4**
MT09 407 (P)	Materials Testing Lab	0	0	3	50	50	3	**2**
MT09 408 (P)	Linear Integrated Circuits and Digital Systems Lab	0	0	3	50	50	3	**2**
	TOTAL	18	6	6				**28**

EN09 401A, ENGINEERING MATHEMATICS-IV
(Common for ME, CE, PE, CH, BT, PT, AM, MT and AN)

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

Objective

     The use of probability models and statistical methods for analyzing data has become common practice in virtually all scientific disciplines. Two modules of this course attempt to provide a comprehensive introduction to those models and methods most likely to be encountered and used by students in their careers in engineering. A broad introduction to some important partial differential equations is also included to make the student get acquainted with the basics of PDE.

Module I: Probability Distributions (13 hours)
Random variables – Mean and Variance of probability distributions – Binomial Distribution – Poisson Distribution – Poisson approximation to Binomial distribution – Hyper Geometric Distribution – Geometric Distribution – Probability densities – Normal Distribution – Uniform Distribution – Gamma Distribution.

Module II: Theory of Inference (14 hours)
Population and Samples – Sampling Distribution – Sampling distribution of Mean (σ known) – Sampling distribution of Mean (σ unknown) – Sampling distribution of Variance – Interval Estimation – Confidence interval for Mean – Null Hypothesis and

Tests of Hypotheses – Hypotheses concerning one mean – Hypotheses concerning two means – Estimation of Variances – Hypotheses concerning one variance – Hypotheses concerning two variances – Test of Goodness of fit.

Module III: Series Solutions of Differential Equations (14 hours)
Power series method for solving ordinary differential equations – Legendre's equation – Legendre polynomials – Rodrigue's formula – Generating functions – Relation between Legendre polynomials – Orthogonality property of Legendre polynomials (Proof not required) – Frobenius method for solving ordinary differential equations – Bessel's equation – Bessel functions – Generating functions – Relation between Bessel functions – Orthogonality property of Bessel functions (Proof not required).

Module IV: Partial Differential Equations (13 hours)
Introduction – Formation of PDE – Complete Solution – Equations solvable by direct integration – Linear PDE of First order, Legrange's Equation: $Pp + Qq = R$ – Non-Linear PDE of First Order, $F(p,q) = 0$, Clairaut's Form: $z = px + qv + F(p,q)$, $F(z,p,q) = 0$, $F1(x,q) = F2(y,q)$ – Classification of Linear PDE's – Derivation of one dimensional wave equation and one dimensional heat equation – Solution of these equation by the method of separation of variables – D'Alembert's solution of one dimensional wave equation.

Text Books
Module I: Richard A Johnson, CB Gupta, Miller and Freund's Probability and statistics for Engineers, 7e, Pearson Education- Sections: 4.1, 4.2, 4.3, 4.4, 4.6, 4.8, 5.1, 5.2, 5.5, 5.7

Module II: Richard A Johnson, CB Gupta, Miller and Freund's Probability and statistics for Engineers, 7e, Pearson Education- Sections: 6.1, 6.2, 6.3, 6.4, 7.2, 7.4, 7.5, 7.8, 8.1, 8.2, 8.3, 9.5

Module III: Erwin Kreysig, Advanced Engineering Mathematics, 8e, John Wiley and Sons, Inc.- Sections: 4.1, 4.3, 4.4, 4.5

Module IV: N Bali, M Goyal, C Watkins, Advanced Engineering Mathematics, A Computer Approach, 7e, Infinity Science Press, Fire Wall Media- Sections: 16.1, 16.2, 16.3, 16.4, 16.5, 16.6, 16.7, 16.8, 16.9
Erwin Kreysig, Advanced Engineering Mathematics, 8e, John Wiley and Sons, Inc. Sections: 11.2, 11.3, 11.4, 9.8 Ex.3, 11.5

Reference books

1. William Hines, Douglas Montgomery, avid Goldman, Connie Borror, Probability and Statistics in Engineering, 4e, John Wiley and Sons, Inc.
2. Sheldon M Ross, Introduction to Probability and Statistics for Engineers and Scientists, 3e, Elsevier, Academic Press.
3. Anthony Croft, Robert Davison, Martin Hargreaves, Engineering Mathematics, 3e, Pearson Education.
4. H Parthasarathy, Engineering Mathematics, A Project & Problem based approach, Ane Books India.
5. B V Ramana, Higher Engineering Mathematics, McGrawHill.

6. Sarveswara Rao Koneru, Engineering Mathematics, Universities Press.
7. J K Sharma, Business Mathematics, Theory and Applications, Ane Books India.
8. John bird, Higher Engineering Mathematics, Elsevier, Newnes.
9. M Chandra Mohan, Vargheese Philip, Engineering Mathematics-Vol. I, II, III & IV., Sanguine Technical Publishers.
10. Wylie C.R and L.C. Barret, Advanced Engineering Mathematics, McGraw Hill.
11. V R Lakshmy Gorty, Advanced Engineering Mathematics-Vol. I, II., Ane Books India.
12. Sastry S.S., Advanced Engineering Mathematics-Vol. I and II., Prentice Hall of India.
13. Michael D Greenberg, Advanced Engineering Mathematics, Pearson Education.

Internal Continuous Assessment *(Maximum Marks-30)*

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: Short answer questions (one/two sentences)   *5 x 2 marks=10 marks*
        All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions   *4 x 5 marks=20 marks*
        Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: Descriptive/Analytical/Problem solving questions   *4 x 10 marks=40 marks*
        Two questions from each module with choice to answer one question.
                                        Maximum Total Marks: 70

EN09 402   ENVIRONMENTAL SCIENCE
(Common for all branches)
Teaching scheme   **Credits:** 3
2 hours lecture and 1 hour tutorial per week

Objective
To understand the problems of pollution,loss of forest,solid waste disposal,degradation of environment,loss of biodiversity and other environmental issues and create awareness among the students to address these issues and conserve the environment in a better way.

Module I (8 hours)
The Multidisciplinary nature of environmental science-Definition-scope and importanceneed for public awareness. Natural resources-Renewable and non-

renewable resources: Natural resources and associated problems-forest resources: Use and over exploitation, deforestation, case studies. Timber extraction, mining, dams and their defects on forests and tribal people.- water resources: Use and over utilization of surface and ground water, floods ,drought ,conflicts over water, dams-benefits and problems.- Mineral resources: Use and exploitation,environmental effects of extracting and using mineral resources, case studies.- Food resources: World food problems, changes caused by agriculture over grazing, effects of modern agriculture, fertilizer-pesticide problems, water logging,salinity,case studies.-Energy resources: Growing energy needs, renewable and non-renewable energy resources, use of alternate energy resources,Land resources: Land as a resource, land degradation, man induced land slides, soil erosion and desertification.

Module II (8 hours)
Ecosystems-Concept of an ecosystem-structure and function of an ecosystem – producers, consumers, decomposers-energy flow in the ecosystem-Ecological succession- Food chains, food webs and Ecological pyramids-Introduction, types, characteristics features, structure and function of the following ecosystem-Forest ecosystem- Grassland ecosystem –Desert ecosystem-Aquatic ecosystem(ponds, streams, lakes, rivers, oceans , estuaries)
Biodiversity and its consideration Introduction- Definition: genetic , species and ecosystem diversity-Biogeographical; classification of India –value of biodiversity: consumptive use, productive use, social ethical , aesthetic and option values Biodiversity at Global, national , and local level- India at mega –diversity nation- Hot spot of biodiversity-Threats to biodiversity: habitat loss, poaching of wild life, man , wild life conflicts –Endangered and endemic species of India-Conservation of biodiversity : In-situ and Ex-situ conservation of biodiversity.

Module III (10 hours)
Environmental pollution Definition-Causes, effects and control measures of Air pollution-m Water pollution –soil pollution-Marine pollution-Noise pollution-Thermal pollution-Nuclear hazards-Solid waste management: Causes, effects and control measures of urban and industrial wastes- Role of an individual in prevention of pollution-pollution case studies-Disaster management: floods , earth quake, cyclone and landslides-Environmental impact assessment

Module IV (10 hours)
Environment and sustainable development-Sustainable use of natural resources-Conversion of renewable energy resources into other forms-case studies-Problems related to energy and Energy auditing-Water conservation,rain water harvesting,water shed management-case studies-Climate change,global warming,acid rain,ozone layer depletion, nuclear accidentsand holocaust-Waste land reclamation-Consumerism and waste products-Reduce,reuse and recycling of products-Value education.

Text Books

1. Clark,R.S.Marine pollution,Clanderson Press Oxford.
2. Mhaskar A. K. Matter Hazrdous, Techno-science Publications.
3. Miller T. G. Jr., Environmental Science, Wadsworth Publishing Co.
4. Townsend C., Harper J, Michael Begon, Essential of Ecology, Blackwell Science Trivedi R. K., Goel P. K., Introduction to Air Pollution, Techno-

Science Publications

Internal Continuous Assessment (Maximum Marks-30)
60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as Report of field work, literature survey, seminar etc.
10% - Regularity in the class
Note: Field work can be Visit to a local area to document environmental assets-river/forest/grass land/mountain or Visit to local polluted site-urban/rural/industrial/agricultural etc. or Study of common plants, insects, birds etc. or Study of simple ecosystems-pond, river, hill slopes etc. or mini project work on renewable energy and other natural resources , management of wastes etc.

University Examination Pattern

PART A: Short answer questions (one/two sentences)   5 x 2 marks=10 marks
        All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions   4 x 5 marks=20 marks
        Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: Descriptive/Analytical/Problem solving questions   4 x 10 marks=40 marks
        Two questions from each module with choice to answer one question.
                                                Maximum Total Marks: 70

MT09 403 INSTRUMENTATION AND CONTROL SYSTEMS

Teaching scheme   **Credits:** 4
4 hours lecture and 1 hour tutorial per week
Objective
- *To gain knowledge in the measurement and control that necessary for engineering research and development programme*

Module I (16 hours)
FUNDAMENTAL OF MEASUREMENTS
The Process of Measurement: An Overview - Units and Standards-Introduction- significance of mechanical measurement- fundamental methods of measurements- generalized measuring system - calibration- errors in measurements.
MEASUREMENT OF DISPLACEMENT- STRESS- STRAIN- FORCE AND PRESSURE
Displacement and Dimensional Measurement displacement transducers- differential transformers- Strain and Stress Measurement- Electrical and metallic resistance strain gauge-stress – Elastic transducers-strain gauge- load cells- piezoelectric load cells- torque measurement. Pressure Measurement Bourdon tube- bellows- diaphragms- secondary transducers used with diaphragms- strain gauge pressure cells- measurement of high pressure. Temperature Measurement: Bimaterials- thermo resistive elements- thermocouples- semi conductor junction temperature sensors.

Module II (13 hours)
CONTROL SYSTEMS

Principle of Automatic control- Open loop andclosed loop systems – examples System modeling & approximation -modeling of electrical systems – dynamic equations using KCL & KVL of RL, RC and RLC circuits - development of block diagrams of electrical networks - block diagram reduction - signal flow graphs - Mason's gain formula -Modeling of translational and rotational mechanical systems - differential equations for mass, spring, dashpot elements - D'Alembert's principle - dynamic equations & transfer function for typical mechanical systems - analogous systems – force voltage & force-current analogy - toque-voltage & torque-current analogy – electromechanical systems- PI, PDand PIDcontrollers

Module III (13 hours)
TIME DOMAIN ANALYSIS

continuous systems -standard test signals - step, ramp, parabolic, impulse - transient and steady state response –first order systems - unit impulse, step & ramp responses of first order systems - second order systems -- unit step response- under damped and over damped systems - time domain specifications - steady state error – static position, velocity& acceleration error constants-Concept of stability -stability& location of the poles in S-plane - Routh-Hurwitz stability criterion-Root Locus Method Construction of root locus-Effect of poles and zeros and their location on the root locus

Module IV (12 hours)
FREQUENCY DOMAIN ANALYSIS-

Frequency Response representation- Polar Plot -Logarithmic Plots-Frequency Domain Specifications- Non- Minimum Phase SystemsTransportation Lag- Nyquist Stability Criterion—Stability from polar and Bode Plots Relative Stability- Gain Margin and Phase Margin

---

Text Books
1. Thomas G. Beckwith, Lienhard, Roy D. Marangoni, *Mechanical measurements*, Addison Wesley, 2000.
2. Nagrath I.J. Gopal .M., *Control System Engineering*, Wiley Easter Ltd., 1991.
3. A.Nagoore Kani,Control systems,RBA Publications.

Reference Books
1. Sawhney A.K., *Course in Mechanical Measurements and Instrumentation*, Dhanpat Rai and Sons,1997
2. Ogata, *Modern Control Engineering*, Prentice Hall of India private Ltd., New Delhi,2002.
3. Doeblin E.O., *Measurement System Application and Design*, Mc Graw Hill, 1973.
4. Kuo B.G., *Automatic Control Systems*, Mc Graw Hill, ISE,1983.

Internal Continuous Assessment *(Maximum Marks-30)*

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: Short answer questions (one/two sentences)   *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions   *4 x 5 marks=20 marks*
      Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: Descriptive/Analytical/Problem solving questions   *4 x 10 marks=40 marks*
      Two questions from each module with choice to answer one question.
Maximum Total Marks: 70

MT09 404 MECHANICS OF SOLIDS AND FLUIDS
Teaching scheme   **Credits: 5**
4 hours lecture and 1 hour tutorial per week

Objectives
- *To estimate the displacement and stresses in deformable bodies under the action of forces and torque.*
- *To solve problems in fluid statics, fluid kinematics and incompressible fluid dynamics.*

Module I (18 hours)
STRESS, STRAIN AND DEFORMATION OF SOLIDS
Concept of stress-strain, Hooke's law, Tension, compression and shear, stress-strain diagram, poisson's relation, volumetric strain, Elastic constants and their relation. Stress in simple and composite bars subjected to axial loading and temperature. State of stress at a point, principle plane, principle stress, normal and longitudinal stresses on a given plane – Mohr's circle of stresses.

Module II (18 hours)
TRANSVERSE LOADING ON BEAMS, SHEAR FORCE AND BENDING MOMENT
Types of Beams, Transverse loading on beams shear force and Bending moment in beams – cantilever, simply supported, overhanging beam subjected to concentrated load and UDL – maximum bending moment and point of contra flexure. Theory of simple bending and assumption – Derivation of formulae
$M/I=f/y=E/R$ and its applications to engineering – leaf spring.

Module III (18 hours)
TORSION, SPRINGS AND COLUMNS
Theory of torsion and assumption – Torsion of circular shafts, solid & hollow – strain energy in torsion. Power transmission, strength and stiffness of shafts. Types of springs, stiffness stresses and deflection in helical spring and leaf spring. Columns – Buckling and stiffness due to axial loads – Euler, Rankin and Empirical formulae for columns with different conditions.

Module IV (18 hours)
FLUID FLOW CONCEPTS AND BASIC EQUATIONS
Flow characteristics, concepts of system and control volume – continuity equation – Application of control volume to continuity – Energy Equation – Euler's Equation – Bernoulli equation and Momentum Equation –simple problems.
DIMENSIONAL ANALYSIS AND FLOW THROUGH CIRCULAR CONDUITS

Dimension and units, Buckingham π theorem. Discussions on dimensionless parameters – applications. Fluid flow – Laminar and Turblent flow through circular tubes. Darcy Equation on pipe roughness – Friction factor – Moody diagram, Minor loss.

Text Books
1. Ramamurtham .S and Narayanan .R. *Strength of material*, Dhanpat Rai Pvt. Ltd., New Delhi, 2001.
2. Bansal .R.K *Fluid Mechanics and Hydraulic Machines* Laxmi publications (P) Ltd., New Delhi, 1995.

Reference Books
1. Popov.E.P., *Mechanics of Materials*, Prentice Hall, 1982.
2. Timoshenko .S.P and Gere M.J., *Mechanics of Materials*, C.B.S. publishers, 1986.
3. Ferdinand P. Beer and Russell Johnston. *E Mechanics of Materials* SI metric Edition McGraw Hill, 1992.
4. Srinath L.N. *Advanced Mechanics of Solids* Tata McGraw Hill Ltd., New Delhi.
5. Ramamurthan .S. *Fluid Mechanics and Hydraulics* Dhanpat Rai and Sons, Delhi, 1988.
6. Fox R.W and Mc. Donald .A.T. *Introduction to fluid Mechanics,* 5th Ed. John Wiley and Sons, 1999.

Internal Continuous Assessment *(Maximum Marks-30)*

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: Short answer questions (one/two sentences)   *5 x 2 marks=10 marks*
     All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions   *4 x 5 marks=20 marks*
     Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: Descriptive/Analytical/Problem solving questions   *4 x 10 marks=40 marks*
     Two questions from each module with choice to answer one question.
          Maximum Total Marks: 70

MT09 405 METALLURGY AND MATERIAL SCIENCE

(Common for ME & AM Branches)

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

Objective

To impart knowledge on engineering materials, deformation of the crystals, equilibrium diagrams of selected alloy systems, heat treatment of steels, properties of steels, cast iron and other alloys, and its application

Module I (10 hours)
Introduction to materials science and engineering-Materials classification- Atomic structure and bonding -Primary Secondary bonding-Ionic, metallic, covalent, hydrogenbonding- Crystallography -SC,FCC,BCC,HCP structures-APF-Miller indices-miller bravais indices- polymorphism- allotropy- density computations-Crystal structure determination-X-ray diffraction techniques- Microscopic examination- Specimen preparation-etching- Metallurgical microscope-SEM-TEM-Grain size determination

Module II (15 hours)
Imperfections in crystals- point defects, line defects, surface defects-Mechanical behavior of materials- Elastic, visco elastic, anelastic behavior-Plastic Deformation of Metals and Alloys- Mechanisms of plastic deformation, role of Dislocation; slip and twinning- Schmids law Strengthening mechanisms-grain size reduction-solid solution strengthening-Work hardening; recovery recrystallisation and grain growth Diffusion-laws of diffusion- Mechanisms of diffusion- applications-Fracture- ductile fracture, brittle fracture, fracture toughness, BT- Fatigue-s-n curve- creep- creep curve

Module III (15 hours)
Solidification of metals and alloys- Solid solution, Hume Rothery's rules-Phase diagrams- Phase and Lever Rules relationship of micro Structure and properties –Isomorphous systems- Cu-Ni -eutectic system- Pb-Sn- eutectoid - peritectic reactions- Iron- Carbon equilibrium diagram. Development of microstructure in Iron Carbon alloys, Phase transformation in steel. TTT diagram, Heat treatment of steel, Annealing, tempering, austempering, martempering, Hardenability, Jomni test- surface hardening methods

Module IV (14 hours)
Applications of ferrous and non ferrous alloys-steel- low, medium, high carbon steels- Stainless steels-ferritic, austenitic, martensitic, duplex steels-tool steels cast iron- gray, white, ductile cast irons- copper and its alloys- aluminium and its alloys-magnesium and alloys- titanium and its alloys-refractories- super alloys-ceramics-PZT -PZLTrefractories- composite and glasses-shape memory alloys- Nano materials-bio materials- Optical fibers

---

Text Books
1. William D Callister, *Material Science and Engineering, John wiley and Sons*
2. Raghavan V, *Material science and engineering,*

Reference Books
1. James F Shackelford, *Materials science for Engineers,*
2. Van Vlack, *Materials science and Engineering,*Pearson Education
3. Jose S & Mathew E.V, *Metallurgy and Materials Science*
4. Dieter, G.E., *Mechanical Metallurgy*, Mc Graw Hill, 2001.
5. Thomas H. Courtney., *Mechanical Behaviour of Engineering materials*, McGraw Hill, 2000.

Internal Continuous Assessment *(Maximum Marks-30)*

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: Short answer questions (one/two sentences)   *5 x 2 marks=10 marks*
      All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.
PART B: Analytical/Problem solving questions   *4 x 5 marks=20marks*
      Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.
PART C: Descriptive/Analytical/Problem solving questions   *4 x 10 marks=40 marks*
      Two questions from each module with choice to answer one question.
                            Maximum Total Marks: 70

MT09 406 LINEAR INTEGRATED CIRCUITS AND DIGITAL SYSTEMS

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

Objective

- *To introduce the concepts for realising functional building blocks in ICs, application of IC and fundamentals of Digital Circuits, combinational and sequential circuit.*

Module I (13 hours)
CHARACTERISTICS OF OPAMP & ITS FUNDAMENTALS
Ideal OP-AMP characteristics, DC characteristics, AC characteristics, offset voltage and current: voltage series feedback and shunt feedback amplifiers, differential amplifier; frequency response of OP-AMP; Basic applications of op-amp – summer, differentiator and integrator, V/I &I/V converter**.**

Module II (16 hours)
APPLICATIONS OF OPAMP
Instrumentation amplifier, Basic Comparators, regenerative comparators, multivibrators, waveform enerators, clippers, clampers, peak detector, S/H circuit, First and Second order active filters, D/A converter (R-2R ladder and weighted resistor types), A/D converter - Dual slope, successive approximation and flash types.
SPECIAL ICs& VOLTAGE REGULATORS
555 Timer circuit – Functional block, characteristics & applications; 566-voltage controlled oscillator circuit, OP-Amp Voltage regulator-Series, Shunt and Switching regulator.

Module III (12 hours)
NUMBER SYSTEM, BOOLEAN ALGEBRA & COMBINATIONAL CIRCUITS
Review of number system; types and conversion, codes.
Boolean algebra: De-Morgan's theorem, Minimization of Boolean function using K-maps & Quine Mc Cluskey method.
Combinational circuits: Adder, subtractor, code converters, encoders, decoders, multiplexers and demultiplexers.

Module IV (13 hours)
SYNCHRONOUS & ASYNCHRONOUS SEQUENTIAL CIRCUITS
Flip flops - SR, D, JK , T and MasterSlave FF,Shift registers,Counters-Asynchronous and Synchronous Counters,Up-Down Counter, Modulo Counter, Ring Counter-Analysis of Asynchronous Counters, state diagram; state reduction; state assignment.

Text Books
1. Ramakant A.Gayakward, *Op-amps and Linear Integrated Circuits*, IV edition, Pearson Education, 2003 / PHI.
2. D.Roy Choudhary, Sheil B.Jani, *Linear Integrated Circuits*, II edition, New Age, 2003.
3. M. Morris Mano, *Digital Logic and Computer Design*, Prentice Hall of India, 2002

Reference Books
1. Robert F.Coughlin, Fredrick F.Driscoll, *Op-amp and Linear ICs*, Pearson Education, 4th edition, 2002 /PHI.
2. David A.Bell, *Op-amp & Linear ICs*, Prentice Hall of India, 2nd edition, 1997.
3. Charles H.Roth, *Fundamentals Logic Design*, Jaico Publishing, IV edition, 2002.
4. Floyd, *Digital Fundamentals*, 8th edition, Pearson Education, 2003.

Internal Continuous Assessment *(Maximum Marks-30)*

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: Short answer questions (one/two sentences)   *5 x 2 marks=10 marks*
    All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions   *4 x 5 marks=20 marks*
    Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: Descriptive/Analytical/Problem solving questions   *4 x 10 marks=40 marks*
    Two questions from each module with choice to answer one question.
                                             Maximum Total Marks: 70

MT09 407(P) MATERIALS TESTING LAB

Teaching scheme   **Credits:** 2
3 hours practical per week

Objectives
- *To provide knowledge on the mechanical behaviour of materials.*
- *To acquaint with the experimental methods to determine the mechanical properties of materials.*

List of Experiments

1. Standard tension test on mild steel using Universal Testing Machines and suitable extensometers

2. Stress-strain characteristics of brittle materials – cast iron

3. Spring test – open and closed coiled springs – determination of spring stiffness and modulus of rigidity

4. Determination of modulus of rigidity of wires

5. Hardness tests – Brinnell hardness, Rockwell hardness (B S C scales), Rockwell superficial hardness (N & T scales), and Vickers hardness

6. Impact test – Izod and Charpy

7. Bending test on wooden beams

8. Fatigue testing – study of testing machine

9. Photo elastic method of stress measurements (two dimensional problems)

10. Torsion test on mild steel rod

11. Shear test on mild steel rod

Reference Books
1. William D Callister, *Material Science and Engineering, John wiley and Sons*
2. Raghavan V, *Material science and engineering,*
3. James F Shackelford, *Materials science for Engineers,*
4. Van Vlack, *Materials science and Engineering,* Pearson Education
5. Jose S & Mathew E.V, *Metallurgy and Materials Science*

Internal Continuous Assessment *(Maximum Marks-30)*

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 *(Maximum Marks-100)*

70% - Procedure, conducting experiment, results, tabulation, and inference (70 marks)
20% - Viva voce (20 marks)

10% - Fair Record (10 marks)

MT09 408(P) LINEAR INTEGRATED CIRCUITSAND DIGITAL SYSTEM LABORATORY

Teaching scheme   **Credits:** 2
3 hours practical per week

Objectives
- *To study various digital and linear integrated circuits used in simple system configuration.*

List of Experiments
1. Application of Op-amp-I-Inverting, Non-Inverting, Adder & subtractor.
2. Application of Op-amp II – Differential Amplifier, Comparator, Integrator & Differentiator.
3. Op-amp characteristics – Slew rate verifications, CMRR, Input-Offset voltage.
4. Study of Basic Digital – IC's – Verification of TT for AND, OR, EXOR, NOT, NOR, NAND, JK, RS & DFF.
5. Implementation of Boolean functions, Adder / Subtractor Circuits.
6. Counters: Design and implementation of 4-bit Ripple and Decade counter.
7. Shift registers – SISO, PIPO, PISO, SIPO.
8. Timer IC application – NE555 timer in Astable , Monostable operation.

Reference Books
1. D.Roy Choudhary, Sheil B.Jani, *Linear Integrated Circuits*, II edition, New Age, 2003.

Internal Continuous Assessment *(Maximum Marks-30)*

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 *(Maximum Marks-100)*

70% -   Procedure, conducting experiment, results, tabulation,
             and inference (70 marks)
20%-   Viva voce (20 marks)

10%-   Fair Record (10 marks)

SEMESTER V

SCHEME OF V SEMESTER B.Tech COURSE

Code	Subject	Hours/ Week			Marks		Duration of End Semester examination	Credits
		L	T	P/D	Internal	End Semester		
MT09 501	Control systems	3	1	0	30	70	3	**4**
MT09 502	Manufacturing Technology	2	1	0	30	70	3	**3**
MT09 503	Engineering Economics & Principles of Management	3	1	0	30	70	3	**4**
MT09 504	Sensors and Actuators	3	1	0	30	70	3	**4**
MT09 505	Mechanics of Machinery	4	1	0	30	70	3	**5**
MT09 506	PLC and Data Acquisition Systems	3	1	0	30	70	3	**4**
MT09 507 (P)	Measurements and PLC Lab	0	0	3	50	50	3	**2**
MT09 508 (P)	CAD / CAM Lab	0	0	3	50	50	3	**2**
	TOTAL	18	6	6				**28**

MT09 501 CONTROL SYSTEMS

Teaching scheme   **Credits:** 4
4 hours lecture and 1 hour tutorial per week
Objective
- *To gain knowledge in the measurement and control that necessary for engineering research and development programme*

Module I (14 hours)
CONTROL SYSTEMS
Principle of Automatic control- Open loop and closed loop systems – examples System modeling & approximation -modeling of electrical systems – dynamic equations using KCL & KVL of RL, RC and RLC circuits - development of block diagrams of electrical networks - block diagram reduction - signal flow graphs - Mason's gain formula -Modeling of translational and rotational mechanical systems - differential equations for mass, spring, dashpot elements - D'Alembert's principle - dynamic equations

& transfer function for typical mechanical systems - analogous systems – force voltage & force-current analogy - toque-voltage & torque-current analogy – electromechanical systems- PI, PD and PID controllers

Module II (13 hours)
TIME DOMAIN ANALYSIS

continuous systems -standard test signals - step, ramp, parabolic, impulse - transient and steady state response –first order systems - unit impulse, step & ramp responses of first order systems - second order systems -- unit step response- under damped and over damped systems - time domain specifications - steady state error – static position, velocity& acceleration error constants-Concept of stability -stability& location of the poles in S-plane - Routh-Hurwitz stability criterion-Root Locus Method Construction of root locus-Effect of poles and zeros and their location on the root locus

Module III (13 hours)
FREQUENCY DOMAIN ANALYSIS-

Frequency Response representation- Polar Plot -Logarithmic Plots-Frequency Domain Specifications- Non- Minimum Phase Systems Transportation Lag-Nyquist Stability Criterion—Stability from polar and Bode Plots Relative Stability- Gain Margin and Phase Margin.

Module IV (14Hours)
STATE SPACE ANALYSIS

State Space Analysis -Concept of State, state variables, state vector and state space -comparison with transfer function approach- state models for typical electrical, mechanical and electro-mechanical systems - state space representation of linear time invariant systems- phase variable form-Diagonalisation - Diagonal and Jordan canonical forms- Transfer function from state model- Transfer function Decomposition- state diagrams- solution of time invariant state equation- Zero state and Zero input response State transition matrix- properties-Discrete time state model. Introduction to CS tool box in Mat lab.

Text Books
1. Nagrath I.J. Gopal .M., *Control System Engineering*, Wiley Easter Ltd., 1991.
2. A.Nagoore Kani,Control systems,RBA Publications.
3. Ashfaq Husain & Haroon Ashfaq, Dhanpat rai and co.(p)Ltd.

Reference Books
1. Ogata, *Modern Control Engineering*, Prentice Hall of India private Ltd., New Delhi,2002..
2. Kuo B.G., *Automatic Control Systems*, Mc Graw Hill, ISE,1983.
4. Dr . K. P . Mohandas, Modern Control Engineering, Sanguine T echnical Publishers.

Internal Continuous Assessment *(Maximum Marks-30)*

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

MT09 502 MANUFACTURING TECHNOLOGY

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

Objective
  * *To make aware of various manufacturing processes like metal forming, casting, metal cutting processes, gear manufacturing processes.*

Module I (09 hours)
CASTING AND WELDING
Introduction to casting, Patterns, Types, Pattern materials, Allowances – Moulding – types– Moulding sand, Gating and Risering, Cores &Core making. Special Casting Process– Shell, Investment, Die casting, Centrifugal Casting.
Special welding– Laser, Electron Beam, Ultrasonic, Electro slag, Friction welding, electrical resistance welding.

Module II (09 hours)
MECHANICAL WORKING OF METALS
Hot and Cold Working: Rolling, Forging, Wire Drawing, Extrusion– types– Forward, backward and tube extrusion.
Sheet Metal Operations: Blanking– blank size calculation, draw ratio, drawing force, Piercing, Punching, Trimming, Stretch forming, Shearing, Bending– simple problems– Bending force calculation, Tube forming – Embossing and coining, Types of dies: Progressive, compound and combination dies.

Module III (09 hours)
THEORY OF METAL CUTTING
Orthogonal and oblique cutting– Classification of cutting tools: single, multipoint – Tool signature for single point cutting tool – Mechanics of orthogonal cutting – Shear angle and its significance – Chip formation– Cutting tool materials– Tool wear and tool life – Machinability – Cutting Fluids– Simple problems.
GEAR MANUFACTURING AND SURFACE FINISHING PROCESS
Gear manufacturing processes: Extrusion, Stamping, and Powder Metallurgy. Gear Machining: Forming. Gear generating process– Gear shaping, Gear hobbing.
Grinding process, various types of grinding machine, Grinding Wheel– types– Selection of Cutting speed and work speed, dressing and truing. Fine Finishing– Lapping, Buffing, Honing, and Super finishing.

Module IV (09 hours)
MACHINE TOOLS
Milling Machine – specification, Types, Types of cutters, operations, Indexing methods–simple problems.
Shaping, Planning and Slotting Machine– description, Operations, Work and tool holding Devices. Boring machine– Specification, operations, Jig boring machine. Broaching machine– operations, Specification, Types, Tool nomenclature.

Text Books
1. Sharma, P.C., *A textbook of Production Technology – Vol I and II*, S. Chand & Company Ltd., NewDelhi, 1996.
2. Rao, P.N., *Manufacturing Technology, Vol I & II*, Tata McGraw Hill Publishing Co., New Delhi, 1998.

Reference Books
1. Kalpakjian, "*Manufacturing Engineering and Technology*", Pearson Education, 2005.
2. Degarmo E P, "*Materials and process in Manufacturing*", Macmillan Publishing Co., 1997.

Internal Continuous Assessment *(Maximum Marks-30)*

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: Short answer questions (one/two sentences)   *5 x 2 marks=10 marks*
　　　All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions   *4 x 5 marks=20 marks*
　　　Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: Descriptive/Analytical/Problem solving questions   *4 x 10 marks=40 marks*
　　　Two questions from each module with choice to answer one question.
　　　　　　　　　　　　　　　　　　　　　　　　Maximum Total Marks: 70

MT09 503 ENGINEERING ECONOMICS AND PRINCIPLES OF MANAGEMENT
(Comman for MT, ME and PT)

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

Section A: Engineering Economics

Objective
Impart fundamental economic principles that can assist engineers to make more efficient and economical decisions.

Module 1 (14 Hrs)
Economic reasoning, Circular Flow in an economy, Law of supply and demand, Economic efficiency. Element of costs, Marginal cost, Marginal Revenue, Sunk cost, Private and Social cost, Opportunity cost. Functions of Money and commercial Banking.
Inflation and deflation: concepts and regulatory measures. Economic Policy Reforms in India since 1991: Industrial policy, Foreign Trade policy, Monetary and fiscal policy, Impact on industry.

Module II (13 Hrs)
Value Analysis – Function, aims, procedure.–Time value of money, Single payment compound amount factor, Single payment present worth factor, Equal payment series sinking fund factor, Equal payment series payment Present worth factor- equal payment series capital recovery factor-Uniform gradient series annual equivalent factor. Methods of project analysis (pay back, ARR, NPV, IRR and Benefit -Cost ratio) Break-even analysis-, Process planning.

Text Books

1. Panneer Selvam, R, Engineering economics, Prentice Hall of India, New Delhi, 2002.
2. Wheeler R (Ed) Engineering economic analysis, Oxford University Press, 2004.

Internal Continuous Assessment *(Maximum Marks-15)*
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: Short answer questions (one/two sentences) 2 x 2 marks=4 marks
*   1 x 1 mark = 1 mark*
All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions   2 x 5 marks=10 marks
Candidates have to answer two questions out of three. There should be at least one question from each module and not more than two questions from any module.

PART C: Descriptive/Analytical/Problem solving questions 2 x 10 marks=20 marks
Two questions from each module with choice to answer one question.
*   Maximum Total Marks: 35*
Note: Section A (Engineering Economics) and Section B (Principles of Management) should be written in separate answer sheets.

Section B: Principles of Management

Objective

To provide knowledge on principles of management, decision making techniques, accounting principles and basic management streams

Module III (13 hours)

Principles of management – Evolution of management theory and functions of management Organizational structure – Principle and types.

Decision making – Strategic, tactical & operational decisions, decision making under certainty, risk & uncertainty and multistage decisions & decision tree. Human resource management – Basic concepts of job analysis, job evaluation, merit rating, wages, incentives, recruitment, training and industrial relations

Module IV (14 hours)

Financial management – Time value of money and comparison of alternative methods. Costing – Elements & components of cost, allocation of overheads, preparation of cost sheet, break even analysis Basics of accounting – Principles of accounting, basic concepts of journal, ledger, trade, profit & loss account and balance sheet. Marketing management – Basic concepts of marketing environment, marketing mix, advertising and sales promotion. Project management – Phases, organisation, planning, estimating, planning using PERT & CPM

Reference Books

1. F. Mazda, Engineering management, Addison Wesley, Longman Ltd., 1998
2. Lucy C Morse and Daniel L Babcock, Managing engineering and technology, Pearson Prentice Hall
3. O. P. Khanna, Industrial Engineering and Management, Dhanpat Rai and Sons, Delhi, 2003.
4. P. Kotler, Marketing Management: Analysis, Planning, Implementation and Control, Prentice Hall, New Jersey, 2001
5. Venkata Ratnam C.S & Srivastva B.K, Personnel Management and Human Resources, Tata McGraw Hill.
6. Prasanna Chandra, Financial Management: Theory and Practice, Tata McGraw Hill.
7. Bhattacharya A.K., Principles and Practice of Cost Accounting, Wheeler Publishing
8. Weist and Levy, A Management guide to PERT and CPM, Prantice Hall of India
9. Koontz H, O'Donnel C & Weihrich H, Essentials of Management, McGraw Hill.
10. Ramaswamy V.S & Namakumari S, Marketing Management : Planning, Implementation and Control, MacMillan

Internal Continuous Assessment *(Maximum Marks-15)*
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: Short answer questions (one/two sentences)   *2 x 2 marks=4 marks*
                                        1 x 1 mark = 1 mark

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions   *2 x 5 marks=10 marks*
Candidates have to answer two questions out of three. There should be at least one question from each module and not more than two questions from any module.

PART C: Descriptive/Analytical/Problem solving questions 2 x 10 marks=20 marks
Two questions from each module with choice to answer one question.
                                              Maximum Total Marks: 35
Note: Section A (Engineering Economics) and Section B (Principles of Management) should be written in separate answer sheets.

MT09 504 SENSORS AND ACTUATORS
Teaching scheme   **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives
- *To lay a foundation for the understanding of different measurements required in Engineering, sensors and its application.*

Module I (13 hours)
LINEAR AND ANGULAR MEASUREMNTS
General concepts of measurements – Definition, Standards of measurement – Errors in measurement, Accuracy, Precision. Length standard – Line and end standard – Slip gauges, Micrometers, Vernier, Dial gauges – comparators, types, principle and applications – interferometry – Angular measuring instruments – bevel protractor, levels, clinometers – Sine bar, angle dekkor – auto collimator.

Module II (14 hours)
FORM MEASURMENTS AND COMPUTER AIDED METROLOGY
Straightness, Flatness and roundness measurement, surface finish measurements, Tool makers microscope, various elements of threads – 2 wire and 3 wire methods – gear elements – various errors and measurements.
Co-ordinate measuring machine – construction features – types – application of CMM – Computer aided inspection – Machine vision – Non contact and in-process inspection, Laser Interferometer and its application

Module III (14 hours)
SENSOR
Principles and Applications of displacement sensor – position sensors, linear and angular – velocity sensors – Torque sensors. Principle and applications of pressure sensor, flow sensors, temperature sensors, acoustic sensor and vibration sensors.
MICRO ACTUATORS AND MICRO VALVES
Micro Actuators: Actuation principle, shape memory effects-one way, two way and pseudo elasticity. Types of micro actuators- Electrostatic, Magnetic, Fluidic, Inverse piezo effect, other principles.
Micro valves: Electromagnetic, Piezoelectric, Electrostatic, Thermo pneumatic, Bimetal. Linear actuatorsmagnetic, electrostatic, piezoelectric .

Module IV (13 hours)
MICRO SENSORS AND MICROBOTICS
Micro Sensors: Principles and examples, Force and pressure micro sensors, position and speed micro sensors, acceleration micro sensors, chemical sensors, biosensors, temperature micro sensors and flow micro sensors.
Microbotics: Drive principle, classification, application, micro assembly with the help of microbots, flexible microbots, Automated desktop station using micromanipulation robots.

Text Books
1. Jain .R. K., *Engineering Metrology*, Khanna Publishers, 1994.
2. Patranabis.D, *Sensors and Transducers*, Wheeler publisher, 1994.
3. Sergej Fatikow and Ulrich Rembold, *Microsystem Technology and Microbotics* First edition, Springer–Verlag Newyork, Inc, 1997.

Reference Books
1. Gupta. I.C., *A Text book of Engineering Metrology*, Dhanpat Rai and Sons, 1996.
2. *ASTE Hand Book of Industries Metrology*, Prentice Hall of India, 1992.
3. Thomas . G. Bekwith and Lewis Buck.N, *Mechanical Measurements*, Oxford and IBH publishing Co.Pvt. Ltd.,
4. Massood Tabib and Azar*, Microactuators Electrical, Magnetic, thermal, optical, mechanical, chemical and smart structures* , First edition, Kluwer academic publishers, Springer,1997.
5. Manfred Kohl *, Shape Memory Actuators*, first edition, *Springer*

Internal Continuous Assessment *(Maximum Marks-30)*

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: Short answer questions (one/two sentences)　　　　*5 x 2 marks=10 marks*
　　　　All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions　　　　*4 x 5 marks=20 marks*
　　　　Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: Descriptive/Analytical/Problem solving questions　　*4 x 10 marks=40 marks*
　　　　Two questions from each module with choice to answer one question.
　　　　　　　　　　　　　　　　　　　　　　　　　　　Maximum Total Marks: 70

MT09 505 MECHANICS OF MACHINERY
(Common with AM Branch)

Teaching scheme　　　　　　　　　　　　　　　　　　　　　　**Credits:** 5
4 hours lecture and 1 hour tutorial per week

Objectives
- *To provide knowledge on kinematics of selected mechanisms, design of cams, Theory and Analysis of gears, Gear Trains and Synthesis of Mechanisms.*
- *To develop the design and practical problem solving skills in the area of Mechanisms in the future courses.*

Module I (18 hours)
Introduction to kinematics and mechanisms - Various mechanisms, kinematic diagrams, degree of freedom- Grashof's criterion, inversions, Coupler curves - straight line mechanisms exact, approximate – Ackerman Steering Mechanism - Hooke's joint - Geneva Mechanism - Mechanical advantage, Transmission angle – Displacement Velocity and Acceleration analysis - Relative motion - Relative velocity - Instant centre -Kennedy's theorem - Relative acceleration - Coriolis acceleration - Graphical and analytical methods – Complex number methods - Computer oriented methods.

Module II (18 hours)
Cams - Classification of Cam and followers - Displacement diagrams, Velocity and Acceleration analysis of SHM, Uniform Velocity, Uniform acceleration, Cycloidal – Graphical Cam profile synthesis –Pressure angle- Analysis of Tangent cam with roller follower and Circular cam with flat follower. Introduction to Polynomial cams.

Module III (18 hours)
Gears – Terminology of Spur gears – Law of Gearing - Involute spur gears - Involutometry - Contact ratio - Interference - Backlash - Gear standardization - Interchangability - Non-standard gears Centre distance modification, Long and Short Addendum system. - Internal gears - Theory and details of bevel, helical and worm gearing - Gear trains - Simple and Compound gear trains - Planetary gear trains – Differential -Solution of planetary gear train problems – Applications

Module IV (18 hours)
Kinematic synthesis (Planar Mechanisms) - Tasks of kinematic synthesis – Type, Number and dimensional synthesis – Precision points - Graphical synthesis for motion - Path and prescribed timing - Function generator – 2 position and 3 position synthesis – Overlay Method - Analytical synthesis techniques Freudenstein's equation – Complex number methods - One case study in synthesis of mechanism.

Text Book
1. S. S. Rattan, *Theory of Machines*, 2nd Edition,, Tata Mc Graw Hill

Reference Books
1. J. E. Shigley, J. J. Uicker, *Theory of Machines and Mechanisms*, McGraw Hill
2. C. E. Wilson, P. Sadler, *Kinematics and Dynamics of Machinery*, 3rd edition, Pearson Education.
3. Ghosh, A. K. Malik, *Theory of Mechanisms and Machines*, Affiliated East West Press
4. G. Erdman, G. N. Sandor, *Mechanism Design: Analysis and synthesis Vol I & II*, Prentice Hall of India
5. D. H. Myskza, *Machines and Mechanisms Applied Kinematic Analysis*, Pearson Education.

Internal Continuous Assessment *(Maximum Marks-30)*

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: Short answer questions (one/two sentences)   5 x 2 marks=10 marks
      All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions   4 x 5 marks=20 marks
      Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: Descriptive/Analytical/Problem solving questions   4 x 10 marks=40 marks
      Two questions from each module with choice to answer one question.
Maximum Total Marks: 70

MT09 506 PLC AND DATA ACQUISITION SYSTEMS

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

Objective
- *To provide the fundamentals of PLC and Data acquisition system*

Module I (13 hours)
COMPUTER CONTROL-INTRODUCTION
Need of computer in a control system-Functional block diagram of a computer control system-Data loggers-Supervisory computer control- Direct digital control-Digital control interfacing-SCADA.(Elementary treatment only).

Module II (13 hours)
DATA CONVERTERS
DACs-Basic DAC Techniques-Weighted Resistor, R-2R Ladder and Inverted R-2R ladder type DACs- ADCs – Parallel ADC, Dual slope ADC, Successive Approximation ADC-Comparison of A/D conversion techniques- DAC/ADC specifications - Typical IC's for DAC, ADC – Isolation amplifiers.

Module III (14 hours)
DATA ACQUISITION SYSTEMS
Sampling theorem – Sampling and digitising – Aliasing – Sample and hold circuit – Practical implementation of sampling and digitising – Definition, design and need for data acquisition systems – Interfacing ADC and DAC with Microprocessor / Multiplexer - Multiplexed channel operation –Microprocessor/PC based acquisition systems.

Module IV (14 hours)
PLC
Evolution of PLC's – Sequential and programmable controllers – Architecture- Programming of PLC – Relay logic – Ladder logic – Gates, Flip flops and Timers.
COMMUNICATION IN PLC's

Requirement of communication networks of PLC – connecting PLC to computer – Interlocks and alarms – Case study of Tank level control system and Sequential switching of motors.

Text Books
1. Curtis D. Johnson *Process Control Instrumentation Tech* 8TH Edition Prentice Hall June 2005.
2. D.Roy Choudhury and Shail B.Jain, *Linear Integrated circuits*, New age International Pvt .Ltd, 2003.

Reference Books
1. Petrezeulla, *Programmable Controllers*, McGraw Hill , 1989.
2. Hughes .T, *Programmable Logic Controllers*, ISA Press, 1989.
3. G.B.Clayton, *Data Converters* The Mac Millian Press Ltd., 1982.

Internal Continuous Assessment *(Maximum Marks-30)*

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: Short answer questions (one/two sentences)   5 x 2 marks=10 marks
        All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions   4 x 5 marks=20 marks
        Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: Descriptive/Analytical/Problem solving questions   4 x 10 marks=40 marks
        Two questions from each module with choice to answer one question.
                                                                Maximum Total Marks: 70

MT09 507(P) MEASUREMENTS AND PLC LABORATORY
Teaching Scheme   **Credits**: 2
3 hours practical and demonstration per week

Objectives
To provide the hands on experience on measuring instruments and PLC.

List of Experiments

1. Strain gage and load cell characteristics
2. LVDT characteristics
3. Characteristics of thermocouples
4. Characteristics of RTD and thermostats
5. LDR and opt coupler characteristics
6. AD590 characteristics

7. Capacitive transducer characteristics
8. Study of PLC
9. Implementation of logic gates using PLC
10. Implementation of timers and flip-flops using PLC
11. Sequential switching of motors using PLC – simulation
12. Tank level control using PLC – simulation

Reference Books
1. Hughes .T, *Programmable Logic Controllers*, ISA Press, 1989.
2. G.B.Clayton, *Data Converters* The Mac Millian Press Ltd., 1982.
3. Curtis D. Johnson *Process Control Instrumentation Tech* 8TH Edition Prentice Hall June 2005.

Internal Continuous Assessment *(Maximum Marks-30)*

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 *(Maximum Marks-100)*

70% -   Procedure, conducting experiment, results, tabulation, and inference (70 marks)
20% -   Viva voce (20 marks)

10% -   Fair Record (10 marks)

MT09 508(P) CAD - CAM LAB

Teaching scheme   **Credits:** 2
3 hours practical per week

Objectives
- *To train the students in solid modelling*
- *To practise static and dynamic analyses using FEM*
- *To practise computer controlled manufacturing methods*

1. Exercises on solid modeling (6hours)
Introduction to computer graphics - viewing transformations, curves and surfaces generation, curve fitting and curve fairing techniques - 2D, wire frame, 3D shading - familiarity with Boolean operations - sweep, revolve, loft, extrude, filleting, chamfer, splines etc. - windowing, view point, clipping, scaling and rotation transformations using commercial solid modeling packages

2. Exercises on finite element analysis (6 hours)
Introduction to FEM - 1D, 2D and 3D elements - shape functions - preprocessing - boundary

conditions, structured and free mesh generation - analysis - linear and non linear analysis – static and dynamic analysis - post processing - display, animation, extraction of nodal data – exercises on heat conduction and elasticity may be given using commercial FEM packages

3. Assembly and mechanism design (6 hours)
Assembling of various parts and tolerance analysis - synthesis and design of mechanisms - animations - exercises on various mechanisms like four bar linkages and its variations - cam and follower - two and four stroke engines

4. Computer aided manufacturing (9 hours)
Part programming fundamentals - manual part programming and computer aided part programming - hands on training in computer controlled turning and milling operations - familiarity with windows based software packages - tool path generation and simulation - exercises on CNC lathe and machining center/milling machines

5. Programming of industrial robots (6 hours)
Introduction to robotics - structure, workspace analysis and various components - actuators - sensors - encoders - end effectors - applications - hands on training on industrial robots – manual and programmed path planning

6. Computer aided inspection and quality control (3 hours)
Introduction to CMM - classification - structure - components - familiarity with measurement software packages and its modules - demonstration of the capability of coordinate measuring machine using a sample component e.g. - engine block - concepts of reverse engineering and rapid prototyping technology

Reference Books
1. D. F. Rogers, J. A. Adams, Mathematical Elements for Computer Graphics, McGraw Hill
2. F. R. David, Procedural Elements for Computer Graphics, McGraw Hill
3. R. D. Cook, D. S. Malkus, M. E. Plesha, R. J. Witt, Concepts & Applications of Finite Element Analysis, John Wiley & Sons
4. K. Yoram, Computer Control of Manufacturing Systems, McGraw Hill
5. K. Rao, Tewari, Numerical Control and Computer Aided Manufacturing, Tata McGraw Hill
6. V. Ramamurthy, Computer Aided Mechanical Design, Tata McGraw Hill
7. K. S. Fu, R. C. Gonzalez, C. S. G. Lee, Robotics: Control, Sensing, Vision and Intelligence, McGraw Hill
8. K. Yoram, Robotics for Engineers, McGraw Hill
9. J. A. Bosch, Coordinate Measuring Machines and Systems, Marcel Decker Inc.

Internal Continuous Assessment *(Maximum Marks-30)*

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 *(Maximum Marks-100)*

70% -   Procedure, conducting experiment, results, tabulation,
             and inference (70 marks)
20%-   Viva voce (20 marks)

10%-   Fair Record (10 marks)

SEMESTER VI

SCHEME OF VI SEMESTER B.Tech COURSE

Code	Subject	Hours/ Week			Marks		Duration of End Semester examination	Credits
		L	T	P/D	Internal	End Semester		
MT09 601	Robotics Engineering	3	1	0	30	70	3	**4**
MT09 602	Microprocessors and Microcontrollers	2	1	0	30	70	3	**3**
MT09 603	Design of Mechatronics Systems	4	1	0	30	70	3	**5**
MT09 604	Embedded Systems	3	1	0	30	70	3	**4**
MT09 605	Intelligent Manufacturing Technology	3	1	0	30	70	3	**4**
MT09 606	Elective I	3	1	0	30	70	3	**4**
MT09 607 (P)	Microprocessors Lab	0	0	3	50	50	3	**2**
MT09 608 (P)	**Mini Project**	0	0	3	50	50	3	**2**
	TOTAL	18	6	6				**28**

ELECTIVE I (VI SEMESTER)

Code	Subject
MT09 606(A)	Computer Aided Inspect ion and Quality Assurance
MT09 606 (B)	Environmental Pollution Control
MT09 606 (C)	Non Conventional Machining Techniques
MT09 606 (D)	Marketing Management
MT09 606 (E)	Composite Materials

MT09 601 ROBOTICS ENGINEERING

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

Objective

- *To provide engineering aspects of robots, robot programming and its applications.*

ModuleI (14 Hours)

Robotics -Robotics in Science Fiction - A Brief History of Robotics – The Robot and Its Peripherals-Robot Activation and Feedback Components - Position Sensors -Velocity Sensors - Actuators - Power Transmissions Systems - Robot Joint Control Design- Introduction to Manipulator Kinematics - Homogeneous Transformations and Robot Kinematics -Manipulator Path Control - Robot Dynamics - Configuration of a Robot Controller .

Module II (13 hours)

ROBOT   DRIVE   SYSTEM   AND   END   EFFECTORS
Pneumatic Drives – Hydraulic Drives – Mechanical Drives – Electrical Drives – D.C. Servo Motors, Stepper Motor, A.C. Servo Motors – Salient Features, Applications and Comparison   of   All   these   Drives
End Effectors – Grippers – Mechanical Grippers, Pneumatic and Hydraulic Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations

Module III (15 hours)

SENSORS   AND   MACHINE   VISION
Requirements of a sensor, Principles and Applications of the following types of sensors – Position of sensors (Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders, Pneumatic Position Sensors), Range Sensors (Triangulation Principle, Structured, Lighting Approach, Time of Flight Range Finders, Laser Range Meters), Proximity Sensors (Inductive, Hall Effect, Capacitive, Ultrasonic and Optical Proximity Sensors), Touch Sensors, (Binary Sensors, Analog Sensors), Wrist Sensors, Compliance Sensors, Slip Sensors Camera, Frame Grabber, Sensing and Digitizing Image Data – Signal Conversion, Image Storage, Lighting Techniques. Image Processing and Analysis – Data Reduction, Edge detection, Segmentation Feature Extraction, Object Recognition, Other Algorithms. Applications – Inspection, Identification, Visual Serving and Navigation.

Module IV (10 hours)
ROBOT PROGRAMMING AND APPLICATIONS
Methods of Robot Programming - on-line/off-line - Show and Teach - Teach Pendant - Lead and Teach. Explicit languages, task languages - Characteristics and task point diagram. Lead Teach method – robot program as a path in space - motion interpolation - WAIT - SIGNAL - DELAY Commands - Branching - capabilities and Limitations. 1st and 2nd generation languages - structure - Constants, Variables data objects - motion commands – end effector and Sensor commands.
Application - Machining – Welding - Assembly - Material Handling - Loading and Unloading in hostile and remote environment.

Text Books
1. John J. Craig, *Introduction to Robotics*, Addison Wesley, ISE 1999.
2. Mikell P. Groover, *Industrial Robotics*, McGraw Hill, 2nd Edition, 1989.
3. Deb. S.R., *Robotics Technology and Flexible Automation*, Tata McGraw - Hill Publishing Company Limited, 1994.

Reference Books
1. Arthor Critchlow, *Introduction to Robotics*, Macmillan, 1985.
2. Mohsen Shahinpoor, *A Robot Engineering Text Book*, Harper and Row, 1987.
3. Francis N. Nagy, *Engineering Foundations of Robotics*, Addison Wesley, 1987.

University Examination Pattern

PART A: Short answer questions (one/two sentences)   *5 x 2 marks=10 marks*
    All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions   *4 x 5 marks=20 marks*
    Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: Descriptive/Analytical/Problem solving questions   4 x 10 marks=40 marks
    Two questions from each module with choice to answer one question.
                                                        Maximum Total Marks: 70

MT09 602 MICROPROCESSORS AND MICROCONTROLLERS

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

Objective
  • *To gain knowledge on microprocessor and microcontrollers based system design.*

Module I (10 hours)
INTRODUCTION TO 8085 MICROPROCESSOR
Evolution of Microprocessors and computers-Intel 8085 architecture-Functions of various blocks and signals- Addressing modes-Instruction set- -Simple program-Basic timing diagrams.
PHERIPHERAL INTERFACING
Data transfer schemes-Interrupts-Software interrupt-Programmable interrupt controller 8259-Programmable peripheral interface 8255-Programmable interval timer 8253-Programmable communication interface 8251 USART-DMA controller 8257.

Module II (8 hours)
INTRODUCTION TO 8086 MICROPROCESSOR
Architecture of 8086-Minmum mode-Maximum mode and Timings-Instruction set-Addressing modes- Assembler directives-Interrupts-Simple programs.

Module III (9 hours)
INTRODUCTION TO 8031/8051 MICROCONTROLLERS
Role of microcontrollers-8 bit microcontrollers-Architecture of 8031/8051-Signal description of 8051-Register set of 8051-Instruction set-Addressing modes-Simple programs.

Module IV (9 hours)
INTERFACING AND APPLICATIONS
Stepper motor control-Keyboard interfacing-Alpha-Numeric display interfacing-Analog to digital converter interfacing-Digital to analog converter interfacing-Interfacing of Electronic weighing bridge.

Text Book
1. Ramesh .S. Gaonkar, *Microprocessor Architecture, Programming and Applications with the 8085* Penram International.
2. A.K. Roy, K.M. Bhurchandi, *Advanced Microprocessors and Peripherals* McGraw-Hill International
3. Muhammed Ali Mazadi and Janice Gilli Mazdi. *The 8051 Microcontroller and embedded systems* Pearson Education.

Reference Books
1. Douglas V Hall, *Microprocessors And Interfacing Programming and Hardware* Tata McGraw-Hill
2. Mohammed Rafiquzzaman, *Microprocessors and Microcontrollers based System Design* Universal Book Stall
3. Kenneth J Ayala, *Intel 8051 Architecture and Programming* PHI

Internal Continuous Assessment *(Maximum Marks-30)*

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: Short answer questions (one/two sentences)   *5 x 2 marks=10 marks*
       All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions   *4 x 5 marks=20 marks*
       Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: Descriptive/Analytical/Problem solving questions   *4 x 10 marks=40 marks*
       Two questions from each module with choice to answer one question.
                                       Maximum Total Marks: 70

MT09 603 DESIGN OF MECHATRONIC SYSTEMS
Teaching scheme   **Credits:** 5
4 hours lecture and 1 hour tutorial per week

Objective

- *To design a system with the aid of mechanical and electronic components.*

Module I (18 hours)
SYSTEMS AND DESIGN
Mechatronic systems – Integrated design issue in mechatronic – mechatronic key element, mechatronics approach – control program control – adaptive control and distributed system – Design process – Type of design – Integrated product design – Mechanism, load condition, design and flexibility – structures – man machine interface, industrial design and ergonomics, information transfer, safety.

Module II (18 hours)
CONTROL AND DRIVES
Control devices – Electro hydraulic control devices, electro pneumatic proportional controls – Rotational drives – Pneumatic motors : continuous and limited rotation – Hydraulic motor : continuous and limited rotation – Motion convertors, fixed ratio, invariant motion profile, variators.
REAL TIME INTERFACING
Real time interface – Introduction, Elements of a data acquisition and Control system, overview of I/O process, installation of I/O card and software – Installation of the application software – over framing.

Module III (18 hours)
CASE STUDIES – I
Case studies on data acquisition – Testing of transportation bridge surface materials – Transducer calibration system for Automotive application – strain gauge weighing system – solenoid force – Displacement calibration system – Rotary optical encoder – controlling temperature of a hot/cold reservoir – sensors for condition monitoring – mechatronic control in automated manufacturing.

Module IV (18 hours)
CASE STUDIES – II
Case studies on data acquisition and Control – thermal cycle fatigue of a ceramic plate – pH control system. Deicing temperature control system – skip control of a CD player – Auto focus Camera.
Case studies on design of mechatronic product – pick and place robot – car park barriers – car engine management – Barcode reader.

Text Books
1. Bolton, *Mechatronics – Electronic Control Systems in Mechanical and Electrical Engineering*, 2nd Edition, Addison Wesly Longman Ltd., 1999.
2. Devdas shetty, Richard A. Kolkm, *Mechatronics System Design*, PWS Publishing company, 1997.
3. Bradley, D. Dawson, N.C. Burd and A.J. Loader, *Mechatronics : Electronics in products and Processes*, Chapman and Hall, London, 1991.

Reference Books
1. Brian Morriss, *Automated Manufacturing Systems – Actuators Controls, Sensors and Robotics*,
2. McGraw Hill International Edition, 1995.
3. Gopel, "*Sensors A comprehensive Survey Vol I & Vol VIII*", BCH Publisher, New York.

Internal Continuous Assessment *(Maximum Marks-30)*

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: Short answer questions (one/two sentences)   *5 x 2 marks=10 marks*
     All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions   *4 x 5 marks=20 marks*
     Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: Descriptive/Analytical/Problem solving questions   *4 x 10 marks=40 marks*
     Two questions from each module with choice to answer one question.
                                  Maximum Total Marks: 70

MT09 604 EMBEDDED SYSTEMS

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

Objective
- *To expose the concepts of embedded system principles, Software development tools and RTOS.*

Module I (14 hours)
INTRODUCTION REVIEW OF EMBEDDED HARDWARE
Embedded system overview – design challenge – processor technology- - IC and design technology trade – offs. **Custom single purpose processors. Hardware** – combinational logic – sequential logic – custom single purpose processor and RT – level custom single purpose processor design – optimizing custom single purpose processor.

Module II (14 hours)
PROCESSORS OVERVIEW
General purpose processor: Software. Standard Single –purpose processor: peripheral Interrupts –
Microprocessor Architecture – Interrupt basics & shared data problem – Interrupt latency – Introduction to memory.
INTERFACING
Communication basics – microprocessor interfacing – arbitration –multilevel bus architecture – advanced
communication principles – protocols – design examples.

Module III (13 hours)
DEVELOPMENT TOOLS AND SOFTWARE ARCHITECTURE

Development tools: Host and Target machines – linker / locators – debugging techniques.
S/W Architectures:
Round robin-round robin with interrupt – function queue scheduling- RTOS.

Module IV (13 hours)
REAL TIME OPERATING SYSTEMS
Tasks and Task states – Tasks and data – semaphores and shared data – message queues, mailboxes and pipes – event – timer functions.

Text Books
1. Frank Vahid and Tony Givargis, *Embedded system design: A unified hardware/ software approach*, Pearson Education Asia 1999.
2. David E.Simon, *an embedded software primer*, Pearson Education Asia 2001.

Reference Book
1. Dainel W. Lewis, *Fundamentals of embedded software where C and assembly meet,* PHI 2002.

Internal Continuous Assessment *(Maximum Marks-30)*

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: Short answer questions (one/two sentences)   5 x 2 marks=10 marks
        All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions   4 x 5 marks=20 marks
        Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: Descriptive/Analytical/Problem solving questions   4 x 10 marks=40 marks
        Two questions from each module with choice to answer one question.
                                                Maximum Total Marks: 70

MT 09 605 INTELLIGENT MANUFACTURING TECHNOLOGY

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

Objective

- *To expose the various types of sensors used in manufacturing and fundamentals of condition monitoring.*

Module I (10 hours)

INTRODUCTION

Introduction – Role of sensors in manufacturing automation-operation principles of different sensors –electrical, optical, acoustic, pneumatic, magnetic, electro-optical, photo – electric, vision, proximity, tactile, range sensors.

Module II (14 hours)
SENSORS IN MANUFACTURING

Sensors in manufacturing – Temperature sensors in process control-Pressure sensors – Fiber optic sensors and their principles and applications – Displacement sensor for robotic application-
Sensors for CNC machine tools – Linear and angular position sensors, velocity sensors.
Sensors in Robotics – encoder, resolver, potentiometers, range, proximity, touch sensors.

Module III (16 hours)
PROCESS MONITORING

Principle, Sensors for Process Monitoring - online and off line quality control, Quality parameter design Direct monitoring of fault based on process signals.
CONDITION MONITORING

Condition monitoring of manufacturing systems-principles –sensors for monitoring force, vibration and noise. Selection of sensors and monitoring techniques. Acoustics emission sensors-principles and applications-online tool wear monitoring.

Module IV (14 hours)
AUTOMATIC IDENTIFICATION TECHNIQUES

MRP-MRPII-Shop floor control –Factory data collection systems – Automatic identification methods – Bar code technology, automated data collection system – Agile manufacturing-flexible manufacturing-Enterprise integration and factory information system.

Text Book
1. Sabrie salomon, *Sensors and Control Systems in Manufacturing*, McGraw Hill int. edition, 1994.
2. Patranabis .D, *Sensors and Transducers, Wheeler publishers*, 1994.
3. S.R.Deb, Robotics technology and flexible automation, Tata McGraw Hill publishing Co. Ltd., 1994.

Reference Books
1. Mikell P. Groover, *Automation Production System and Computer Integrated Manufacturing,* Prentice Hall of India Ltd., 2001.
2. Richard D.Klafter, *Robotic Engineering*, Prentice Hall of India Pvt., Ltd., 2001.
3. Julian W.Gardner, *Micro Sensor MEMS and Smart Devices*, John Wiley & Sons, 2001.
4. Randy Frank, *Understanding Smart Sensors*, Artech house, USA, 1996.

Internal Continuous Assessment *(Maximum Marks-30)*

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

MT09 606 (A) COMPUTER AIDED INSPECTION AND QUALITY ASSURANCE

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

Objective
- *To introduce the role of computers in inspection and quality assurance.*

Module I (16 hours)
INTERNATIONAL STANDARDS OF LENGTH AND LASER METROLOGY
Units of length – legal basis for length measurement – Traceability – Characteristics – LASER light source – LASER interferometer – LASER alignment telescope – LASER micrometer-on-line and in-process measurements of diameter and surface roughness using LASER – Microholes and topography measurements – Straightness and flatness measurement.

Module II (15 hours)
CO-ORDINATE MEASURING MACHINES
Evolution of measurement – co-ordinate measuring machines – Non Cartesian CMMS – Accessory elements – Application software – Performance evaluations – Temperature fundamentals – Environmental control – Accuracy enhancement – Applications – Measurement integration.

OPTO ELECTRONIC MEASURMENTS SYSTEMS AND DEVELOPMENT IN METROLOGY
Opto electronic devices, contact and non contact types, Applications in on-line and in-process monitoring systems – Tool wear measurement – Manufacturing metrology – 3D Surface roughness – Pattern generation studies – Roundness measurement using LASER.

Module III (13 hours)
IMAGE PROCESSING AND ITS APPLICATION IN METROLOGY
Shape identification – Edge detection Techniques – Normalization – Grey scale correlation – Template Techniques – Surface roughness using vision system – Interfacing robot and image processing system –Measurement of length and diameters.

Module IV (10 hours)
COMPUTER INTEGRATED QUALITY ASSURANCE
Total quality control – quality assurance – Zero defects – POKA-YOKE Statistical evaluation of data using computer data integration of CMM and data logging in computers – TQM.

Text Books
1. Thomas G.G –*Engineering metrology*, Butterworth Pub. 1974.
2. Robert .G. Seippel, *Optoelectronics for technology and engineering*, Prentice Hall New Jersey, 1989.
3. Besterfield .H. Dale, Total quality management, Pearson printice Hall, India,2007

Reference Books
1. Watson .J., *Optoelectronics* – Van Nostrand Rein hold (UK) Co Ltd., 1988.
2. Ulrich –Rembold, Armbruster And Ulzmann, "*Interference technology for computer controlled*
3. *manufacturing processes*, Marcel Dekker Pub. New York, 1993.
4. *International Journals on CIRP*.
5. Taguchi .G and Syed . L. et al., *Quality Engineering in production systems*, McGraw Hill, 980.
6. John Bank, *Essence of TQM* Prentice Hall of India Pvt. Ltd., 1990.

Internal Continuous Assessment *(Maximum Marks-30)*

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: Short answer questions (one/two sentences)   *5 x 2 marks=10 marks*
    All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions   *4 x 5 marks=20 marks*
    Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: Descriptive/Analytical/Problem solving questions   *4 x 10 marks=40 marks*
    Two questions from each module with choice to answer one question.
                             Maximum Total Marks: 70

MT09 606 (B) ENVIRONMENTAL POLLUTION CONTROL
Teaching scheme   **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objective
To make aware of the Pollution and the ways to control them.

Module 1 (13hours)
Environmental aspects - Impact of environment - Environmental quality – Role of environmental engineer.

Classification of industrial wastewater - types of pollutants and their effects - monitoring and analysis methods - water pollution laws and standards - industrial wastewater treatment - processes and equipment

Module 2 (14hours)
Definition, characteristics - Types and sources of solid waste - Solid wastemanagement - generation, collection, storage and processing techniques -Solid waste disposal-Water pollution control in industries - pulp and paper, textile processing, food processing wastes, pharmaceutical wastes, chloralkali industries, fertilizer industry, petrochemical industry, rubber processing industry, metal industries, nuclear power plant wastes, thermal power plant wastes.

Module 3 (13hours)
Air pollution control in industries: source and classification of industrial air pollutants – monitoring equipment and method of analysis - damages to health, vegetation and materials - air pollution laws and standards - treatment method in specific industries - thermal power plants - cement - fertilizers - petroleum refineries - iron and steel - chlor-alkali.

Module 4 (14hours)
Industrial odour control - sources and solutions - odour control by adsorption and wet scrubbing - industrial noise control methods - sludge treatment and disposal - industrial hazardous waste management, waste minimization. Environmental Impact Assessment and risk assessment-Environmental Audit and Environmental management system- Concept of common effluent treatment plants.

Text Book
1. Rao C.S., Environmental Pollution Control Engineering, New Age Int. Pub

Reference Books
1. Nelson & Nemerow, Industrial Water pollution-Origin, Characteristics and treatment, Addison, Wesley Publishing Co.
2. Gerard Kiely,Environmental Engineering, McGraw Hill
3. Rao M.N. & Rao H,Air Pollution, Tata McGraw Hill
4. Sincero A.P.& Sincero G.A., Environmental Engineering, A Design Approach, Prentice Hall of India
5. Rao C.S., Environmental Pollution Control Engineering, New Age Int. Pub.
6. Mahajan S.P., Pollution Control in Process Industries, Tata McGraw Hill
7. Babbitt H.E, Sewage & Sewage Treatment, John Wiley
8. Abbasi S.A, & Ramasami E, Biotechnical Methods of Pollution Control, Universities Press(India) Ltd.
9. Metcalf and Eddy Inc, " Waste Water Engineering Treatment and Disposal Second Edition ", (1979), Mc Graw Hill, New York.
10. Tchobanoglous.G, H.Theisan and R.Elaisen, " Solid Water: Engineering Principles and Management Issues ", (1977), Mc Graw Hill, New York.
11. Howard S. Peavy, Donald R.Rowe, and George Tchobanoglous, " Environmental Engineering ", (1985), Mc Graw Hill, New Delhi

---

Internal Continuous Assessment *(Maximum Marks-30)*

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: Short answer questions (one/two sentences)   *5 x 2 marks=10 marks*
        All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions   *4 x 5 marks=20 marks*
        Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: Descriptive/Analytical/Problem solving questions   *4 x 10 marks=40 marks*
        Two questions from each module with choice to answer one question.
                                                        Maximum Total Marks: 70

MT09 606 (C) NON CONVENTIONAL MACHINING TECHNIQUES

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

Objective
To make aware of non-conventional techniques in production.

Module I (14hours)
The need of the process-classification - Energies employed in the processes-EDM, EC, USM, LBM, PAM, AJM, WJM etc. Electrical Discharge Machining Process, operating principles-Breakdown mechanism-Dielectric fluid-Electrode material-Tool wear – Power generator circuits- Process parameters - Metal removal rate - wire out EDM – Recent Developments in EDM. Applications

Module II (14hours)
Electro Chemical Machining Process-principles-Equipment-Analysis of metal removal-tool material-Insulation-Process parameters-ECH,ECG etc. Applications Electron Beam Machining Process, Principle-gun construction - Types of gun - Vacuum and non-vacuum technique Applications

Module III (13hours)
Laser Beam Machining Process, principles, pumping processes, emission types-beam control. Applications Ultrasonic Machining Process-working principles-types of transducersconcentrators- nodal point clamping-feed mechanism-metal removal rate- Process parameters. Applications

Module IV (13hours)
Abrasive Jet Machining Processes-Principle-Equipment-Metal removal rate process parameters. Applications Water Jet Machining Process-Principle-Equipment. Applications

---

Text Book
   1. *A Text Book: of Production Engineering*, P.C.Sharma, 1995
Reference Book
   1. "*Non Conventional Machining* ", P.K.Mishra, The Institution of Engineers (India) Text Books: Series, 1997.

Internal Continuous Assessment *(Maximum Marks-30)*

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: Short answer questions (one/two sentences)   *5 x 2 marks=10 marks*
         All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions   *4 x 5 marks=20 marks*
         Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: Descriptive/Analytical/Problem solving questions   *4 x 10 marks=40 marks*
         Two questions from each module with choice to answer one question.
                                       Maximum Total Marks: 70

MT09 606 (D) MARKETING MANAGEMENT

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

Objective
To familiarize the managing techniques in marketing

Module I (13 hours)
Introduction to marketing : Defining marketing for the twenty first century, marketing – scope, tasks, concept of market and marketing, company orientations towards the market place – production , product,selling, marketing, customer and societal marketing concepts.Marketing environment : Controllable factors, identifying and responding to the major macroenvironment – uncontrollable factors – demographic, economic, natural technological, political- legal andsocial – cultural environment.

Module II (13 hours)
Market Oriented strategic planning – key areas, organizational levels, corporate and division strategic planning – corporate mission, strategic business units, Planning new businesses – Growth – Intensive, integrative, diversification, Marketing mix – variables, marketing-mix strategy. Market-segmentation – levels, patterns, procedure, effectiveness. Market targeting – Evaluation, target market selection.

Module III (13 hours)
Marketing research – Need, scope – Marketing research process. Consumer behaviour – factors influencing buyer behaviour – Cultural, social personal, psychological factors. Defining customer value and satisfaction. Product life cycles – marketing strategies for different stages of product life cycle.

Module IV (15 hours)
Marketing communications – process – developing effective communications – Identification of the target audience, determination of communication objectives, Designing the message, select the communication channels, establishing the total marketing communications budget –

Deciding on the marketing communications mix – promotional tools an over view – advertising, sales promotion, public relations and publicity, sales force and direct marketing-developing and managing an advertising program – setting objectives, deciding budget, choosing message – an overview on measuring effectiveness of a media – sales promotion – purpose, major decisions.

Text Book
1. Saxena, *Marketing Management*, 2nd Edition, Tata Mc Graw Hill (2002).

Reference Books
1. Kotler P., Keller, Koshy, Jha, *Marketing Management, Pearson, 14th edition, New Delhi.(2013)*
2. V. S. Ramaswamy, S. Namkumari, *Marketing Management*, Mc Millan India Ltd, NewDelhi (1997).

Internal Continuous Assessment *(Maximum Marks-30)*

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: Short answer questions (one/two sentences)   *5 x 2 marks=10 marks*
  All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions   *4 x 5 marks=20 marks*
  Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: Descriptive/Analytical/Problem solving questions   *4 x 10 marks=40 marks*
  Two questions from each module with choice to answer one question.
Maximum Total Marks: 70

MT09 606 (E) COMPOSITE MATERIALS

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

Objective
To make acquainted with the Composite Materials, its manufacturing techniques and its applications

Module I (13 hours)
Introduction to composites: Characteristics and classifications of composites – study of fibers, flake and particulate composites.
Manufacturing methods: Production of various fibers – matrix materials and surface

treatments – fabrication of composites – fabrication of thermosetting resin matrix composites – fabrication of thermoplastic resin matrix composites – short fiber composites – fabrication of metal matrix and ceramic matrix composites.

Module II (13 hours)

Testing aspects of composites: Experimental characterisation of composites – uniaxial tension, compression and shear tests – determination of interlaminar fracture toughness – damage identification through non-destructive evaluation techniques – ultrasonic, acoustic emission and radiography.

Module III (14 hours)

Mechanical behaviour of UD composites: Longitudinal strength and stiffness – transverse strength and stiffness – failure modes – analysis of laminated composites – stress-strain variation in a laminate.

Module IV (14 hours)

Special laminates: Symmetric laminates, uni-directional, cross-ply and angle-ply laminates, quasi-isotropic laminates. Recent trends in composite materials – carboncarbon composites, Bucky Papee. Application of composite materials in aerospace, automotive, defence and industry.

Text Book
1. B. D. Agarwal, L. J. Broutman, *Analysis and Performance of Fiber Composites*, John Wiley.

Reference Books
1. R. F. Gibson, *Principle of Composite Material Mechanics*, McGraw Hill
2. M. M. Schwartz, *Composite Materials Handbook*, McGraw Hill. Inc.
3. R. M. Jones, *Mechanics of Composite Materials*, McGraw Hill. Inc
4. S. W. Tsai, *Introduction to Composite Materials*, Technomic Publishing Company.

Internal Continuous Assessment *(Maximum Marks-30)*

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: Short answer questions (one/two sentences)   *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions   *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions*   *4 x 10 marks=40 marks*
Two questions from each module with choice to answer one question.
Maximum Total Marks: 70

MT09 607(P) MICROPROCESSORS AND MICROCONTROLLERS LAB

Teaching scheme   **Credits:** 2
3 hours practical per week

Objectives

- *To enable to do basic programming in the microprocessor and microcontroller.*

List of Experiments

1. 8086 kit familiarization and basic experiments
2. Programming exercise using BCD and Hexadecimal numbers
3. Programming exercise : sorting ,searching and string
4. Interfacing with A/D and D/A converters
5. Interfacing with stepper motors
6. IBM PC programming : Basic programs using DOS and BIOS interrupts
7. Interfacing with PC: Serial communication and Parallel printer interfacing

Interfacing experiments using 8051
1. Parallel interfacing I/O ports(Matrix keyboards)
2. Serial communication with PC
3. Parallel interfacing –LCD
4. Interfacing with serial EEPROM

Note: Minimum of **10** experiments must be conducted

Reference Book
1. Ramesh .S. Gaonkar, *Microprocessor Architecture, Programming and Applications with the 8085* Penram International.

Internal Continuous Assessment *(Maximum Marks-30)*

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 *(Maximum Marks-100)*

70% - Procedure, conducting experiment, results, tabulation,
          and inference (70 marks)
20%-   Viva voce (20 marks)

10%-   Fair Record (10 marks)

MT09 608(P): MINI PROJECT

Teaching scheme   **Credits:** 2
3 hours practical per week

Objectives

- *To estimate the ability of the student in transforming the theoretical knowledge studied so far into a model.*
- *For enabling the students to gain experience in organisation and implementation of a small project and thus acquire the necessary confidence to carry out main project in the final year*

Note: Projects related to Mechatronics is mandatory

In this practical course, each group consisting of three/four members is expected to design and develop a moderately complex system with practical applications; this should be a working model. The basic concepts of product design may be taken into consideration while designing the project.

Internal continuous assessment will be carried out by the Guide. End Semester evaluation of individual student will be carried out by a committee consisting of minimum three faculty members. Students have to submit a report on the mini project and demonstrate the mini project before the evaluation committee.

Internal Continuous Assessment by the Guide *(Maximum marks - 50)*
40% - Design and development
30% - Final result and Demonstration
20% - Report
10% - Regularity in the class

Semester End Examination *(Maximum Marks-50)*

20% - Demonstration of mini project
50% - Practical test connected with Mini Project
20% - Viva voce
10% - Final Report

SEMESTER VII

SCHEME OF VII SEMESTER B.Tech COURSE

Code	Subject	Hours/Week			Marks		Duration of End Semester examination	Credits
		L	T	P/D	Internal	End Semester		
MT09 701	Design of Machine Elements	4	1	0	30	70	3	5
MT09 702	Micro Electro Mechanical Systems	3	1	0	30	70	3	4
MT09 703	Digital Signal Processing	2	1	0	30	70	3	3
MT09 704	Computer Integrated Manufacturing	2	1	0	30	70	3	3
MT09 705	Elective II	3	1	0	30	70	3	4
MT09 706	Elective III	3	1	0	30	70	3	4
MT09 707 (P)	Digital Signal Processing Lab	0	0	3	50	50	3	2
MT09 708 (P)	Mechatronics Lab	0	0	3	50	50	3	2
MT09 709 (P)	Project	0	0	1	**100**	-	-	1
	TOTAL	17	6	7				28

ELECTIVE-II (VII SEMESTER)

Sl No	Code	Subject
1	MT09 705 (A)	Industrial Automation
2	MT09 705 (B)	Artificial Intelligence
3	MT09 705 (C)	Logistics & Supply Chain Management
4	MT09 705 (D) – (Global Elective)	Alternate Energy Sources

ELECTIVE -III (VII SEMESTER)

Sl No	Code	Subject
1	MT09 706 (A)	Nano Technology
2	MT09 706 (B)	Industrial Tribology
3	MT09 706 (C)	Non Destructive Testing
4	MT09 706 (D)	Entrepreneurship development

5	MT09 706 (E)	Computational Fluid Dynamics

MT09 701 DESIGN OF MACHINE ELEMENTS

Teaching scheme   **Credits:** 5
4 hours lecture and 1 hour tutorial per week

Objective

- *To introduce the basic design principles and to apply them to loads.*
- *To design various transmission systems.*

Module I (12 hours)
FUNDAMENTALS OF DESIGN
Phases of design computer aided design –Mechanical properties of materials – Types of loads-stresses –static, varying – Soderberg's and Goodman's equation - Factors of safety – Theories of failure – Stress concentration – Notch sensitivity.

Module II (18 hours)
SHAFT, KEY, COUPLING AND SPRINGS
Shafts-materials for shafts – standard diameter of shafts – Design for strength and rigidity. Keys – Various types of keys – Design of keys. Design of flange coupling, flexible coupling – bush type and disc type. Spring – Types of springs – Uses of springs – Design of helical springs and leaf springs.

Module III (24 hours)
SPUR AND HELICAL GEAR
Introduction to transmission elements – Positive drives and friction drives, Gear drives – Standard modules and various proportions – design of spur and helical gears based on contact stress and beam strength –Based on Lewis and Buckingham equations.
BEVEL GEAR AND WORM GEAR
Bevel gear – Nomenclature – Design based on contact stress and beam strength – Based on Lewis and
Buckingham equations. Worm and Worm wheel – Nomenclature –Design procedure – heat balance.

Module IV (18 hours)
BELT, ROPE AND CHAIN DRIVES
Importance of friction drives – Power and motion transmission over long distance. Belt drives – design of belt drives – calculation of length of belt-number of plies and width of the belt; Vee belts – Cross section – selection procedure of vee belts – pulley details for both flat belts and vee belts. Rope drive – Design and application of rope drive –chain drives – selection of chain and sprockets for various application – selection procedure.

Text Books
1. Joseph Shigley, *Mechanical Engineering Design*, McGraw Hill, 1989.
2. Robert .C.Juvinall, *Fundamentals of Machine Component Design*, John Willey and Sons, 3rd edition, 2002.
3. Spotts.M.F., *Design of Machine Elements*, PHI, 1988.

Reference Books
1. Dobrovolsky, *Machine Elements* MIR Publication, 1983.
2. William Orthwein, *Machine Component Design – Vol – I & II* Jaico Publishing House, Chennai, 1996. Prabhu. T.J., *Design of Transmission systems*, Private Publication, 1999.
3. Prabhu .T.J., *Design of Machine Elements*, Private Publication, 1999.
4. Maitra, *Hand Book of Machine Design*, TMH, 1986.
5. Maitra, *Hand Book of Gear Design*, TMH, 1986.
6. *Design Data* PSG College of Technology, 2000.

Internal Continuous Assessment *(Maximum Marks-30)*

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: Short answer questions (one/two sentences)   *5 x 2 marks=10 marks*
     All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions   *4 x 5 marks=20 marks*
     Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: Descriptive/Analytical/Problem solving questions   *4 x 10 marks=40 marks*
     Two questions from each module with choice to answer one question.
        Maximum Total Marks: 70

MT09 702 MICRO ELECTRO MECHANICAL SYSTEMS
Teaching scheme   **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objective

- *To provide students a background in fabrication, testing and characterization of MEMS.*

Module I (13 hours)
INTRODUCTION
Overview of MEMS, need for microscale and nanoscale systems, important physical and chemical principles relevant to MEMS – Mechanical properties of materials in microscale – Introduction to sensor and actuation technology.

Module (14 hours)
FABRICATION TECHNOLOGY
Lithography technique – shadow masking, grey scale lithography. Etching – wet and dry etching methods, selective etching, directional etching, directional etching Deposition methods – Physical and chemical vapour deposition method, electro plating, electroless – plating and electro deposition thin film deposition. Surface micromachining – bulk micro machining, advanced surface micromachining – LIGA, and DRIE.

Module (13 hours)
MECHANICAL BEHAVIOUR OF MEMS MATERIALS
Mechanics – stress, strain, bending, beam – mass systems, Lumped element modeling of state behaviour of elementary beams, membrane and plates, effect of residual stress and stress gradients, dynamics – normal modes, damping.

Module (14 hours)
TRANSDUCTION PRINCIPLES
Introduction to various transduction principles – Capative, inductive, magnetic, optical, piezo resistive and piezo electric, Thermal methods.
PROCESS INTEGRATION TECHNIQUES
Aligned wafer – level bonding – fusion, anodic and thermal compression, chemical mechanical polishing (CMP).

Text Books
1. Madou M.J., *Fundamentals of micro fabrication*, CRC Press, 1997.
2. N. Maluf, *an Introduction to Microelectro Mechanical Systems Engineering*, Artech House, 2000.
3. Chang Liu, *Foundation of MEMS*, Illinois ECE Series, Pearson Prentice Hall 2006.

Reference Books
1. M. Gad-el-Hak, *The MEMS Hand book*, CRC Press, 2002.
2. Julian W. Gardner, *Microsensors – Principles and Applications*, Wiley, 1994.
3. L. Ristic, *Sensor Technology and Devices*, Artech House, 1994.

Internal Continuous Assessment *(Maximum Marks-30)*

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: Short answer questions (one/two sentences)   *5 x 2 marks=10 marks*
       All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions   *4 x 5 marks=20 marks*
       Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

> *PART C: Descriptive/Analytical/Problem solving questions   4 x 10 marks=40 marks*
> Two questions from each module with choice to answer one question.
> *Maximum Total Marks: 70*

MT09 703 DIGITAL SIGNAL PROCESSING

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

Objective

- *To introduce the basics of Signal and Systems, Digital Signal Processing, and introduction to DSP processor*.

Module I (9 hours)
SIGNALS AND SYSTEMS
Introduction to continuous, Discrete and Digital signals, Classification of continuous and Discrete Time signal – Periodic, Even and Odd, Energy and Power, Deterministic and Random, Complex exponential signlas, Elementary signals – UNIT step, Ramp, Impulse, Classification of systems : Linear, Time invariant, Causal, Stable, Invertible systems, BIBO Stability criterion.

Module II (9 hours)
TRANSFORMATION OF DISCRETE TIME SIGNALS
Spectrum of discrete time signal, Discrete Time Fourier transform and its properties, Discrete Fourier Transform and its properties, Linear and circular convolution, Linear convolution using DFT, Fast Fourier Transform, Ztransform and its properties, Inverse Z-transform using partial fraction and residue methods.

Module III (9 hours)
IIR FILTERS
Design of analog filters using Butterworth and Chebyshev approximation, Frequency transformation, Design of digital IIR filters-Impulse Invariant and Bilinear transformation methods, Structures for IIR digital filters.
FIR FILTERS
Design of digital FIR filters – Fourier series, Frequency sampling and windowing methods, Structure for FIR filters, Comparison of IIR and FIR filters.

Module IV (9 hours)
FINITE WORD LENGTH EFFECTS AND DSP PROCESSOR
Representation of Numbers in Digital System – Fixed and Floating point Numbers, Finite word length effects, Introduction to TMS320C5X Processor architecture, Central processing unit, Memory, Addressing modes, Pipelining.

Text Book
1. Alan V. Oppenheim, Ronald W. Schaffer, *Discrete Time Signal Processing*, PHI, 1999.
2. John G. Proakis and Dimitris C. Manolakis, *Digital Signal Processing Principles, Algorithms and Applications*, Prentice Hall of India, 3rd edition, 1996.

Reference Books
1. Rabiner L. R. and C. B. Gold, *Theory and Applications of Digital Signal Processing*, Prentice Hall India, 1987.
2. Sanjit Mitra, *Digital Signal Processing – A Computer Based Approach*, Tata Mc Graw Hill, 2001.
3. Ashok Ambardar, *Digital Signal processing – A modern Introduction*, Thomson Publishers 2007.

Internal Continuous Assessment *(Maximum Marks-30)*

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: Short answer questions (one/two sentences)   *5 x 2 marks=10 marks*
     All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions   *4 x 5 marks=20 marks*
     Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: Descriptive/Analytical/Problem solving questions   *4 x 10 marks=40 marks*
     Two questions from each module with choice to answer one question.
Maximum Total Marks: 70

MT09 704 COMPUTER INTEGRATED MANUFACTURING

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

Objectives
- *To familiarize the CNC concepts, FMS techniques*

Module I (9 hours)
Introduction- fundamentals of numerical control- advantages of NC system - classification of NC system - NC and CNC - open loop and closed loop systems - features of NC machine tools - fundamentals of machining- design considerations of NC machine tools- methods of improving machine accuracy and productivity- special tool holders.

Module II (10 hours)

NC part programming - manual programming - part programming examples- point to point programming and contour programming- computer aided programming concepts- post processor- program languages- APT- programming - part programming examples.

Module III (8 hours)
Controls in CIM- material handling in CIM- AGV- Vehicle guidance- vehicle management and safety automated storage systems- ASRS components and operations- features of ASRS- automatic data capture- barcode technology- magnetic strips- optical character recognition- group technology- part family- part classification and coding - features OPITZ classification and multi class coding system.

Module IV (9 hours)
Flexible manufacturing system- types of FMS- components of FMS- FMS workstations- material handling and storage systems- FMS layout- configurations- computer control systems in FMS applications and benefits of FMS- industrial robotics- robot anatomy- configurations- joints- drive systems- robot control systems- end effectors- sensors in robots- industrial robot applications- robot programming- on line and off line programming(Quantitative treatment only).

Text Books
1. Yoram Koran, *Computer control of manufacturing systems*, Mc Graw Hill IntI. Book Co., John Wiley & Sons, N. Y., 2002
2. Mickel. P. Grooer, *Automation, Production Systems and Computer Integrated Manufacturing*, Pearson Education

Reference Books
1. H.M.T, *Mechatronics,* Tata Mc Graw Hill
2. Mickel. P. Groover, *Industrial Robotics Technology, Programming and Applications*, Mc
3. Graw Hill.
4. Radhakrishnan P., *Computer Numerical Control Machines*, New Central Book Agency.
5. Radhakrishnan P., Subramanian S., *CAD/CAM and CIM*, Wiley Eastern, 1994.
6. Groover, *Automation, Production Systems and CIM*, Prentice Hall, 1990.
7. Nagpal G.R. , *Machine Tool Engineering*, Khanna Publishers, 2000

Internal Continuous Assessment *(Maximum Marks-30)*

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: Short answer questions (one/two sentences)   5 x 2 marks=10 marks
        All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions   4 x 5 marks=20 marks
        Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: Descriptive/Analytical/Problem solving questions   4 x 10 marks=40 marks
Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

MT09 705 (A) INDUSTRIAL AUTOMATION

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

Objectives
- *To make aware of Automation and its benefits in industries*

Module I (13 Hours)
Introduction to automation: Basic notions and definitions, technical and economic requisites. Automation as a means of control and inspection- Basic control system concepts - control system analysis, systems of automatic control.

Module II (14 Hours)
Sensors**:** Sensory equipment, range sensing - proximity sensing - touch sensing - force and torque sensing - signal conditioning equipment.
Introduction to machine vision, sensing and digitizing - image processing and analysis - applications. Introduction to robots: Definition of robot - basic concepts - robot configurations - types of robot drives - basic robot motions - point to point control - continuous path control.

Module III (14 Hours)
Components and operations: Basic actuation mechanisms - robot actuation and feed back, manipulators –director and inverse kinematics, coordinate transformation - brief robot dynamics. types of robot and effectors - grippers - tools as end effectors – robot end - effort interface. Robot programming: Methods - languages - capabilities and limitation - artificial intelligence – knowledge representation – search techniques - AI and robotics.

Module IV (13 Hours)
Industrial Applications: Application of robots in machining - welding - assembly - material handling - loadingand unloading - CIM - hostile and remote environments. Parts handling automation, products inspection automation, machine tool automation, In-plant transport automation, automatic transfer machines, assembly automation.

Text Book
   1. K. S. Fu., R. C.Gonalez, C. S. G.Lee, Robotics Control Sensing, Vision and Intelligence, McGraw Hill International Edition, 1987.

Reference Books
   1. Mikell P. Groover, mitchell Weiss, *Industrial Robotics, Technology, Programming, and Applications*, McGraw Hill International Editions, 1986.
   2. Richard D. Klafter, Thomas A. Chmielewski, Michael Negin, *Robotic Engineering – An Integrated Approach*, Prentice Hall Inc, Englewoods Cliffs, NJ, USA, 1989.
   3. Yu.Kozyrev, *Industrial Robots*
   4. V. Tergan, I. Andreev, B. Liberman, *Fundamentals of Industrial Automation*

Internal Continuous Assessment *(Maximum Marks-30)*

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: Short answer questions (one/two sentences)   5 x 2 marks=10 marks
      All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions   4 x 5 marks=20 marks
      Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: Descriptive/Analytical/Problem solving questions   4 x 10 marks=40 marks
      Two questions from each module with choice to answer one question.
Maximum Total Marks: 70

MT09 705 (B) ARTIFICIAL INTELLIGENCE

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

Objectives
- *To have the comprehensive knowledge in AI*

Module I (10 hours)
Introduction - definition and basic concepts - aims - approaches - problems in AI - AI applications - perception and action - representing and implementing action functions - production systems - networks - problem solving methods - forward versus backward reasoning - search in state spaces - state space graphs - uninformed search - breadth first search - depth first search - heuristic search - using evaluation functions - general graph-searching algorithm - algorithm A* - admissibility of A* - the consistency condition - iterative deepening A* - algorithm AO* - heuristic functions and search efficiency - alternative search formulations and applications - assignment problems - constraint satisfaction - heuristic repair - two agent games - the mini-max search - alpha beta procedure - games of chance

Module II (10 hours)
Knowledge representation - the propositional calculus - using constraints on feature values – the language - rules of inference - definition of proof - semantics - soundness and completeness – the PSAT problem - meta-theorems - associative and distributive laws - resolution in propositional calculus - soundness of resolution - converting arbitrary wffs to conjunctions of clauses - resolution refutations - horn clauses - the predicate calculus - motivation - the language and its syntax - semantics - quantification - semantics of quantifiers - resolution in predicate calculus - unification - converting arbitrary wffs to clause form - using resolution to prove theorems - answer extraction - knowledge representation by networks - taxonomic knowledge – semantic networks - frames - scripts

Module III (08 hours)
Neural networks - introduction - motivation - notation - the back propagation method -

generalisation and accuracy - reasoning with uncertain information - review of probability theory - probabilistic inference - bayes networks - genetic programming - program representation in GP - the GP process - communication and integration - interacting agents - a modal logic of knowledge - communication among agents - speech acts - understanding language strings – efficient communication - natural language processing - knowledge based systems - reasoning with horn clauses - rule based expert systems

Module IV (08 hours)

Programming in LISP - basic LISP primitives - definitions - Predicates - conditionals - and Binding - recursion and iteration - association lists - properties and data abstraction - lambda expressions - macros - I/O in LISP - examples involving arrays and search

---

Text Books
1. Nilsson N.J.*, Artificial Intelligence - A New Synthesis* , Harcourt Asia Pte. Ltd.
2. Michael Negnevitsky, *Artificial Intelligence - A Guide to Intelligent*, 2/e, Pearson, 2012.
3. George F Luger, *Artificial Intelligence-Structures & strategies for complex problem solving*, 5/e,,Pearson, 2009.
4. Uma Rao, *Artificial Intelligence & Neural Networks*, Pearson, 2011.

Reference Books
1. Luger G.F. & Stubblefield W.A., *Artificial Intelligence* , Addison Wesley
2. Stuert Russel, Peter Norvig, *Artificial Intelligence- A Modern Approach*, 3/e, Pearson, 2012.
3. Elain Rich & Kevin Knight, *Artificial Intelligence* , Tata McGraw Hill
4. Tanimotto S.L., *The Elements of Artificial Intelligence* , Computer Science Press
5. Winston P.H., *LISP*, Addison Wesley

Internal Continuous Assessment *(Maximum Marks-30)*

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: Short answer questions (one/two sentences)   *5 x 2 marks=10 marks*
      All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions   *4 x 5 marks=20 marks*
      Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: Descriptive/Analytical/Problem solving questions   *4 x 10 marks=40 marks*
      Two questions from each module with choice to answer one question.
Maximum Total Marks: 70

MT09 705 (C) LOGISTICS AND SUPPLY CHAIN MANAGEMENT

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

Objectives
- *To familiarize the logistics approach in managing the Supply Chain*

Module I (13 hours)
Concept of Supply Chain – Decision phases in Supply Chain – Process view of Supply Chain – Supply Chain flows - Supply Chain and competitive performance – performance measures of Supply Chain – Strategic fit – Drivers and Obstacles

Module II (14 hours)
Demand forecasting in Supply Chain – Components of forecast and forecasting methods – Managing supply, Managing demand and Managing variability – Inventory Management in Supply Chain – Uncertainties of demand

Module III (13 hours)
Sourcing decisions in Supply Chain – Pricing and revenue management in Supply Chain – Coordination in Supply Chain – IT and Supply Chain

Module IV (14 hours)
Logistics Management – Definition of Logistics and concept of Logistics – Logistic activities – Functions of Logistics system – Transportation in Supply Chain – Design options for a transportation network – Trade offs in transportation design – Designing distribution network

---

Text Books
1. Fawcet,Ellram,Ogden, Supply Chain Management- From vision to implementation, Pearson, 2012.
2. Chopra S. & Meindl P., Supply Chain Management: Strategy, Planning, and Operation, Pearson Education, South Asia, 2005

Reference Books
1. Janat Shah, *Supply Chain Management: Text and Cases,* Pearson Education South Asia, 2009
2. Ronald H Ballou and Samir K Srivastava, *Business Logistics/ Supply Chain Management,,* Pearson Education South Asia, 2007
3. Harald Dyckhoff et al, *Supply Chain Management and Reverse Logistic,* Springer, 2004
4. Christopher M., Logistics and Supply Chain Management , Pitman Publishing Company
5. John Mortimer (Editor), Logistics in Manufacturing: An IFS Executive Briefing , IFS Publications, U.K. & Springer-Verlag
6. Raghuram G. & Rangaraj N., Logistics and Supply Chain Management: Cases and Concepts , Macmillan India Limited

---

Internal Continuous Assessment *(Maximum Marks-30)*

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: Short answer questions (one/two sentences)   *5 x 2 marks=10 marks*
        All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions   *4 x 5 marks=20 marks*
        Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: Descriptive/Analytical/Problem solving questions   *4 x 10 marks=40 marks*
        Two questions from each module with choice to answer one question.
                                                        Maximum Total Marks: 70

MT09 705(D) ALTERNATE ENERGY SOURCES

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

Objectives
- *To familiarize the Energy sources such as, gaseous fuels, solar power and Hybrid vehicles*

MODULE-I (15hours)
Introduction: Need for non-conventional energy sources, energy conservation in transportation sector, alternative energy, alcohol, hydrogen, biomass, and electric energy
Alcohol: Methanol and Ethanol production methods, properties of methanol and ethanol as engine fuels, use of alcohols in Sl engines. performance of methanol and gasoline blends. Combustion characteristics of alcohols in S.I engines, use of alcohols in Cl engines, different methods of use- Alcohol Diesel emulsions, dual fuel systems, Flex fuel Vehicles (FFV)
Hydrogen energy: Properties of hydrogen, sources of hydrogen, production of hydrogen, electrolysis of water, thermal decomposition of water, thermo chemical production and biochemical production, storage and transportation methods, applications to engines, modifications necessary, precautions and safety for use, performance characteristics in engines, use in fuel cells.
MODULE-II (13hours)
Gaseous fuels: Biogas production, description of biogas plant, application of biogas as a single fuel and dual fuel, performance of LPG, property & its use in Sl engines, fuel metering system, natural gas and producer gas - use in S.I. and C.1 engines.
Vegetable oil: Vegetable oil properties, Production of Bio-diesel, esterification of vegetable oil, Soya bean diesel, rapeseed oil, rice bran oil etc., diesel and vegetable oil blends, and engine performance with vegetable oil.
MODULE-III (13hours)
Solar power: Collection and storage of solar energy, collection devices, flat plate collectors, concentrating type collectors, principle and working photovoltaic conversion, application to automobiles
MODULE IV (13hours)

Electric vehicles: Design considerations, limitations, batteries for electric vehicles, types & capacities, driving requirements, applicability of electric cars, comparative use of fuel and energy recharging, Hybrid vehicles - types and layouts.

Text Book
1. James halder man, james Linder, Automotive Fuel and Emissions Control Systems, 3/e Pearson, 2012.

Reference Books
1. T. K. Garrett: Automotive fuels system, SAE INC, Warrendale, 1991
2. David Powell and Richard P. Brennan- The Automobile technology and society Prentice Hall.
3. Keeith Owen & Trevor Colley - Automotive Fuels reference book, SAE
4. Tom Koppel- Powering the future, SAE
5. Richard L. Bechtold- Alternate fuels guide book, SAE
6. Bob Brant.- Build your own Electric Vehicle, SAE
7. SAE papers: 73802, 750121, 750118. 74708
8. Energy research group- Alternate liquid fuels Willey Eastern Ltd,New Delhi, 1990
9. T.N Vezgirigiu- Alternative energy sources
10. Mathur and Sharma- IC. Engines, Dhanpat Rai and Sons.

Internal Continuous Assessment *(Maximum Marks-30)*

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: Short answer questions (one/two sentences)   5 x 2 marks=10 marks
        All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions   4 x 5 marks=20 marks
        Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: Descriptive/Analytical/Problem solving questions   4 x 10 marks=40 marks
        Two questions from each module with choice to answer one question.
                                        Maximum Total Marks: 70

MT09 706 (A) NANOTECHNOLOGY

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

Objectives
- *To provide the knowledge of nano technology and its applications*

Module I (13 hours)
Introduction and scope-Classification of nanostructures: Quantum dots, quantum wires, quantum wells, nanoclusters, nanotubes, super lattices, nanocrystalline materials-Effects of nanometer length scale – Changes to the system total energy, changes to the system structures- Effect of Nanoscale dimensions on various properties – structural, thermal, chemical, mechanical, magnetic, optical and electronic properties.

Module II (13 hours)
Fabrication methods: Top down and bottom up approaches-Top down processes: Milling, Lithographics, machining process, pulsed laser methods- Bottom up processes: Vapour phase deposition methods, PVD, CVD, electrodeposition, plasma assisted deposition process, MBE, chemical methods, colloidal and solgel methods

Module III (13 hours)
Characterisation methods: General classification of characterization methods, Microscopy techniques: Scanning Electron Microscopy, Transmission Electron Microscopy, Scanning Tunneling Microscopy, Atomic Force Microscopy, Diffraction Techniques-Spectroscopy Techniques – Raman Spectroscopy, Surface analysis and depth profiling- Mechanical Properties-Magnetic and Thermal properties.

Module IV (15 hours)
Applications of Nanotechnology (nano materials and devices)-Applications of nanocomposites, nanocrystalline materials, nanolayered structures, nanomagnetic materials-magneto resistance- Carbon nanotubes: SW, MW, nanostructured coatings- nano sensors: order from chaos, characterization, perception, nanosensor based on quantum size effect, Electrochemical sensors, Sensors based on physical properties, Nanobiosensors, smart dustnanomachines: covalent and non covalent approaches, Molecular motors and machines, molecular devices, single molecular devices, practical problems with molecular device-nanofluids: nanoparticles, preparation of nanofluids, thermophysical properties of nanofluids in comparison with base fluidnanoswitches - nano computers- nanofilters

---

Text Book
1. A.K. Bandyopdhyay, *Nanomaterials*,New age international publishers

Reference Books
1. V.S.Muralidharan, A Subramnya, *Nano science and Technology* Ane books Pvt Ltd
2. T Pradeep , *Nano: The essentials* McGraw – Hill education
3. Lynn E. Foster, *Nanotechnology - Science, Innovations & Opportunity*, Pearson, 2012
4. John Mongillo, *Nano Technology* Greenwood Press
5. Jeremy Ramsden, *Nanotechnology*
6. Kelsall Robert. W, Ian Hamley, Mark Geoghegan, , *Nanoscale Science and Technology* Wiley Eastern
7. Gregory Timp, *Nanotechnology*,Springer-Verlag,
8. Charles P Poole, Frank J Owens, *Introduction to Nanotechnology*, John Wiley and Sons.
9. Bharat Bhushan, *Handbook of Nanotechnology*, Springer
10. Mark Ratner, Daniel Ratner, *Nanotechnology- A Gentle Introduction to the Next Big Idea*, Pearson, 2003.

Internal Continuous Assessment *(Maximum Marks-30)*

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: Short answer questions (one/two sentences)   *5 x 2 marks=10 marks*
    All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions   *4 x 5 marks=20 marks*
    Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: Descriptive/Analytical/Problem solving questions   4 x 10 marks=40 marks
    Two questions from each module with choice to answer one question.
    Maximum Total Marks: 70

MT09 706 (B) INDUSTRIAL TRIBOLOGY

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

Objectives
  • *To impart the knowledge of Tribology in industrial sectors*

Module I (13 Hours)
Introduction – viscosity and its temperature dependents – models of visco elastic materials – Navier Stoke's equations – derivation of Reynold's equation from Navier Stoke's equation – one dimensional journal bearing – infinitely long bearing – infinitely short bearing - one dimensional thrust bearing.

Module II (13 Hours)
Finite journal and thrust bearings – journal bearing work – axial and circumferential feeding – journal bearing solutions – centrally loaded partial bearings – axial groove bearings – non circular bearings – finite thrust bearings – step bearings.

Module III (14 Hours)
Hydrodynamic gas bearing – general equations – limiting characteristics – infinitely long slider bearings – parallel, plane, inclined, slider, step slider – finite slider bearings – infinitely long journal bearings – journal bearings with inertia considered – journal bearings with inertia neglected – finite journal bearings – perturbation and numerical solutions.

Module IV (14 Hours)
Friction and wear – mixed friction theory of sliding friction – boundary friction – extreme pressure lubrications – surface layer – extreme pressure additives – thick boundary film thickness – scuffing boundary friction – stick – slip- wear- adhesive wear – mild and sever wear – abrasive wear – fatigue and corrosive wear- delaminations – measurement of friction and wear.

Text Book
1. B. C. Majumdar, *Introductin to Tribology*, A H Wheeler, Bangalore

Reference Books
2. Pinkus and Sternilincht, *Theory of hydrodynamic lubrication*, John Wiley and Son, Newyork
3. D. F. Moore, *Principle and Application of Tribology*, Pergamon Press, Newyork
4. E. Rabinnowizc, *Friction & Wear of Metals*, John Wiley & Sons , Newyork
5. K. L. Johnson, *Contact Mechanics*, Cambridge University Press.
6. T. R. Thomas, *Rough Surfaces*, Longman Inc.

Internal Continuous Assessment *(Maximum Marks-30)*

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: Short answer questions (one/two sentences)   *5 x 2 marks=10 marks*
        All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions   *4 x 5 marks=20 marks*
        Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: Descriptive/Analytical/Problem solving questions   4 x 10 marks=40 marks
        Two questions from each module with choice to answer one question.
                                                    Maximum Total Marks: 70

MT09 706 (C) NON DESTRUCTIVE TESTING

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

Objectives
*   *To instruct the techniques involved in detecting the defects in the materials without destroying them.*

Module I (13hours)
Introduction: Visual methods: Optical aids, In-situ metallography, Optical holographic methods, Dynamic inspection. Penetrant flaw detection: Principles: Process: Penetrant systems: Liquid Penetrant materials: Emulsifiers: cleaners developers: sensitivity: Advantages: Limitations: Applications.

Module II (13hours)
Radiographic methods and Limitations: Principles of radiography: sources of radiation, Ionising radiation - X-rays sources, gama-rays sources Recording of radiation: Radiographic sensitivity: Fluoroscopic methods: special techniques: Radiation safety.

Module III (13hours)
Ultrasonic testing of materials: Advantages, disadvantages, Applications, Generation of Ultrasonic waves, general characteristics of ultrasonic waves: methods and instruments for ultrasonic materials testing: special techniques.

Module IV (15hours)
Magnetic methods: Advantages, Limitations, Methods of generating fields: magnetic particles and suspending liquids Magnetography, field sensitive probes: applications. Measurement of metal properties. Electrical methods: Eddy current methods: potential-drop methods, applications. Electromagnetic testing: Magnetism: Magnetic domains: Magnetization curves: Magnetic Hysteresis: Hysteresis-loop tests: comparator - bridge tests Absolute singlecoil system: applications. Other methods: Acoustic Emission methods, Acoustic methods: Leak detection: Thermal inspection.

Text Book
1. Warren J.Mcgomnagle, *Non-Destructive Testing*, McGrawhill.

Reference Books
1. P. Halmshaw*, Non-Destructive Testing*
2. Metals Handbook Vol.II, *Nondestructive inspection and quality control*
3. Baldev Raj, *Non-Destructive Testing*, Narosa Publishing House.

Internal Continuous Assessment *(Maximum Marks-30)*

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: Short answer questions (one/two sentences)　　　　*5 x 2 marks=10 marks*
　　　　All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions　　　　*4 x 5 marks=20 marks*
　　　　Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: Descriptive/Analytical/Problem solving questions　　*4 x 10 marks=40 marks*
　　　　Two questions from each module with choice to answer one question.
　　　　　　　　　　　　　　　　　　　　　　　　Maximum Total Marks: 70

MT09 706 (D) ENTREPRENEURSHIP DEVELOPMENT

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

Objectives
- *To impart the knowledge of becoming an entrepreneur*

Module I (14 hours)
Entrepreneurial perspectives- understanding of entrepreneurship process- entrepreneurial decision process- entrepreneurship and economic development- characteristics of entrepreneur- entrepreneurial competencies- managerial functions for enterprise.

Module II (14 hours)
Process of business opportunity identification and evaluation- industrial policy- environment-market survey and market assessment- project report preparation-study of feasibility and viability of a project assessment of risk in the industry

Module III (13 hours)
Process and strategies for starting venture- stages of small business growth- entrepreneurship in international environment- entrepreneurship- achievement motivation- time management creativity and innovation structure of the enterprise- planning, implementation and growth

Module IV (13 hours)
Technology acquisition for small units- formalities to be completed for setting up a small scale unitforms of organizations for small scale units-financing of project and working capital-venture capital and other equity assistance available- break even analysis and economic ratios technology transfer and business

---

Text Book
1. Pandey G.W., *A complete Guide to successful Entrepreneurship*, Vikas Publishing

Reference Books
1. Harold Koontz & Heinz Weihrich, *Essentials of Management*, McGraw hill International
2. Hirich R.D. &Peters Irwin M.P., *Entrepreneurship*, McGraw Hill
3. Rao T.V., Deshpande M.V., Prayag Mehta &Manohar S. Nadakarni, *Developing Entrepreneurship a Hand Book*, Learning systems
4. Donald Kurado & Hodgelts R.M., *Entrepreneurship A contemporary Approach*, The Dryden Press
5. Dr. Patel V.G., *Seven Business Crisis*, Tata McGraw hill
6. Timmons J.A., *New venture Creation- Entrepreneurship for 21st century*, McGraw Hill International
7. Patel J.B., Noid S.S., *A manual on Business Oppurnity Identification*, selections, EDII
8. Rao C.R., *Finance for small scale Industries*

Internal Continuous Assessment *(Maximum Marks-30)*

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: Short answer questions (one/two sentences)   *5 x 2 marks=10 marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions   *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: Descriptive/Analytical/Problem solving questions   4 x 10 marks=40 marks
Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

MT09 706 (E) COMPUTATIONAL FLUID DYNAMICS

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

Objective
- *To emerge the knowledge of mechatronics systems in latest technologies*

Module I (13 hours)
Classification of partial differential equations - system of first and second-order partial differential equations - initial and boundary conditions - finite difference formulations - finite difference equations – simple applications in steady state conduction and convection.

Module II (13 hours)
Elliptic partial differential equations – relaxation method. Parabolic partial differential equations - explicit and implicit method – ADE and ADI method. Hyperbolic partial differential equations – method of characteristics - explicit and implicit method. Consistency, errors and stability analysis.

Module III (14 hours)
Fundamentals of fluid flow modelling – upwind scheme – artificial viscosity – hybrid scheme. Solution of viscous incompressible flows by the stream function – vorticity formulation. Solution of Navier- Stokes equations for incompressible flows using MAC and SIMPLE algorithms – stability considerations.

Module IV (14 hours)
Introduction to finite volume method – regular finite volume – approximations in the discretization technique – discretization procedure – semi-explicit method – implementation of boundary conditions (only elementary theory and no direct problems).

Text Book
1. T. Sundararajan, *Computational fluid flow and heat transfer*, Narosa publishing House
Reference Books
1. Hoffmann Klaus, *Computational Fluid Dynamics for Engineers - Volume I*, Engineering
2. Education System, Wichita
3. V. Patankar Suhas, *Numerical Heat Transfer and Fluid Flow*, Taylor & Francis
4. C. A. J. Fletcher, *Computational Techniques for Fluid Dynamics I*, Springer Verlag

Internal Continuous Assessment *(Maximum Marks-30)*

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: Short answer questions (one/two sentences)   *5 x 2 marks=10 marks*
    All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions   *4 x 5 marks=20 marks*
    Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: Descriptive/Analytical/Problem solving questions   4 x 10 marks=40 marks
    Two questions from each module with choice to answer one question.
                                                        Maximum Total Marks: 70

MT 13 707(P) DIGITAL SIGNAL PROCESSING LAB

Teaching scheme   **Credits:** 2
3 hours practical and demonstration per week

Objective
- *To provide the students hands on experience on digital signal processing*

List of Experiments
Experiments using MAT Lab
1. Generation of Time signals – UNIT step, Impulse, Ramp, Exponential
2. Computation of Fast Fourier Transform
3. Linear convolution of two sequences.
4. Design of Butterworth IIR filters – Low pass and high pass filters.
5. Design of FIR Filters using Hanning and Hamming windowing methods

Experiments using TMS320C5X DSP Processor Kit
1. Perform Addition and Subtraction of Two 16 bit numbers
2. Perform Multiplication and Division of Two 16 bit numbers
3. Sum of series 1+2+3+4+ ………………… upto N
4. Perform linear convolution of two given sequences
5. Discrete Fourier Transformation.

Reference Books
1. Rabiner L. R. and C. B. Gold, *Theory and Applications of Digital Signal Processing*, Prentice Hall India, 1987.
2. Sanjit Mitra, *Digital Signal Processing – A Computer Based Approach*, Tata Mc Graw Hill, 2001.
3. Ashok Ambardar, *Digital Signal processing – A modern Introduction*, Thomson Publishers 2007.

Internal Continuous Assessment *(Maximum Marks-30)*

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: Short answer questions (one/two sentences)   *5 x 2 marks=10 marks*
      All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions   *4 x 5 marks=20 marks*
      Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: Descriptive/Analytical/Problem solving questions   *4 x 10 marks=40 marks*
      Two questions from each module with choice to answer one question.
Maximum Total Marks: 70

MT09 708(P) MECHATRONICS LAB

Teaching scheme   **Credits:** 2
3 hours practical per week

Objective
- *To provide hands on experience to apply the knowledge gain and in theory*

List of Experiments
1. Exercise using Electro pneumatic kit
2. Speed control stepper and servo motor using micro processor kit.
3. Programming Robot (Pick and place robot)
4. Sensors for automotives
5. Tool condition monitoring using sensors.
6. PID Controller
7. Automatic door opening and closing
8. Virtual Instrumentation
   a. Data acquisition
   b. Image acquisition
   c. Stepper and servo control device
   d. Signal conditioning of strain gauge. LVDT, Thermocouple, pressure transducer, etc.,
9. A/D and D/A conversion
10. Machine Vision system

Reference Books
1. H.M.T. Ltd, *Mechatronics*, Tata McGraw Hill Publishers, 1998
2. Bolton, W., *Mechatronics*, Pearson Education Asia, 2004.
3. Shetty, D., and Kolk, R.A., *Mechatronics System Design*, Thomson Learning, 2001
4. Necsulescu, D., *Mechatronics*, Parson Education Asia, 2002.

Internal Continuous Assessment *(Maximum Marks-30)*

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 *(Maximum Marks-70)*

70% - Procedure, conducting experiment, results, tabulation, and inference (70 marks)
20%- Viva voce (20 marks)

10%- Fair Record (10 marks)

MT09 709(P) : Project

Teaching scheme   **Credits:** 1
1 hour practical per week

Objectives

- *To judge the capacity of the students in converting the theoretical knowledge into practical systems/investigative analysis.*

Note: Projects related to Mechatronics is mandatory

Project work is for duration of two semesters and is expected to be completed in the eighth semester. Each student group consisting of not more than five members is expected to design and develop a complete system or make an investigative analysis of a technical problem in the relevant area. The project may be implemented using software, hardware, or a combination of both. Project evaluation committee consisting of the guide and three/four faculty members specialised in the above field shall perform the screening and evaluation of the projects.

Each project group should submit project synopsis within three weeks from start of seventh semester. Project evaluation committee shall study the feasibility of each project work before giving consent. Literature survey and 40% of the work has to be completed in the seventh semester.

Students should execute the project work using the facilities of the institute. However, external projects can be taken up in reputed industries, if that work solves a technical problem of the external firm. Prior sanction should be obtained from the head of

department before taking up external project work and there must be an internal guide for such projects.

Each student has to submit an interim report of the project at the end of the 7th semester. Members of the group will present the project details and progress of the project before the committee at the end of the 7th semester.

50% of the mark is to be awarded by the guide and 50% by the evaluation committee.

Internal Continuous Assessment
20% - Technical relevance of the project
40% - Literature survey and data collection
20% - Progress of the project and presentation
10% - Report
10% - Regularity in the class

SEMESTER VIII

SCHEME OF VIII SEMESTER B.Tech COURSE

Code	Subject	Hours/ Week			Marks		Duration of End Semester examination	Credits
		L	T	P/D	Internal	End Semester		
MT09 801	Power Electronics	4	1	0	50	70	3	5
MT09 802	Operations Research	3	1	0	50	70	3	3
MT09 803	Elective IV	3	1	0	50	70	3	4
MT09 804	Elective V	3	1	0	50	70	3	4
MT09 805 (P)	Seminar	0	0	3	**100**	-	-	2
MT09 806 (P)	Project	0	0	11	**100**	-	-	7
MT09 807 (P)	Viva Voce	0	0	0	-	100	-	3
	TOTAL	13	4	14				28

ELECTIVE - IV (VIII SEMESTER)

Sl No	Code	Subject
1	MT09 803 (A)	Quality Engineering & Management
2	MT09 803 (B)	Research Methodology
3	MT09 803 (C)	Micromachining
4	MT09 803 (D)	Industrial Safety and Environment
5	MT09 803 (E)	Image Processing and Machine Vision

ELECTIVE - V (VIII SEMESTER)

Sl No	Code	Subject
1	MT09 804 (A)	Flexible Manufacturing Methods
2	MT09 804 (B)	Management Information System
3	MT09 804 (C)	Computational methods in Engineering
4	MT09 804 (D)	Creativity, Innovation & Product Development
5	MT09 804 (E)	Fluid Power Control

MT09 801 POWER ELECTRONICS

Teaching scheme   **Credits:** 5
4 hours lecture and 1 hour tutorial per week

Objective

- *To enable to gain a fair knowledge on characteristics and applications of power electronic devices*

Module I (18 hours)
SEMICONDUCTOR DEVICES
Basic structure & Switching characteristics of Power diode, Power transistor, SCR, Triac, GTO, MOSFET & IGBT, ratings of SCR, series parallel operation of SCR, di/dt & dv/dt protection Introduction of ICT, SIT, SITH & MCT.

Module II (18 hours)
CONTROLLED RECTIFIERS
Operation of 1-phase half wave rectifiers with R, RL, & RLE load. 1-phase FWR with R, RL & RLE load (Fully controlled & half controlled) operation & analysis of rectifiers using R & RL loads (RMS, average & PF) operation 3-phase HWR & FWR with R & RL loads for continuous. current, Effect of source inductance in 1- phase FWR, 1-phase dual converter operation – simple problems.

Module III (18 hours)
CHOPPERS
Types of forced commutation, classification & operation of choppers (A, B, C, D, E),. Control strategies, operation of voltage, current & load commutated choppers. Multiphase chopper operation – applications of choppers
AC CHOPPER
Types of control (phase & Integrated cycle control) operation 1-phase voltage regulator with R, RL loads. Operation of 3-phase AC voltage controls (with Anti parallel SCR configuration) with R load operation 1-phase step up & step down cyclo converters. 1-phase to 3-phase C.C with R, RL loads.

Module IV (18 hours)
INVERTERS
Types of inverters, operation of 1-phase ,3 phase (120o 180 o) modes ∏ & ⊗ 'R' loads .operation of CSI with ideal switches, 1-phase ASCSI operation basic series inverter, modified series & Improved series inverter – 1- phase parallel inverter operation (with out feed back diodes) 1-phase basic McMurray inverter.

Text Books
1. Bhimbra. Dr.P.S., *Power Electronics* Khanna Publishers, 2001

Reference Books
1. Muhammad H. Rashid, *Power Electronics – Circuits, Devices & Applications*, Prentice Hall of India, New Delhi, 1995.
2. Singh. M.D & Khanchandani. K.B *Power Electronics* Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2000.
3. Dubey, G.K., et.al, *Thyristorised Power Controllers,* New Age International (P) Publishers Ltd., 2002.
4. Vedam Subramaniam, *Power Electronics*, New Age International (P) Publishers Ltd., 2000.

Internal Continuous Assessment *(Maximum Marks-30)*

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: Short answer questions (one/two sentences)   *5 x 2 marks=10 marks*
         All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions   *4 x 5 marks=20 marks*
         Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: Descriptive/Analytical/Problem solving questions   *4 x 10 marks=40 marks*
         Two questions from each module with choice to answer one question.
                                     Maximum Total Marks: 70

MT09 802   OPERATIONS RESEARCH

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

Objective

- *To enlighten the students with the various optimized techniques*

Module I (10 hours)
LINEAR PROGRAMMING
Operations research and decision making, Types of mathematical models and constructing the model, Formulation of linear programming problem, Simplex method (Analytical & Graphical), Two phase and Big M methods.

ASSIGNMENT & TRANSPORTATION MODELS
Assignment models, Transportation problem – North west corner method – Least cost method – Vogel's approximation method – Modi method, Unbalance and degeneracy in transportation model, Replacement model – Replacement of items that deteriorate, gradually, fail suddenly, group replacement policy analysis.

Module II (8 hours)
SCHEDULING AND NETWORK ANALYSIS
Problem of sequencing – Processing 'n' jobs through two machines and three machines, Processing two jobs through 'm' machines. Network analysis – PERT and CPM, Total slack, free slack, Probability of achieving completion date, Cost analysis

Module III (10 hours)
INVENTORY CONTROL AND QUEING THEORY
Variables in an inventory problem, Inventory models with penalty, Storage quantity discount, Safety stock, Inventory models with probability, Demand, Multi item deterministic model.

Queing Theory : Poisson arrivals and exponential service times, Waiting time and idle time cost, Single channel, multi channel problem, Monto Carlo technique applied to Queing problems, Poisson arrivals and Service time.

Module IV (8 hours)
DECISION THEORY AND GAME THEORY
Steps in decision theory approach – Decision making conditions – Decision trees – Decisions under uncertainityconditions. **Game theory:** Optimal solution of two person zero sum games mixed strategies, graphical solution of (2xn) and (mx2) games – solution of (mxn) games by linear programming.

Text Book
1. Handy .A. Taha, *Operations Research, Prentice Hall of India.*, *5th Edition, 1995*
2. Philip and Ravindran, Operational Research, John Wiley, 1992

Reference Books
1. Premkumar, Gupta & Hira, *Operation Research, Schand Company Ltd, 1986*.
2. Fredric S.Hilleer, Gerold J. Lieberman, *Introduction to Operation Research*, CBS 2nd Edition 1974.

Internal Continuous Assessment *(Maximum Marks-30)*

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: Short answer questions (one/two sentences)   *5 x 2 marks=10 marks*
      All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions   *4 x 5 marks=20 marks*
      Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: Descriptive/Analytical/Problem solving questions   *4 x 10 marks=40 marks*
      Two questions from each module with choice to answer one question.
Maximum Total Marks: 70

MT09 803(A) QUALITY ENGINEERING AND MANAGEMENT

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

Objective
- *To impart the importance of Quality and the knowledge of tools in assuring Quality in Engineering*

Module I (14 hours)

Concepts of quality: Quality – Quality control – Quality assurance – Quality management-Quality costs Total Quality Management: Axioms – Management commitment- Deming's approach – Quality council – Customer satisfaction and retention – Employee involvement and empowerment – Suggestion system – Quality circle – Continuous process improvement – Juran's trilogy – PDSA cycle – Kaizen – Six-sigma – Crosby's quality treatment

Module II (13 hours)
Management tools and techniques: Benchmarking – ISO 9000-14000 quality management systems, OHSAS certification– Quality function deployment – Quality by design – Failure mode and effect analysis – Affinity diagram – Block diagram – Pareto chart – Fish bone diagram – Flow chart – Run chart – Scatter diagram – Tree diagram – Matrix diagram

Module III (14 hours)
Statistical tools 1-control charts: Basic concepts - Attributes and variables - Random and assignable causes of variations- Patterns of variation - Measures of central tendency and dispersion – Probability distributions: Binomial, Poisson and Normal
Control charts for variables : $\overline{X}$, R and sigma charts – Details of construction and uses
Control charts for attributes: p, np, c and u charts – Details of construction and uses (Numerical problems included)

Module IV (13 hours)
Statistical tools 2- Acceptance sampling, Reliability and Life testing: Sampling Vs inspection - OC curve - Single and double sampling plans - ATI - AOQL - Life testing - Bathtub curve – MTBF - OC curve for Life testing - System reliability (Numerical problems included)

Text Book
1. Bester Field, Dale H, Carol Boeterfreld – Muchna, Glen H, Boeterfreld Mery Boeterfeld- 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
    1. Gerals M Smith- 2004, *Statistical Process Control and Quality Improvement*- 5th edition

---

Internal Continuous Assessment *(Maximum Marks-30)*

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: Short answer questions (one/two sentences)   *5 x 2 marks=10 marks*
      All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions   *4 x 5 marks=20 marks*
      Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: Descriptive/Analytical/Problem solving questions   4 x 10 marks=40 marks
      Two questions from each module with choice to answer one question.
Maximum Total Marks: 70

MT09 803 (B) RESEARCH METHODOLOGY

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

Objective
- *To enhance the knowledge in methodologies involved in research*

Module 1 (13hours)
Introduction – meaning of research- objectives of research-motivation in research- types of research-research approaches – significance of research- research methods Vs methodology – criteria for good research

Module II (14hours)
Defining research problem- what is a research problem- selecting the problem- necessity of defining the problem- literature review – importance of literature review in defining a problem critical literature review – identifying gap areas from literature review

Module III (14hours)
Research design–meaning of research design-need–features of good design- important concepts relating to research design- different types – developing a research plan
Method of data collection–collection of data- observation method- interview method questionnaire method – processing and analyzing of data- processing options- types of analysis interpretation of results

Module IV (13hours)
Report writing – types of report – research report , research proposal, technical paper-significance different steps in the preparation – lay out, structure and language of typical reports- simple exercises - oral presentation – planning, preparation, practice- making presentation – answering questions-use of visual aids-quality and proper usage-Importance of effective communication with illustrations.

Text Book
1. Krishnaswamy, Sivakumar, Mathirajan, *Management Research Methodology,* Pearson, Newdelhi (2012*)*

Reference Books
1. Coley.S.M and Scheinberg C.A 1990 , *Proposal writing*, Newbury- Sage Publications.
2. Leedy.P.D, *Practical research planning and Design*, 4th edition ,MW Macmillan publishing company.
3. Day Ra,1989 "*How to write and publish a scientific paper*", Cambridge University Press
4. Earl Babbie*,1994, The practice and Social Research,* Wordsworth Publishing Company,
5. J.H. Ansari, Mahavir – *ITPI Reading Material on Planning Techniques.*

Internal Continuous Assessment *(Maximum Marks-30)*

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: Short answer questions (one/two sentences)   5 x 2 marks=10 marks
All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions   4 x 5 marks=20 marks
Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: Descriptive/Analytical/Problem solving questions   4 x 10 marks=40 marks
Two questions from each module with choice to answer one question.
Maximum Total Marks: 70

MT09 803 (C) MICROMACHINING METHODS
Teaching scheme   **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objective
- *To impart the knowledge in micro machining techniques*

Module I (13 hours)
Introduction to Micro System design, Material properties, micro fabrication Technologies. Structural behavior, sensing methods, micro scale transport – feed back systems. Micromechanics: Microstructure of materials, its connection to molecular structure and its consequences on macroscopic properties – Phase transformations in crystalline solids including marten site, ferroelectric, and diffusional phase transformations, twinning and domain patterns, smart materials.

Module II (14 hours)

Micro-fabrication: Bulk processes – surface processes – sacrificial processes and Bonding processes – special machining: Laser beam micro machining- Electrical Discharge Machining – Ultrasonic Machining- Electro chemical Machining. Electron beam machining. Clean room-yield model – Wafer IC manufacturing – PSM – IC industry-New Materials-Bonding and layer transfer devices.

Module III (13 hours)
Mechanical micromachining: Theory of micromachining-Chip formation-size effect in micromachining-microturning, micromilling, microdrilling- Micromachining tool design. Precision Grinding-Partial ductile mode grinding- Ultraprecision grinding- Binderless wheel – Free form optics.

Module IV (14 hours)
Micro electro mechanical system fabrication: Introduction – Advance in Micro electronics – characteristics and Principles of MEMS – Design and application of MEMS: Automobile, defence, healthcare, Aerospace, industrial properties etc., - Materials for MEMS – MEMS fabrication- Bulk Micro Machining-LIGA – Microsystems packaging- Future of MEMS.

Text Book
1. Madore J, "*fundamental of Micro fabrication*", CRC Press, 2002.

Reference Books
1. Sámi Franssila, "*Introduction to Micro Fabrication*", John Wiley and sons Ltd., UK, 2004.
2. Mark J. Jackson, "*Micro fabrication and Nanomanufacturing*", CRC Press, 2006.
3. Peter Van Zant, "*Microchip fabrication*", McGraw Hill, 2004.
4. Mohamed Gad-el-Hak, "*The MEMS Handbook*", CRC Press, 2006.

Internal Continuous Assessment *(Maximum Marks-30)*

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: Short answer questions (one/two sentences)   *5 x 2 marks=10 marks*
    All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions   *4 x 5 marks=20 marks*
    Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: Descriptive/Analytical/Problem solving questions   *4 x 10 marks=40 marks*
    Two questions from each module with choice to answer one question.
Maximum Total Marks: 70

MT09 803 (D) INDUSTRIAL SAFETY AND ENVIRONMENT
Teaching scheme   **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objective
- *To familiarize with the safety issues in design, handling and industrial environment.*

Module I (13 hours)
ACCIDENT PREVENTION
Definitions and theories.- Accident – Injury –unsafe act – unsafe condition – Dangerous occurrence –Theories and principles of accident causation – Cost of accidents – Accident reporting and investigations – Safety committees – need – types – advantages. Safety Education and training- Importance - various training methods – Accident prevention – Motivating factors – Safety suggestion schemes. Safety performance – Definitions connected with measuring safety performance as per Indian and International standards .

Module II (12 hours)
SAFETY IN MATERIAL HANDLING
General safety consideration in material handling - Ropes, Chains, Sling, Hoops, Clamps, Arresting gears – Prime movers.Ergonomic consideration in material handling, design, installation, operation and maintenance of Conveying equipments, hoisting, traveling and slewing mechanisms. Selection, operation and maintenance of Industrial Trucks – Mobile Cranes – Tower crane.

Module III (13 hours)
SAFETY IN CHEMICAL INDUSTRIES
Safety in the design process of chemical plants- Safety in operational and maintenance – Exposure of personnel, Operational activities and hazards – Safety in storage and Handling of chemical and gases – Hazards during transportation – pipeline transport – safety in chemical laboratories. Specific safety consideration for Cement, paper, pharmaceutical, petroleum, petro- chemical, rubber, fertilizer and distilleries.

Module IV (16 hours)
ENVIRONMENTAL IMPACT ASSESSMENT
Evolution of EIA – Concepts – Methodologies – Screening – Scoping — Checklist.Rapid and Comprehensive EIA – Legislative and Environmental Clearance procedure in India – Prediction tools for EIA. Assesment of Impact – Air – Water – Soil – Noise- Biological. Socio cultural environment – Public participation – Resettlement and Rehabilitation. Documentation of EIA .

REGULATIONS FOR HEALTH, SAFETY AND ENVIRONMENT
Factories act and rules; Indian explosive act - Gas cylinder rules. Environmental pollution act - Indian petroleum act and rules. Oil industry safety directorate (OISD) - Indian Electricity act and rules. Mines act and rules - Indian motor vehicles act and rules.

Text Book
1. Handlin, W., *Industrial Hand Book*, McGraw-Hill, 2000.
2. Anton, T. J., *Occupational safety and health management*, (2nd ed.). New York, NY: McGraw Hill, Inc, 1989.

Reference Books
1. Heinrich, H.W., *Industrial Accident Prevention*, McGraw-Hill, 1980
2. Rudenko, N., *Material Handling Equipments*, Mir Publishers, Moscow, 1981.
3. Lees, F.P., *Loss Prevention in Process Industries*, Butterworths, NewDelhi, 1986.
4. Canter, R. L., *Environmental Impact Assessment*, McGraw Hill.

Internal Continuous Assessment *(Maximum Marks-30)*

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: Short answer questions (one/two sentences)   5 x 2 marks=10 marks
     All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions   4 x 5 marks=20 marks
     Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: Descriptive/Analytical/Problem solving questions   4 x 10 marks=40 marks
     Two questions from each module with choice to answer one question.
Maximum Total Marks: 70

MT09 803 (E) IMAGE PROCESSING AND MACHINE VISION
Teaching scheme   **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objective
- *To study the basic concepts of image processing techniques and machine vision techniques.*

Module I (10 hours)
DIGITAL IMAGE FUNDAMENTALS
Elements of digital image processing systems, Elements of visual perception, Image sampling and quantization, Matrix and Singular Value representation of discrete images.

Module II (17 hours)
IMAGE TRANSFORMS
1D DFT,2D DFT, Cosine, Sine, Hadamard, Haar, Slant, KL, SVD transforms and their properties.
IMAGE ENHANCEMENT
Histogram Modification and specification techniques, Image smoothing, Image sharpening, generation of spatial masks from frequency domain specification, Nonlinear filters, Homomorphic filtering, false color, Pseudocolor and color image processing.

Module III (17 hours)
IMAGE RESTORATION AND COMPRESSION
Image degradation models, Unconstrained and constrained restoration, inverse filtering, Least mean square filter, Pattern Classes, optimal statistical classifier. Runlength, Huffman coding, Shift codes, arithmetic coding, bit plane coding, transform coding, JPEG Standard, wavelet transform, predictive techniques, Block truncation coding schemes, Facet modeling.

Module IV (10 hours)
MACHINE VISION

Machine Vision, sensing, low and higher level vision, image acquisition and digitization, cameras, CCD, CID, CPD, etc., illumination and types, image processing and analysis, feature extraction, applications.

Text Book
1. Anil K. Jain, *Fundamentals of Digital Image Processing*, Prentice Hall of India, 1997.
2. Rafel C.Gonzalez and Richard E.Woods. *Digital Image Processing*, Addison Wesley, 1993.
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.

Reference Books
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.
3. Umbaugh, *Computer Vision*

Internal Continuous Assessment *(Maximum Marks-30)*

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: Short answer questions (one/two sentences)   5 x 2 marks=10 marks
 All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions   4 x 5 marks=20 marks
 Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: Descriptive/Analytical/Problem solving questions   4 x 10 marks=40 marks
 Two questions from each module with choice to answer one question.
 Maximum Total Marks: 70

MT09 804 (A) FLEXIBLE MANUFACTURING METHODS

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

Objective
To make proficient in Flexible manufacturing systems

Module I (13 hours)

Introduction Computer technology - hardware - types of memory - input/output devices – software - mini/micro computers and programmable controllers - computer aided design - fundamentals of CAD - the design process - application of computers for design - manufacturing data base.

Module II (13 hours)
Numerical control of machine tools- basic components of NC systems – NC coordinate systems - motion control system - application of numerical control - NC part programming - punched tape - tape coding and format - manual part programming - computer assisted part programming - APT language – NC programming with interactive graphics

Module III (14 hours)
Manufacturing systems - development of manufacturing system – components of FMS - FMS work station - Job coding and classification - group technology - benefits of FMS - tools and tooling - machining centres - head indexers - pallets - fixtures - work handling equipments - system storage – automated guided vehicles - industrial robots - programming of robots - assembly & inspection

Module IV (14 hours)
Flexible manufacturing system management - FMS control software - manning of FMS - tool management - controlling precision - simulation and analysis of FMS - approaches to modelling for FMS - network simulation - simulation procedure - FMS design - economics of FMS - artificial intelligence

---

Text Book
1. Groover M.P. *"Automation, Production Systems and Computer Integrated Manufacturing"*, Prentice Hall of India

Reference Books
1. Groover, Emory & Zimmers, *"CAD/CAM Computer Aided Design and Manufacturing"*, Prentice Hall of India
2. Joseph Talavage & Hannam, "*Flexible Manufacturing Systems in Practice"*, Marcel Dekker Inc.
3. Kant Vajpayee, *"Principles of Computer Integrated Manufacturing"*, Prentice Hall of India.
4. Yoram Koren, *"Computer Control of Manufacturing Systems"*, McGraw, Hill Book Company.

Internal Continuous Assessment *(Maximum Marks-30)*

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: Short answer questions (one/two sentences)   *5 x 2 marks=10 marks*
     All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions   *4 x 5 marks=20 marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: Descriptive/Analytical/Problem solving questions   4 x 10 marks=40 marks
Two questions from each module with choice to answer one question.

Maximum Total Marks: 70

MT09 804 (B) MANAGEMENT INFORMATION SYSTEMS

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

Objective
To make proficient in Management information systems

Module - I: (13 hours)
Information systems - functions of management - levels of management - framework for information systems - systems approach - systems concepts - systems and their environment - effects of system approach in information systems design - using systems approach in problem solving - strategic uses of information technology

Module - II: (11 hours)
An overview of computer hardware and software components - file and database management systems - introduction to network components - topologies and types - remote access - the reasons for managers to implement networks - distributed systems - the internet and office communications

Module - III: (14 hours)
Application of information systems to functional - tactical and strategic areas of management, decision support systems and expert systems

Module - IV: (16 hours)
Information systems planning - critical success factor - business system planning - ends/means analysis - organizing the information systems plan - systems analysis and design - alternative application development approaches - organization of data processing - security and ethical issues of information systems

Text Book
1. James A O'Briean, *Management Information Systems*- Tata Mc Graw Hill
Reference Books
1. C. Laudon and Jane P. Laudon, *Management Information Systems – Managing the digital firm*, Kenneth Pearson education, 2002.
2. Gordon B Davis, *Management Information Systems : Conceptual Foundations, structure and Development,* McGraw Hill
3. Robert .A.S, *Computers and Information Systems* –Prentice-Hall
4. Burch John.G Jr and Others*, Information Systems theory And Practice*, John wiley &Sons
5. Steven Alter, *Information Systems – A Management Perspective* –Addison Wesley, 1999.
6. Murdick and Ross, *Information Systems for Modern management,*

Internal Continuous Assessment *(Maximum Marks-30)*

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: Short answer questions (one/two sentences)   *5 x 2 marks=10 marks*
        All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions   *4 x 5 marks=20 marks*
        Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: Descriptive/Analytical/Problem solving questions   *4 x 10 marks=40 marks*
        Two questions from each module with choice to answer one question.
                                            Maximum Total Marks: 70

MT09 804(C) COMPUTATIONAL METHODS IN ENGINEERING

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

Objective
To emphasis the various computational techniques in engineering

Module I (13 hours)
Errors in numerical calculations: Sources of errors, significant digits and numerical instability – numerical solution of polynomial and transcendental equations – bisection method – method of false position – Newton-Raphson method – fixed-point iteration – rate of convergence of these methods – iteration based on second degree equation – the Muller's method – Chebyshev method – Graeffe's root squaring method for polynomial equations – Bairstow method for quadratic factors in the case of polynomial equations.

Module II (13 hours)
Solutions of system of linear algebraic equations: Direct methods – Gauss elimination and Gauss-Jordan methods – Crout's reduction method – error analysis – iterative methods – Jacobi's iteration – Gauss- Seidal iteration – relaxation method – convergence analysis – solution of system of nonlinear equations by Newton-Raphson method – power method for the determination of Eigen values – convergence of power method. Solution of tri-diagonal system – Thomas algorithm.

Module III (14 hours)
Polynomial interpolation: Lagrange's interpolation polynomial – divided differences – Newton's divided difference interpolation polynomial – error of interpolation – finite difference operators – Gregory- Newton forward and backward interpolations – Stirling's interpolation formula – interpolation with a cubic spline – numerical differentiation –

differential formula in the case of equally spaced points – numerical integration – trapezoidal and Simpson's rules – Gaussian integration – errors of integration formulae.

Module IV (14 hours)

Numerical solution of ordinary differential equations: Taylor series method – Euler and modified Euler methods – Runge-Kutta methods (2nd order and 4th order only) – multistep methods – Milne's predictorcorrector formulae – Adam-Bashforth and Adam-Moulton formula – solution of boundary value problems in ordinary differential equations – shooting method – finite difference methods for solving two dimensional Laplace's equation for a rectangular region – finite difference method of solving heat equation and wave equation with given initial and boundary conditions.

Text Book
1. Chapra and Canale, *Numerical methods for scientist and engineers,* McGraw Hill.

Reference Books
1. Froberg, *Introduction to numerical analysis*, Addison Wesley.
2. Kandaswamy, *Numerical Analysis*, S Chand
3. Hildebrand, *Introduction to Numerical Analysis,* Tata McGraw Hill.

Internal Continuous Assessment *(Maximum Marks-30)*

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: Short answer questions (one/two sentences)   5 x 2 marks=10 marks
All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions   4 x 5 marks=20 marks
Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: Descriptive/Analytical/Problem solving questions   4 x 10 marks=40 marks
Two questions from each module with choice to answer one question.
Maximum Total Marks: 70

MT09 804 (D) CREATIVITY, INNOVATION AND NEW PRODUCT DEVELOPMENT

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

Objective
To enrich the knowledge in creativity, innovation and new product development

Module-I (13 hours)

The process of technological innovation - factors contributing to successful technological innovation - the need for creativity and innovation – creativity and problem solving - brain storming - different techniques.

Invention and Creativity - Intellectual Property (IP) - Importance - Protection of IPR - Basic types of property (i. Movable Property ii. Immovable Property and iii. Intellectual Property).

Module-II (14 hours)

Collection of ideas and purpose of project - Selection criteria - screening ideas for new products (evaluation techniques). Research and new product development - Patents - Patent search - Patent laws - International code for patents - Intellectual property rights (IPR). IP - Patents - Copyrights and related rights - Trade Marks and rights arising from Trademark registration Definitions - Industrial Designs and Integrated circuits - Protection of Geographical Indications at national and International levels – Application Procedures

Module-III (13 hours)

Indian Position Vs WTO and Strategies - Indian IPR legislations - commitments to WTO- Patent Ordinance and the Bill - Draft of a national Intellectual Property Policy - Present against unfair competition.

Module IV (14 hours)

Design of proto type - testing - quality standards - marketing research - introducing new products. Creative design - Model Preparation - Testing - cost evaluation – Patent application

---

Text Book
1. P.N.Khandwalla - " *Fourth Eye (Excellence through Creativity)"* – Wheeler Publishing , Allahabad, 1992.

Reference Books
1. Harry Nystrom, " *Creativity and innovation*", John Wiley & Sons, 1979.
2. Kevin Otto, Kristin Wood, *Product Design-Techniques in Reverse Engg. & New Product Development*, Pearson, 2012.
3. Brain Twiss, " *Managing technological innovation*", Pitman Publishing Ltd., 1992.
4. Harry B.Watton, " *New Product Planning* ", Prentice Hall Inc., 1992.
5. I.P.R. Bulletins, TIFAC, New Delhi, 2005.

Internal Continuous Assessment *(Maximum Marks-30)*

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: Short answer questions (one/two sentences)   *5 x 2 marks=10 marks*
     All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions   *4 x 5 marks=20 marks*
     Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Descriptive/Analytical/Problem solving questions*   *4 x 10 marks=40 marks*
Two questions from each module with choice to answer one question.
Maximum Total Marks: 70

MT 13 804(E) FLUID POWER CONTROL

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

Objective
To expose the learner to the fundamentals of hydraulic and pneumatic power control and their circuits with industrial applications

Module I (15 hours)
HYDRAULIC SYSTEMS
Introduction to fluid power system, Hydraulic fluids- functions, types, properties, selection and application. Construction, operation, characteristics and graphical symbols of hydraulic components – pumps, actuators/motors, valves, switches, filters, seals, fiitings and other accessories.
PNEUMATIC SYSTEMS
Introduction, comparison with hydraulic systems and electrical systems. Construction, operation, characteristics & symbols of pneumatic components. Air treatment – principles and components. Sensors – types, characteristics and applications. Introduction to fluidics and MPL.

Module II (13 hours)
HYDRAULIC / PNEUMATIC CIRCUITS
Reciprocating circuits, pressure dependant circuits, speed control circuits, pilot operated circuits, simple
sequencing circuits, synchronizing circuits, circuits using accumulator, time delay circuits, logic circuits,
cascading circuits, feedback control circuits.

Module III (13 hours)
DESIGN OF FLUID POWER SYSTEMS
Speed, force and time calculations, Calculation of pressure and pressure drop across components, size of
actuators, pumps, reservoirs and accumulators. Calculations on Heat generation in fluid.

Module IV (13 hours)
APPLICATION, MAINTENANCE AND TROUBLE SHOOTING
Development of hydraulic / pneumatic circuits applied to machine tools, presses, material handling systems, automotive systems, packaging industries, manufacturing automation. Maintenance of fluid power systems – preventive and breakdown. Maintenance procedures. Trouble shooting of fluid power systems – fault finding process, equipments/tools used, causes and remedies. Safety aspects involved.

Text Books
1. Anthony Esposito, *Fluid Power with applications*, Prentice Hall international – 1997
2. Majumdar S.R., *Oil Hydraulics*, Tata McGraw Hill, 2002
3. Majumdar S.R., *Pneumatic systems – principles and maintenance*, Tata McGraw Hill 1995.

Reference Books
1. Werner Deppert / Kurt Stoll, *Pneumatic Application*, Vogel verlag – 1986
2. John Pippenger, Tyler Hicks, *Industrial Hydraulics*, McGraw Hill International Edition, 1980.
3. Andrew Parr, *Hydraulics and pneumatics*, Jaico Publishing House, 2003
4. FESTO, *Fundamentals of Pneumatics*, Vol I, II, III
5. Hehn Anton, H., *Fluid Power Trouble Shooting*, Marcel Dekker Inc., NewYork, 1984
6. Thomson, *Introduction to Fluid power*, Prentcie Hall, 2004

Internal Continuous Assessment *(Maximum Marks-30)*

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: Short answer questions (one/two sentences)   5 x 2 marks=10 marks
    All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: Analytical/Problem solving questions   4 x 5 marks=20 marks
    Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: Descriptive/Analytical/Problem solving questions   4 x 10 marks=40 marks
    Two questions from each module with choice to answer one question.
Maximum Total Marks: 70

MT09 805 (P) : SEMINAR

Teaching scheme   **Credits:** 2
3 hours practical per week

Objectives

- *To assess the ability of the student to study and present a seminar on a topic of current relevance in the relevant field of engineering or allied areas*

It enables the students to gain knowledge in any of the technically relevant current topics and acquire the confidence in presenting the topic. The student will undertake a detailed study on the chosen topic under the supervision of a faculty member, by referring papers published in reputed journals and conferences. Each student has to submit a seminar report, based on these papers; the report must not be reproduction of any original paper. A committee consisting of three/four faculty members will evaluate the seminar.

Internal Continuous Assessment (Max. Marks : 100)

20% - Relevance of the topic and literature survey
50% - Presentation and discussion
20% - Report
10% - Regularity in the class and Participation in the seminar

---

MT09 806 (P) : PROJECT

Teaching scheme   **Credits:** 7
11 hours practical per week

Objectives

- *To estimate the ability of the student in transforming the theoretical knowledge studied so far into a working model or a system.*

Note: Projects related to Mechatronics is mandatory

This project work is the continuation of the project initiated in seventh semester. The performance of the students in the project work shall be assessed on a continuous basis by the project evaluation committee through progress seminars and demonstrations conducted during the semester. Each project group should maintain a log book of activities of the project. It should have entries related to the work done, problems faced, solution evolved etc.

There shall be at least an Interim Evaluation and a final evaluation of the project in the 8th semester. Each project group has to submit an interim report in the prescribed format for the interim evaluation.

Each project group should complete the project work in the 8th semester. Each student is expected to prepare a report in the prescribed format, based on the project work. Members of the group will present the relevance, design, implementation, and results of the project before the project evaluation committee comprising of the guide, and three/four faculty members specialised in electrical power system / machines/ electronics/ computer/ instrumentation/ biomedical Engg. etc.

50% of the mark is to be awarded by the guide and 50% by the evaluation committee.

Internal Continuous Assessment *(Maximum Marks - 100)*

40% - Design and development/Simulation and analysis
30% - Presentation & demonstration of results
20% - Report
10% - Regularity in the class

MT13 807 (P) : VIVA VOCE

Credits: 3

Objective

- *To examine the knowledge acquired by the student during the B.Tech. course, through an oral examination*

The students shall prepare for the oral examination based on the theory and laboratory subjects studied in the B.Tech. Course, mini project (if there is), seminar, and project. There is only university examination for viva-voce. University will appoint two external examiners and an internal examiner for viva-voce. These examiners shall be senior faculty members having minimum five years teaching experience at engineering degree level.

For final viva-voce, candidates should produce certified reports of mini project, seminar, and project. If he/she has undergone industrial training/industrial visit/educational tour or presented a paper in any conference, the certified report/technical paper shall also be brought for the viva-voce.

Allotment of marks for viva-voce shall be as given below.

Assessment in Viva-voce *(Maximum marks – 100)*

40% - Subjects
30% - Project and Mini Project
20% - Seminar
10% - Industrial training/industrial visit/educational tour or Paper presented at National-level

---