# 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 2014 SCHEME

## VISION OF THE INSTITUTION

To mould true citizens who are millennium leaders and catalysts of change through excellence in education.

## MISSION OF THE INSTITUTION

NCERC is committed to transform itself into a center of excellence in Learning and Research in Engineering and Frontier Technology and to impart quality education to mould technically competent citizens with moral integrity, social commitment and ethical values.

We intend to facilitate our students to assimilate the latest technological know-how and to imbibe discipline, culture and spiritually, and to mould them in to technological giants, dedicated research scientists and intellectual leaders of the country who can spread the beams of light and happiness among the poor and the underprivileged.

## 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 with entrepreneur skills, 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 EIGHTH SEMESTERS

# OF

# BACHELOR OF TECHNOLOGY

# IN

# MECHATRONICS ENGINEERING

## FROM 2014 ADMISSION ONWARDS

## CALICUT UNIVERSITY (P.O), THENHIPALAM

## 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 | | |
| EN14 301 | Engineering Mathematics III | 3 | 1 | 0 | 50 | 100 | 3 | **4** |
| EN14 302 | Computer Programming in C | 3 | 1 | 0 | 50 | 100 | 3 | **4** |
| MT14 303 | Metrology & Instrumentation | 3 | 1 | 0 | 50 | 100 | 3 | **4** |
| MT14 304 | Electronic Devices and Circuits | 3 | 1 | 0 | 50 | 100 | 3 | **4** |
| MT14 305 | Electrical Technology | 3 | 1 | 0 | 50 | 100 | 3 | **4** |
| MT14 306 | Control Systems | 3 | 1 | 0 | 50 | 100 | 3 | **4** |
| MT14 307 (P) | Electrical Technology Lab | 0 | 0 | 3 | 50 | 100 | 3 | **2** |
| MT14 308 (P) | Electronics Devices and Circuits Lab | 0 | 0 | 3 | 50 | 100 | 3 | **2** |
| | TOTAL | 18 | 6 | 6 | | | | **28** |

Note:
For EN 14 302 Computer Programming in C, the end semester examination will be held by the University as a theory paper.

## 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 | | |
| EN14 401 | Engineering Mathematics IV | 3 | 1 | 0 | 50 | 100 | 3 | **4** |
| EN14 402 | Environmental Science | 3 | 1 | 0 | 50 | 100 | 3 | **4** |
| MT14 403 | Metallurgy & Material Science | 3 | 1 | 0 | 50 | 100 | 3 | **4** |
| MT14 404 | Mechanics of Solids and Fluids | 3 | 1 | 0 | 50 | 100 | 3 | **4** |
| MT14 405 | Linear Integrated Circuits and Digital Systems | 3 | 1 | 0 | 50 | 100 | 3 | **4** |
| MT14 406 | Computer Assisted Machine Drawing | 3 | 1 | 0 | 50 | 100 | 3 | **4** |
| MT14 407 (P) | Materials Testing Lab | 0 | 0 | 3 | 50 | 100 | 3 | **2** |
| MT14 408 (P) | Linear Integrated Circuits and Digital Systems Lab | 0 | 0 | 3 | 50 | 100 | 3 | **2** |
| | TOTAL | 18 | 6 | 6 | | | | **28** |

## 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 | | |
| MT14 501 | Engineering Economics & Principles of Management | 3 | 1 | 0 | 50 | 100 | 3 | **4** |
| MT14 502 | Manufacturing Technology | 3 | 1 | 0 | 50 | 100 | 3 | **4** |
| MT14 503 | Thermal Engineering | 3 | 1 | 0 | 50 | 100 | 3 | **4** |
| MT14 504 | Sensors and Actuators | 3 | 1 | 0 | 50 | 100 | 3 | **4** |
| MT14 505 | Embedded Systems | 3 | 1 | 0 | 50 | 100 | 3 | **4** |
| MT14 506 | PLC and Data Acquisition Systems | 3 | 1 | 0 | 50 | 100 | 3 | **4** |
| MT14 507 (P) | Measurements and PLC Lab | 0 | 0 | 3 | 50 | 100 | 3 | **2** |
| MT14 508 (P) | CAD / CAM Lab | 0 | 0 | 3 | 50 | 100 | 3 | **2** |
| | TOTAL | 18 | 6 | 6 | | | | **28** |

## 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 | | |
| MT14 601 | Robotics Engineering | 3 | 1 | 0 | 50 | 100 | 3 | **4** |
| MT14 602 | Microprocessors and Microcontrollers | 3 | 1 | 0 | 50 | 100 | 3 | **4** |
| MT14 603 | Design of Mechatronics Systems | 3 | 1 | 0 | 50 | 100 | 3 | **4** |
| MT14 604 | Mechanics of Machinery | 3 | 1 | 0 | 50 | 100 | 3 | **4** |
| MT14 605 | Intelligent Manufacturing Technology | 3 | 1 | 0 | 50 | 100 | 3 | **4** |
| MT14 606 | Composite Materials | 3 | 1 | 0 | 50 | 100 | 3 | **4** |
| MT14 607 (P) | Microprocessors Lab | 0 | 0 | 3 | 50 | 100 | 3 | **2** |
| MT14 608 (P) | **Mini Project** | 0 | 0 | 3 | 50 | 100 | 3 | **2** |
| | TOTAL | 18 | 6 | 6 | | | | **28** |

# 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 | | |
| MT14 701 | Design of Machine Elements | 3 | 1 | 0 | 50 | 100 | 3 | **4** |
| MT14 702 | Micro Electro Mechanical Systems | 3 | 1 | 0 | 50 | 100 | 3 | **4** |
| MT14 703 | Digital Signal Processing | 3 | 1 | 0 | 50 | 100 | 3 | **4** |
| MT14 704 | Elective I | 3 | 1 | 0 | 50 | 100 | 3 | **4** |
| MT14 705 | Elective II | 3 | 1 | 0 | 50 | 100 | 3 | **4** |
| MT14 706 (P) | Digital Signal Processing Lab | 0 | 0 | 3 | 50 | 100 | 3 | **2** |
| MT14 707 (P) | Mechatronics Lab | 0 | 0 | 3 | 50 | 100 | 3 | **2** |
| MT14 708 (P) | Project | 0 | 0 | 4 | **100** | - | - | **4** |
| | TOTAL | 15 | 5 | 10 | | | | **28** |

## ELECTIVE-I (VII SEMESTER)

| Sl No | Code | Subject |
|---|---|---|
| 1 | MT14 704 (A) | Artificial Intelligence |
| 2 | MT14 704 (B) | Industrial Automation |
| 3 | MT14 704 (C) | Computer Integrated Manufacturing |
| 4 | MT14 704 (D) – (Global Elective) | Logistics & Supply Chain Management |
| 5 | MT14 704 (E) | Alternate Energy Sources |

## ELECTIVE-II (VII SEMESTER)

| Sl No | Code | Subject |
|---|---|---|
| 1 | MT14 705 (A) | Nano Technology |
| 2 | MT14 705 (B) | Industrial Tribology |
| 3 | MT14 705 (C) | Non Destructive Testing |
| 4 | MT14 705 (D) | Entrepreneurship development |
| 5 | MT14 705 (E) | Special Electrical Machines |

# 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 | | |
| MT14 801 | Automobile Electronics | 3 | 1 | 0 | 50 | 100 | 3 | 4 |
| MT14 802 | Operations Research | 3 | 1 | 0 | 50 | 100 | 3 | 4 |
| MT14 803 | Modelling and Simulation | 3 | 1 | 0 | 50 | 100 | 3 | 4 |
| MT14 804 | Elective III | 3 | 1 | 0 | 50 | 100 | 3 | 4 |
| MT14 805 | Elective IV | 3 | 1 | 0 | 50 | 100 | 3 | 4 |
| MT14 806 (P) | Seminar | 0 | 0 | 3 | **100** | - | - | 2 |
| MT14 807 (P) | Project | 0 | 0 | 7 | **100** | - | - | 5 |
| MT14 808 (P) | Viva Voce | 0 | 0 | 0 | - | 100 | - | 3 |
| | TOTAL | 15 | 5 | 10 | | | | 30 |

## ELECTIVE - III (VIII SEMESTER)

| Sl No | Code | Subject |
|---|---|---|
| 1 | MT14 804 (A) | Quality Engineering & Management |
| 2 | MT14 804 (B) | Research Methodology |
| 3 | MT14 804 (C) | Micromachining |
| 4 | MT14 804 (D) | Industrial Safety and Environment |
| 5 | MT14 804 (E) | Image Processing and Machine Vision |

## ELECTIVE - IV (VIII SEMESTER)

| Sl No | Code | Subject |
|---|---|---|
| 1 | MT14 805 (A) | Flexible Manufacturing Methods |
| 2 | MT14 805 (B) | Management Information System |
| 3 | MT14 805 (C) | Computational methods in Engineering |
| 4 | MT14 805 (D) | Creativity, Innovation & Product Development |
| 5 | MT14 805 (E) | Fluid Power Control |

# 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 | | |
| EN14 301 | Engineering Mathematics III | 3 | 1 | 0 | 50 | 100 | 3 | **4** |
| EN14 302 | Computer Programming in C | 3 | 1 | 0 | 50 | 100 | 3 | **4** |
| MT14 303 | Metrology & Instrumentation | 3 | 1 | 0 | 50 | 100 | 3 | **4** |
| MT14 304 | Electronic Devices and Circuits | 3 | 1 | 0 | 50 | 100 | 3 | **4** |
| MT14 305 | Electrical Technology | 3 | 1 | 0 | 50 | 100 | 3 | **4** |
| MT14 306 | Control Systems | 3 | 1 | 0 | 50 | 100 | 3 | **4** |
| MT14 307 (P) | Electrical Technology Lab | 0 | 0 | 3 | 50 | 100 | 3 | **2** |
| MT14 308 (P) | Electronics Devices and Circuits Lab | 0 | 0 | 3 | 50 | 100 | 3 | **2** |
| | TOTAL | 18 | 6 | 6 | | | | **28** |

# EN14 301: ENGINEERING MATHEMATICS III

(Common for all branches)

**Teaching scheme** **Credits:** 4

3 hours lecture and 1 hour tutorial per week

**Objective**

- *To provide a quick overview of the concepts and results in complex analysis that may be useful in engineering.*
- *To introduce the concepts of linear algebra and Fourier transform which are wealths 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: $e^Z$, sinz, 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 (No proof) – Laurent series (No proof) – Singularities - Zeros – Poles - Residues – Evaluation of residues – Cauchy's residue theorem – Evaluation of real definite integrals.

**Module III: Linear Algebra (13 hours) – (**Proofs not required**)**

Vector spaces – Definition, Examples – Subspaces – Linear Span – Linear Independence – Linear Dependence – Basis – Dimension– Orthogonal and Orthonormal Sets – Orthogonal Basis – Orthonormal Basis – Gram-Schmidt orthogonalisation process – Inner product spaces – Definition – Examples – Inequalities ; Schwartz, Triangle (No proof).

**Module IV: Fourier Transforms (14 hours)**

Fourier Integral theorem (Proof not required) – Fourier Sine and Cosine integral representations – Fourier transforms – transforms of some elementary functions – Elementary properties of Fourier transforms – Convolution theorem (No proof) – Fourier Sine and Cosine transforms – transforms of some elementary functions –Properties of Fourier Sine and Cosine 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, 6.8, 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. Anuradha Gupta, *Complex Analysis*, Ane Books India.
4. Shahnaz bathul, *Text book of Engineering Mathematics, Special functions and Complex Variables,* Prentice Hall of India.
5. Gerald Dennis Mahan, *Applied mathematics*, Springer International Edition.
6. David Towers, *Guide to Linear Algebra*, MacMillan Mathematical Guides.
7. Inder K Rana, *An Introduction to Linear Algebra*, Ane Books India.
8. Surjeet Singh, *Linear Algebra,* Vikas Publishing House.
9. Howard Anton, Chris Rorres, *Elementary Linear Algebra, Applications Version*, John Wiley and Sons.
10. Anthony Croft, Robert Davison, Martin Hargreaves, *Engineering Mathematics*, Pearson Education


**Internal Continuous Assessment** *(Maximum Marks-50)*

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

**University Examination Pattern**

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

*Maximum Total Marks: 100*

## EN14 302 COMPUTER PROGRAMMING IN C

*(Common for all branches)*

**Teaching scheme** Credits: 4

3 hours lectures and 1hour lab per week

**Objectives**

- *To impart the basic concepts of computer and information technology*
- *To develop skill in problem solving concepts through learning C programming in practical approach.*

**Module I (8 hours)**

**Introduction to Computers**: CPU, Memory, input-output devices, secondary storage devices, Processor Concepts - Evolution and comparative study of processors. Machine language, assembly language, and high level language. Inside a PC, Latest trends and technologies of storage, memory, processor, printing etc. Concept of Program and data, System software - BIOS, Operating System- Definition-Functions-Windows, and Linux. Compilers and assemblers, Computer networks, LAN, WiFi.

**Module II (9 hours)**

**Basic elements of C**: Flow chart and algorithm – Development of algorithms for simple problems. Structure of C program – Operators and expressions – Procedure and order of evaluation – **Input and Output functions.** *while, do-while* and *for* statements, *if, if-else, switch, break, continue, goto,* and *labels.* Programming examples.

**Module III (10 hours)**

**Functions** and Program structures: Functions – declaring, defining, and accessing functions – parameter passing methods – **Recursion** – Storage classes – *extern, auto, register* and *static.* Library functions. Header files – C pre-processor. Example programs. **Arrays**: Defining and processing arrays – passing arrays to functions – two dimensional and multidimensional arrays – application of arrays. Example programs.

**Module IV (9 hours)**

**Structures** – declaration, definition and initialization of structures, unions, **Pointers**: Concepts, declaration, initialization of pointer variables simple examples **Concept of a file** – File operations File pointer.

**Text Books**

1. P. Norton, *Peter Norton's Introduction to Computers*, Tata McGraw Hill, New Delhi.
2. E. Balaguruswamy, *Programming in ANSI C*, 3rd ed., Tata McGraw Hill, New Delhi, 2004

**Reference Books**

1. B. Gottfried, *Programming with C*, 2nd ed, Tata McGraw Hill, New Delhi, 2006
2. B. W. Kernighan, and D. M. Ritchie, *The C Programming Language*, Prentice Hall of India, New Delhi, 1988
3. K. N. King. *C Programming: A Modern Approach*, 2nd ed., W. W. Norton & Company, 2008
4. P. Norton, *Peter Norton's Computing Fundamentals*, 6th ed., Tata McGraw Hill, New Delhi, 2004.
5. S. Kochan, *Programming in C*, CBS publishers & distributors
6. M. Meyer, R. Baber, B. Pfaffenberger, *Computers in Your Future*, 3rd ed., Pearson Education India

**Internal Continuous Assessment** *(Maximum Marks-50)*

50% - Lab Practical Tests
20% - Assignments
20% - Main Record
10% - Regularity in the class

**University Examination Pattern**

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

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

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

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

*Maximum Total Marks: 10*

## MT14 303 METROLOGY & INSTRUMENTATION

**Teaching scheme** **Credits: 4**

3 hours lecture and 1 hour tutorial per week

**Objectives**

- *To provide the fundamental concepts and principles of metrology and instrumentation*

- *To impart the various methods of measurement of physical and mechanical quantities*

**Module I (18 hours)**
Mechanical measurement – direct comparison and indirect comparison –classification – Generalized Measurement system – types of input quantities – measurement standards – calibration – uncertainty – classifications of errors Static performance characteristics– introduction to uncertainty – propagating uncertainty Kline and Mclintock approach – Zero, First and Second order instruments –Response of Zero, First & Second order instruments to Step, Ramp and Sinusoidal inputs-methods of correcting for spurious inputs – inherent insensitivity – high gain feedback – signal filtering and opposing inputs.

**Module II (18 hours)**
Sensors – loading error – primary and secondary transducers – variable resistance transducers - sliding contact devices – variable inductance elements – self-inductance and mutual inductance elements – differential transformer – construction and characteristics – rotary differential transformer –variable reluctance transducer – capacitance transducers – active and passive transducers – piezo electric transducers – photoelectric sensors – Hall Effect transducers – Resistance wire strain gages – types – theory of metallic strain gauges — calibration of strain gauges – application of strain gauges-load cells

**Module III (18 hours)**
Measurement of temperature – liquid in glass thermometer – partial and total immersion thermometers – resistance thermometers – constructional details – resistance thermometer circuits – lead wire compensation for resistance thermometers – thermistors – constructional details – Thermo electric thermometers – laws of thermocouples – industrial thermocouples and their ranges – making of thermocouple junctions – ambient temperature compensation-use of extension wires. Pyrometers – optical, total radiation and photo electric pyrometers – linear Quartz thermometer Measurement of flow – need for flow metering – rotameter – theory and constructional details – magnetic flow meters – hotwire anemometers – Measurement of low pressure – McLeod gauge – thermal conductivity gauge – measurement of high pressure – bulk modulus gauge

**Module IV (18 hours)**
Linear and angular measurement: Spring calipers, Vernier calipers and micrometers – slip gauges - Measurement of angles – sine bar – sine center – Sources of error – angle gauges – optical instruments for angular measurement- auto collimator – applications – straightness and squareness –angle dekkor – precision spirit levels – Clinometers Measurement of surface roughness – surface texture – primary texture – secondary texture and the lay specification for surface textures – methods of measuring surface finish . The Talysurf instrument – the profilograph – Tomlinson surface meter – Tracer type profilograph – Measurement of screw thread profiles – errors in pitch– microscopic method – measurement of internal thread – measurement of effective diameter – two wire and three wire method – measurement of root diameter – gear tooth measurement – measurement of gear profile – tooth thickness – tooth spacing – pitch circle diameter – Parkinson s gear tester. The coordinate measuring machine construction – operation and programming – Machine vision Image acquisition and digitization - image processing and analysis

**Text Books**

1. Ernest O. Doebelin, *Measurement Systems Application and Design*, McGraw-Hill
2. Publishing Company
3. Thomas G Beckwith, Roy D M, John H L, *Mechanical Measurements*, 6/E , Pearson Prentice Hall
4. Jain R.K., *Engineering Metrology*, Khanna Publishers, Delhi

5. Holman J.P., *Experimental Methods for Engineers*, McGraw Hill Co

**Reference Books**

1. R K Jain, *Mechancial& Industrial Measurements*, Khanna Publishers, Delhi
2. D S Kumar, *Mechanical Measurements*,Prentice Hall of India.
3. A.K. Thayal; *Instrumentation and mechanical measurements*
4. Figliola, Richard S, & Beasley, Donald E, "*Theory and Design for Mechanical Measurements*", Third edition, John Wiley & Sons Inc
5. Collett, CV, & Hope, AD, "*Engineering Measurements*", Second edition, ELBS/Longman.
6. R.K. Rajput; *Mechanical Measurement and Instrumentation*; S.K. Kataria and Sons
7. RegaRajendra; *Principles of Engineering Metrology*; Jaico Publication
8. R.K. Rajput; *Engineering Metrology and Instrumentation*; S.K. Kataria and Sons
9. I. C. Gupta, *A text book of Engineering Metrology*; DhanpatRai Publications
10. ASME, *Hand book of Industrial Metrology*

**Internal Continuous Assessment** *(Maximum Marks-50)*

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

**University Examination Pattern**

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

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

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

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

*Maximum Total Marks: 100*

## MT14 304 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-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions,

quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Attendance and Regularity in the class

**University Examination Pattern**

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

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

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

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

*Maximum Total Marks: 100*

# MT14 305 ELECTRICAL TECHNOLOGY

*(Common with ME Branch)*

**Teaching scheme** **Credits:** 4

3 hours lecture and 1 hour tutorial per week

***Objectives***

- *To study the operation, performance and characteristics of different types of electrical machines*
- *To familiarise various electrical measuring instruments.*
- *To study an overview of power electronic converters & electric drives*

**Module I (12 hours)**

Review of transformers – equivalent circuit – phasor diagram – voltage regulation – losses and efficiency – open circuit and short circuit test – Autotransformer – saving of copper – 3 phase transformer - Δ-Δ, Y-Y, Δ - Y, Y - Δ connections – applications. Principle of indicating instruments – moving coil, moving iron and dynamometer type instruments - principle and working of induction type energy meter

**Module II (15 hours)**

Power semiconductor devices – symbol & static characteristics of SCR – turn-on by gate triggering – RC-firing circuit – comparison of SCR, power MOSFET & IGBT – Controlled rectifier – 1-phase fully controlled rectifier with R load & waveforms (load voltage & current only) – expression for average output voltage - 1-phase full-bridge inverter with R load & waveforms – expression for RMS output voltage - 1-phase full-wave ac voltage controller with R load & waveforms – expression for RMS output voltage – Step-down dc-dc converter with RL load & waveforms (output voltage & current only)
(Reference Book 1 or 2)
Electrical Drives – advantages of electric drives - parts of electrical drives – fundamental torque equation – four quadrant operation – components of load torque - friction, windage& load torques – steady state stability

**Module III (14 hours)**

Review of DC generators – DC generator on no load – open circuit characteristics –Armature reaction and commutation (basics only) - load characteristics of shunt, series and compound generators – Review of dc motors – performance characteristics of shunt, series and compound motors – starter – need of starter - 3 point starter –losses in DC machines – power flow diagram – efficiency – speed control – armature voltage control of a separately excited dc motor – 1-phase full converter drive. 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)**

Review of 3-phase induction motor – slip – rotor frequency – equivalent circuit – phasor diagram – torque equation – torque-slip characteristics – losses and efficiency – power flow diagram – no-load and blocked rotor tests – starting of 3-phase induction motors – direct-on-line, auto transformer, star-delta and rotor resistance starting - 3-phase induction motor drives – stator voltage control by using a 3-phase AC voltage controller (concept only; no waveform analysis) – stator voltage & frequency control (block diagram approach)

**Text Books**

1. Ashfaq Hussain, Electrical Machines, DhanpatRai& Co.

**Reference Books**

1. P.S. Bimbhra, Power Electronics, Khanna Publishers
2. A.K. Gupta, L.P. Singh &AkhileshUpadhyay, Power Electronics, DhanpatRai Publishing Co.
3. Dubey G.K., Fundamentals of Electrical Drives, Narosa Publishing House
4. VedamSubrahmanyam, Electric Drives – Concepts & Applications, Tata McGraw Hill Education
5. A. K. Sawhney, Electrical and Electronics measuring Instruments, DhanpatRai& Sons

**Internal Continuous Assessment** *(Maximum Marks-50)*

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

**University Examination Pattern**

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

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

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

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

*Maximum Total Marks: 100*

# MT14 306 CONTROL SYSTEMS

**Teaching scheme** **Credits:** 4

3 hours lecture and 1 hour tutorial per week

**Objective**

- *To gain knowledge in the control systems that necessary for engineering research and development programme*

**Module I (14hours)**

**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 (14hours)**

**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(13Hours)**

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.

**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.

**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-50)*

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

**University Examination Pattern**

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

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

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

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

*Maximum Total Marks: 100*

## MT14 307(P) ELECTRICAL TECHNOLOGY LAB

**Teaching scheme** **Credits:** 2

3 hours practical per week

**Objectives**

- *To understand the concepts of electric circuits*
- *To gain application knowledge*

- *To obtain the performance characteristics of machines.*

**List of Experiments**

1. Verification of Thevenin's theorem
2. Verification of Norton's theorem
3. Verification of Superposition theorem
4. Verification of Maximum power transfer theorem
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. Load test on 3-phase induction motor

**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-50)*

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

**University Examination Pattern** *(Maximum Marks-100)*

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

10%- Fair Record (10 marks)

## MT 13 308(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-50)*

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

**University Examination Pattern** *(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 | | |
| EN14 401 | Engineering Mathematics IV | 3 | 1 | 0 | 50 | 100 | 3 | **4** |
| EN14 402 | Environmental Science | 3 | 1 | 0 | 50 | 100 | 3 | **4** |
| MT14 403 | Metallurgy & Material Science | 3 | 1 | 0 | 50 | 100 | 3 | **4** |
| MT14 404 | Mechanics of Solids and Fluids | 3 | 1 | 0 | 50 | 100 | 3 | **4** |
| MT14 405 | Linear Integrated Circuits and Digital Systems | 3 | 1 | 0 | 50 | 100 | 3 | **4** |
| MT14 406 | Computer Assisted Machine Drawing | 3 | 1 | 0 | 50 | 100 | 3 | **4** |
| MT14 407 (P) | Materials Testing Lab | 0 | 0 | 3 | 50 | 100 | 3 | **2** |
| MT14 408 (P) | Linear Integrated Circuits and Digital Systems Lab | 0 | 0 | 3 | 50 | 100 | 3 | **2** |
| | TOTAL | 18 | 6 | 6 | | | | **28** |

# EN14 401 ENGINEERING MATHEMATICS IV

**(Common for ME, CE, PE, CH, BT, PT, AM, and AN)**

**Teaching scheme** **Credits:** 4

3 hours lecture and 1 hour tutorial per week

**Objective**

- *To provide a comprehensive introduction to those models and methods most likely to be encountered and used by students in their careers in engineering.*
- *To provide an introduction to some important partial differential equations*

**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 ($\sigma$ known) – Sampling distribution of Mean ($\sigma$ 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 – Frobenius method for solving ordinary differential equations – Bessel's equation – Bessel functions – enerating functions (No proof) – 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.

**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, 4.4, 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, 9.8 Ex.3, 11.5

**Reference Books**


1. J.S.Chandan, Statisitcs for Business and Economics, Vikas Publishing House.
2. Anthony Croft, Robert Davison, Martin Hargreaves, Engineering Mathematics, Pearson Education.
3. H Parthasarathy, Engineering Mathematics, A Project & Problem based approach,Ane Books
4. India.
5. B V Ramana, Higher Engineering Mathematics,McGrawHill.
6. J K Sharma, Business Mathematics, Theory and Applications,Ane Books India.
7. John bird, Higher Engineering Mathematics, Elsevier, Newnes.
8. Wylie C.R and L.C. Barret, Advanced Engineering Mathematics, McGraw Hill.
9. V R Lakshmy Gorty, Advanced Engineering Mathematics-Vol. I, II., Ane Books India.
10. Sastry S.S., Advanced Engineering Mathematics-Vol. I and II., Prentice Hall of India.
11. Michael D Greenberg, Advanced Engineering Mathematics, Pearson Education.
12. Babu Ram, Engineering Mathematics Vol.I & II, Pearson Education.
13. S.Palaniammal, Probability and Random Processes, Prentice Hall of India.


**Internal Continuous Assessment** *(Maximum Marks-50)*

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

**University Examination Pattern**

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

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

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

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

*Maximum Total Marks: 100*

# EN14 402 ENVIRONMENTAL SCIENCE

(Common for all branches)

**Teaching scheme** **Credits: 4**

2 hours lecture and 1 hour tutorial per week

**Objectives**

- *To understand the problems of pollution, loss of forest, solid waste disposal, degradation of environment, loss of biodiversity and other environmental issues*
- *To 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 importance-need 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 landslides, 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-Bio-geographical; 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-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 accidents and holocaust-Waste land reclamation Consumerism and waste products-Reduce, reuse and recycling of products-Value education.

**Text Books:**

1. Daniels & Krishnaswamy, Environmental studies, Wiley India pvt ltd, 2009
2. Raman Sivakumar, Introduction to environmental science and engineering, 2nd edn, .Tata McGraw Hill, 2010
3. Anindita Basak, Environmental Studies, Pearson Education, 2009
4. Suresh K.D, Environmental Engineering and Management, Katson Books, 2007
5. Benny Joseph, Environmental studies, 2nd edn, McGraw Hill, 2009

**References:**

1. Raghavan Nambiar,K Text book of Environmental Studies,Scitech Publishers(India) Pvt. Ltd
2. S.P Misra, S.N Pandey, Essential Environmental studies, Ane books, Pvt Ltd, 2009
3. P N Palanisamy, P Manikandan,A Geetha, Manjula Rani, Environmental Science, Pearson Education, 2012
3. D.L. Manjunath, Environmental Studies, Pearson Education, 2011

**Internal Continuous Assessment** *(Maximum Marks-50)*

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

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

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

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

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

*Maximum Total Marks: 100*

# MT14 403 METALLURGY & MATERIAL SCIENCE

**Teaching scheme** **Credits:** 4

3 hours lecture and 1 hour tutorial per week

**Objectives**

- *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- polymorphism-allotropy-levels of structure- microscopic examination-Specimen preparation for microstructural examination–etching-metallurgical microscope--scanning electron microscope(SEM) and Transmission Electron Microscope(TEM)-Crystal structure of metallic materials. Imperfections in crystals. - Point defects- line defects- surface defects.

**Module II(16 hours)**

Solidification of metals and alloys- Solid solution, Hume Rothery's rules-Diffusion-laws of diffusion- Mechanisms of diffusion- applications-Phase diagrams- Phase rule- -Isomorphous systems-Lever Rule- 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 III(14 hours)**

Elastic, anelastic and visco - elastic, behavior - Plastic Deformation of Metals and Alloys-Mechanisms of plastic deformation, role of Dislocation; slip and twinning - Schmid s law. Strengthening mechanisms - Grain size reduction, solid solution strengthening, Work hardening; Recovery recrystallisation and grain growth - failure of materials – Fracture - ductile fracture, brittle fracture, -protection against fracture-fracture toughness, Fatigue-mechanism of fatigue, S-N curve - creep curve

**Module IV (14 hours)**

Applications of ferrous alloys-Steels-low carbon steels-high strength low alloy steels-Medium carbon steels-high carbon steels-Stainless steels - ferritic, austenitic and martensitic stainless steels - Cast irons - Grey cast irons - Ductile cast irons - White iron and Malleable iron - copper and its alloys - brasses and bronzes - aluminum and its alloys - magnesium and its alloys - titanium and its alloys - Refractory metals - Super alloys – Composites - particle reinforced and fiber reinforced composites - the fiber phase and the matrix phase - polymer and metal matrix composites - processing of fiber reinforced composites - shape memory alloys - Nano materials - bio materials - bio compatibility

**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-50)*

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

University Examination Pattern

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

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

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

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

*Maximum Total Marks: 100*

## MT14 404 MECHANICS OF SOLIDS AND FLUIDS

**Teaching scheme** **Credits: 4**

3 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 $\pi$ 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-50)*

60% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.

10% - Attendance and Regularity in the class

**University Examination Pattern**

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

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

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

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

*Maximum Total Marks: 100*

# MT14 405 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 (13 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.

## Module III (15 hours)

**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.

**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-50)*

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

**University Examination Pattern**

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

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

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

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

*Maximum Total Marks: 100*

## MT14 406 COMPUTER ASSISTED MACHINE DRAWING

**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**

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-50)*

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

**Note:**
*Drawing practical classes have to be conducted by using any standard CAD software and using drawing instruments in alternative weeks (3 Hours) preferably for each half of the students.*

*Semester End examination (3 Hours) shall be conducted by using drawing instruments only. All drawing exercises mentioned above are for class work. Additional exercises where ever necessary may be given as home assignments.*

**University Examination Pattern**
Question I: One question of 20 marks from Module I.
Question II: Two questions of 20 marks from Module II.
Question III: Two questions of 20 marks from Module III.

## MT14 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-50)*

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

**University Examination Pattern** *(Maximum Marks-100)*

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

10%- Fair Record (10 marks)

## MT14 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-50)*

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

**University Examination Pattern** *(Maximum Marks-100)*

*70%* - Procedure, conducting experiment, results, tabulation, and inference (70 marks)

20%- Viva voce (20 marks)

10%- Fair Record (10 marks)

# SEMSTER 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 | | |
| MT14 501 | Engineering Economics & Principles of Management | 3 | 1 | 0 | 50 | 100 | 3 | **4** |
| MT14 502 | Manufacturing Technology | 3 | 1 | 0 | 50 | 100 | 3 | **4** |
| MT14 503 | Thermal Engineering | 3 | 1 | 0 | 50 | 100 | 3 | **4** |
| MT14 504 | Sensors and Actuators | 3 | 1 | 0 | 50 | 100 | 3 | **4** |
| MT14 505 | Embedded Systems | 3 | 1 | 0 | 50 | 100 | 3 | **4** |
| MT14 506 | PLC and Data Acquisition Systems | 3 | 1 | 0 | 50 | 100 | 3 | **4** |
| MT14 507 (P) | Measurements and PLC Lab | 0 | 0 | 3 | 50 | 100 | 3 | **2** |
| MT14 508 (P) | CAD / CAM Lab | 0 | 0 | 3 | 50 | 100 | 3 | **2** |
| | TOTAL | 18 | 6 | 6 | | | | **28** |

# MT14 501 ENGINEERING ECONOMICS AND PRINCIPLES OF MANAGEMENT

(Common with ME, PE, CS, IC, IT, PT and AM)

**Teaching scheme** **Credits:** 4
2 hours lecture and 2 hour tutorial per week

## Section 1: Engineering Economics

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

**Objective**

- *The prime objective of the Engineering Economics course is to make students familiar with the economic way of thinking. This course provides the students with the foundations of economic theory, tools and techniques for use in the process of efficient economic decision-making in their engineering and managerial profession.*

**Module1 (14 Hrs)**

Introduction to Engineering Economics – Technical efficiency, Economic efficiency – Cost concepts: Elements of costs, Opportunity cost, Sunk cost, Private and Social cost, Marginal cost, Marginal revenue, Profit maximisation, Break-even analysis.

Supply and Demand: Determinants of demand, Law of demand, Determinants of supply, Law of supply, Market equilibrium. Elasticity of demand – Types of elasticity, Factors affecting the price elasticity of demand.

National Income Concepts: GDP and GNP, Per capita income, Methods of measuring national income. Inflation and Deflation: Concepts and regulatory measures – Monetary policy and Fiscal policy.

**Module II (13 Hrs)**

Value Analysis - Time value of money - Interest formulae and their applications: Single-payment compound amount factor, Single-payment present worth factor, Equal-payment series compound amount factor, Equal-payment series sinking fund factor, Equal-payment series present worth factor, Equal-payment series capital recovery factor, Effective interest rate.

Investment criteria: Pay Back Period, Net Present Value, Internal Rate of Return, Benefit-cost ratio.

**Text Books**

1. Panneer Selvam, R, "*Engineering Economics*", Prentice Hall of India Ltd, New Delhi, 2001.
2. Dwivedi, D.N., "*Managerial Economics, 7/E"*, Vikas Publishing House, 2009.

**Reference Books**

1. Sullivan, W.G, Wicks, M.W., and Koelling. C.P., "*Engineering Economy 15/E*", Prentice Hall, New York, 2011.
2. Chan S. Park, "*Contemporary Engineering Economics*", Prentice Hall of India, 2002.
3. Prasanna Chandra, "*Financial Management: Theory & Practice, 8/E"*, Tata-McGraw Hill, 2011.

**Internal Continuous Assessment** *(Maximum Marks-25)*

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 for Section 1**

*PART A: Analytical/problem solving SHORT questions* *4x 5 marks=20 marks*

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

*PART B: Analytical/Problem solving DESCRIPTIVE questions* *2 x 15 marks=30 marks*

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

*Maximum Total Marks: 50*

**University Examination Pattern – for Section 1**
**Note: Section 1 and Section 2 are to be answered in separate answer books**
Maximum 50 marks each for Section 1 and Section 2

## Section 2: Principles of Management

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

**Objective**

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

**Module I (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 II (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*


**Internal Continuous Assessment** *(Maximum Marks-25)*

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 for Section 1**

*PART A: Analytical/problem solving SHORT questions* *4x 5 marks=20 marks*

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

*PART B: Analytical/Problem solving DESCRIPTIVE questions* *2 x 15 marks=30 marks*

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

*Maximum Total Marks: 50*

**University Examination Pattern – for Section 2**
**Note: Section 1 and Section 2 are to be answered in separate answer books**
Maximum 50 marks each for Section 1 and Section 2

# MT14 502 MANUFACTURING TECHNOLOGY

**Teaching scheme** **Credits: 4**

3 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 (14 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 (13 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 (14 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 (13 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-50)*

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

**University Examination Pattern**

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

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

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

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

*Maximum Total Marks: 100*

# MT14 503 THERMAL ENGINEERING

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

**Objective**
*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 - Pressure 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-50)*

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

**University Examination Pattern**

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

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

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

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

*Maximum Total Marks: 100*

## MT14 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-50)*

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

**University Examination Pattern**

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

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

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

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

*Maximum Total Marks: 100*

# MT14 505 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 – advancedcommunication 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-50)*

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

**University Examination Pattern**

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

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

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

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

*Maximum Total Marks: 100*

## MT14 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-50)*

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

**University Examination Pattern**

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

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

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

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

*Maximum Total Marks: 100*

# MT14 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-50)*

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

**University Examination Pattern** *(Maximum Marks-100)*

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

10%- Fair Record (10 marks)

# MT14 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-50)*

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

**University Examination Pattern** *(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 | | |
| MT14 601 | Robotics Engineering | 3 | 1 | 0 | 50 | 100 | 3 | **4** |
| MT14 602 | Microprocessors and Microcontrollers | 3 | 1 | 0 | 50 | 100 | 3 | **4** |
| MT14 603 | Design of Mechatronics Systems | 3 | 1 | 0 | 50 | 100 | 3 | **4** |
| MT14 604 | Mechanics of Machinery | 3 | 1 | 0 | 50 | 100 | 3 | **4** |
| MT14 605 | Intelligent Manufacturing Technology | 3 | 1 | 0 | 50 | 100 | 3 | **4** |
| MT14 606 | Composite Materials | 3 | 1 | 0 | 50 | 100 | 3 | **4** |
| MT14 607 (P) | Microprocessors Lab | 0 | 0 | 3 | 50 | 100 | 3 | **2** |
| MT14 608 (P) | **Mini Project** | 0 | 0 | 3 | 50 | 100 | 3 | **2** |
| | TOTAL | 18 | 6 | 6 | | | | **28** |

# MT14 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.*

## Module I (16 hours)

**INTRODUCTION TO ROBOTICS**

RIA definition - History of Robotics - Justification - Anatomy - Classification - Applications, Configurations of Manipulator - Cartesian - Cylindrical - Polar - Joint arm, Work Volume, Spatial resolution – Accura0cy and Repeatability of Robotics.

**COMPONENTS OF ROBOTICS**

Linckged and Joints of manipulators, drive systems, feed back devices, Degrees of freedom, end effectors - grippers, wrist configurations, motion - roll - Pitch - Yaw, sensors - sensor areas for robots - contact and non contact sensors - Machine vision - introduction.

## Module II (13 hours)

**INTRODUCTION TO MATRIX FORMULATIONS**

Descriptions - Positions - Orientations, frames, Mappings - Changing descriptions from frame to frame.

Transformation arithmetic - translations - rotations - transformations - transform equations - rotation matrix, transformation of free vectors. Introduction to manipulations – Forward Kinematics and inverse Kinematics.

## Module III (15 hours)

**ROBOT PROGRAMMING**

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.

## Module IV (10 hours)

**ROBOT APPLICATIONS**

Robot cell layout - work cell design and control, robot cycle time analysis. 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.

**Internal Continuous Assessment** *(Maximum Marks-50)*

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

**University Examination Pattern**

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

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

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

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

*Maximum Total Marks: 100*

## MT14 602 MICROPROCESSORS AND MICROCONTROLLERS

**Teaching scheme** **Credits:** 4
3 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-50)*

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

**University Examination Pattern**

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

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

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

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

*Maximum Total Marks: 100*

## MT14 603 DESIGN OF MECHATRONIC SYSTEMS

**Teaching scheme** **Credits: 4**

3 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-50)*

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

**University Examination Pattern**

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

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

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

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

*Maximum Total Marks: 100*

# MT14 604 MECHANICS OF MACHINERY

**Teaching scheme** **Credits:** 4

3 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 (14 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 (13 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 (14 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 (13 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-50)*

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

**University Examination Pattern**

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

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

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

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

*Maximum Total Marks: 100*

## MT 3 605 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-50)*

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

**University Examination Pattern**

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

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

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

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

*Maximum Total Marks: 100*

# MT14 606 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-50)*

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

**University Examination Pattern**

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

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

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

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

*Maximum Total Marks: 100*

## MT14 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-50)*

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

**University Examination Pattern** *(Maximum Marks-100)*

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

10%- Fair Record (10 marks)

## MT14 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-100)*

60% - Demonstration and Presentation of mini project
30% - 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 | | |
| MT14 701 | Design of Machine Elements | 3 | 1 | 0 | 50 | 100 | 3 | **4** |
| MT14 702 | Micro Electro Mechanical Systems | 3 | 1 | 0 | 50 | 100 | 3 | **4** |
| MT14 703 | Digital Signal Processing | 3 | 1 | 0 | 50 | 100 | 3 | **4** |
| MT14 704 | Elective I | 3 | 1 | 0 | 50 | 100 | 3 | **4** |
| MT14 705 | Elective II | 3 | 1 | 0 | 50 | 100 | 3 | **4** |
| MT14 706 (P) | Digital Signal Processing Lab | 0 | 0 | 3 | 50 | 100 | 3 | **2** |
| MT14 707 (P) | Mechatronics Lab | 0 | 0 | 3 | 50 | 100 | 3 | **2** |
| MT14 708 (P) | Project | 0 | 0 | 4 | **100** | - | - | **4** |
| | TOTAL | 15 | 5 | 10 | | | | **28** |

## ELECTIVE-I (VII SEMESTER)

| Sl No | Code | Subject |
|---|---|---|
| 1 | MT14 704 (A) | Artificial Intelligence |
| 2 | MT14 704 (B) | Industrial Automation |
| 3 | MT14 704 (C) | Computer Integrated Manufacturing |
| 4 | MT14 704 (D) – (Global Elective) | Logistics & Supply Chain Management |
| 5 | MT14 704 (E) | Alternate Energy Sources |

## ELECTIVE-II (VII SEMESTER)

| Sl No | Code | Subject |
|---|---|---|
| 1 | MT14 705 (A) | Nano Technology |
| 2 | MT14 705 (B) | Industrial Tribology |
| 3 | MT14 705 (C) | Non Destructive Testing |
| 4 | MT14 705 (D) | Entrepreneurship development |
| 5 | MT14 705 (E) | Special Electrical Machines |

# MT14 701 DESIGN OF MACHINE ELEMENTS

**Teaching scheme** **Credits: 4**

3 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-50)*

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

**University Examination Pattern**

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

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

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

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

*Maximum Total Marks: 100*

## MT14 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 – Capactive, 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-50)*

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

**University Examination Pattern**

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

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

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

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

*Maximum Total Marks: 100*

# MT14 703 DIGITAL SIGNAL PROCESSING

**Teaching scheme** **Credits: 4**

3 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-50)*

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

**University Examination Pattern**

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

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

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

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

*Maximum Total Marks: 100*

## MT14 704 (A) ARTIFICIAL INTELLIGENCE

**Teaching scheme** **Credits:** 4

3 hours lecture and 1 hour tutorial per week

**Objectives**

- *To have the comprehensive knowledge in AI*

**Module I (16 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 (14 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 (12 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 (12 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-50)*

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

**University Examination Pattern**

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

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

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

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

*Maximum Total Marks: 100*

# MT14 704 (B) 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-50)*

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

**University Examination Pattern**

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

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

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

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

*Maximum Total Marks: 100*

## MT14 704 (C) 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 (11 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 (13 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 (15 hours)**

Controls in CIM- material handling in CIM- AGV- Vehicle guidance- vehicle management and safetyautomated 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 (15 hours)**

Flexible manufacturing system- types of FMS- components of FMS- FMS workstations- material handling and storage systems- FMS layout- configurations- computer control systems in FMSapplications 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

**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-50)*

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

**University Examination Pattern**

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

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

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

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

*Maximum Total Marks: 100*

# MT14 704 (D) 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-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions,

quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Attendance and Regularity in the class

**University Examination Pattern**

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

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

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

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

*Maximum Total Marks: 100*

## MT14 704(E) 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. 741008
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-50)*

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

**University Examination Pattern**

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

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

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

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

*Maximum Total Marks: 100*

# MT14 705 (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-50)*

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

**University Examination Pattern**

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

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

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

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

*Maximum Total Marks: 100*

## MT14 705 (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-50)*

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

**University Examination Pattern**

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

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

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

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

*Maximum Total Marks: 100*

# MT14 705 (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-50)*

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

**University Examination Pattern**

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

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

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

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

*Maximum Total Marks: 100*

# MT14 705 (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-50)*

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

**University Examination Pattern**

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

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

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

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

*Maximum Total Marks: 100*

## MT14 705 (E) SPECIAL ELECTRICAL MACHINES

**Teaching scheme** **Credits:** 4

3 hours lecture and 1 hour tutorial per week

**Objective**

- *To introduce special types of electric machines and their controls for special applications.*

**ModuleI (12hours)**

Stepping Motors - Constructional features, principle of operation, modes of excitation, single phase stepping motors, torque production in variable Reluctance (VR) stepping motor,

Dynamic characteristics, Drive systems and circuit for open loop control, Closed loop control of stepping motor, microprocessor based controller.

**ModuleII (12hours)**
Switched Reluctance Motors - Constructional features, principle of operation. Torque equation, Power controllers, Characteristics and control. Microprocessor based controller. Sensor less control. Synchronous Reluctance Motors-Constructional features: axial and radial air gap Motors. Operating principle, reluctance torque – Phasor diagram, motor characteristics.

**ModuleIII (15hours)**
Permanent Magnet Brushless DC Motors - Commutation in DC motors, Difference between mechanical and electronic commutators, Hall sensors, Optical sensors, Multiphase Brushless motor, Square wave permanent magnet brushless motor drives, Torque and emf equation, Torque speed characteristics, Controllers-Microprocessor based controller. Sensorless control.

**ModuleIV(15hours)**
Permanent Magnet Synchronous Motors - Principle of operation, EMF, power input and torque expressions, Phasor diagram, Power controllers, Torque speed characteristics, Self control, Vector control, Current control schemes. Sensor less control.

**Text Book**

1. Miller T J E, *Switched Reluctance Motor and Their Control*, Clarendon Press, Oxford,1993.
2. Miller T J E, *Brushless Permanent Magnet and Reluctance Motor Drives*, Clarendon Press,Oxford,1989.
3. B K Bose, *Modern Power Electronics & AC drives*, Pearson, 2002.
4. Athani V.V. "stepper motors – Fundamentals, Applications &Design" New Age International

**Reference Books**

1. Kenjo T, Sugawara A, *Stepping Motors and Their Microprocessor Control*, Clarendon Press, Oxford, 1994.
2. Kenjo T, *Power Electronics for the Microprocessor Age*, Oxford University Press, 1990.
3. Ali Emadi (Ed), *Handbook of Automotive Power Electronics and Motor Drives*, CRC Press, 2005.
4. R Krishnan, *Electric Motor Drives – Modeling, Analysis and Control*, PHI, 2003.
5. H A Toliyat, S Campbell, *DSP Based Electro Mechanical Motion Control*, CRC Press, 2004.

**Internal Continuous Assessment** *(Maximum Marks-50)*

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

**University Examination Pattern**

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

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

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

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

*Maximum Total Marks: 100*

## MT 13 706(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-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions,

quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Attendance and Regularity in the class

**University Examination Pattern** *(Maximum Marks-100)*

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

10%- Fair Record (10 marks)

## MT14 707(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-50)*

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

**University Examination Pattern** *(Maximum Marks-100)*

| | |
|---|---|
| *70%* - | Procedure, conducting experiment, results, tabulation, and inference (70 marks) |
| 20%- | Viva voce (20 marks) |
| 10%- | Fair Record (10 marks) |

# MT14 708(P) : Project

**Teaching scheme** **Credits:**4
4 hours 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 $7^{th}$ semester. Members of the group will present the project details and progress of the project before the committee at the end of the $7^{th}$ 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<br>20% - Progress of the project and presentation<br>10% - Report<br>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 | | |
| MT14 801 | Automobile Electronics | 3 | 1 | 0 | 50 | 100 | 3 | 4 |
| MT14 802 | Operations Research | 3 | 1 | 0 | 50 | 100 | 3 | 4 |
| MT14 803 | Modelling and Simulation | 3 | 1 | 0 | 50 | 100 | 3 | 4 |
| MT14 804 | Elective III | 3 | 1 | 0 | 50 | 100 | 3 | 4 |
| MT14 805 | Elective IV | 3 | 1 | 0 | 50 | 100 | 3 | 4 |
| MT14 806 (P) | Seminar | 0 | 0 | 3 | **100** | - | - | 2 |
| MT14 807 (P) | Project | 0 | 0 | 7 | **100** | - | - | 5 |
| MT14 808 (P) | Viva Voce | 0 | 0 | 0 | - | 100 | - | 3 |
| | TOTAL | 15 | 5 | 10 | | | | 30 |

## ELECTIVE - III (VIII SEMESTER)

| Sl No | Code | Subject |
|---|---|---|
| 1 | MT14 804 (A) | Quality Engineering & Management |
| 2 | MT14 804 (B) | Research Methodology |
| 3 | MT14 804 (C) | Micromachining |
| 4 | MT14 804 (D) | Industrial Safety and Environment |
| 5 | MT14 804 (E) | Image Processing and Machine Vision |

## ELECTIVE - IV (VIII SEMESTER)

| Sl No | Code | Subject |
|---|---|---|
| 1 | MT14 805 (A) | Flexible Manufacturing Methods |
| 2 | MT14 805 (B) | Management Information System |
| 3 | MT14 805 (C) | Computational methods in Engineering |
| 4 | MT14 805 (D) | Creativity, Innovation & Product Development |
| 5 | MT14 805 (E) | Fluid Power Control |

# MT14 801 AUTOMOBILE ELECTRONICS

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

**Objective**

- To provide knowledge about application of electronics in Automobiles

**MODULE I(13Hrs)**
**FUNDAMENTAL OF AUTOMOTIVE ELECTRONICS**
Current trend in Automobiles - Open loop and closed loop systems - Components for electronic engine management. Electronic management of chassis system.
**SENSORS AND ACTUATORS**
Introduction, basic sensor arrangement, types of sensors such as -oxygen sensors, Crank angle position sensors - Fuel metering, vehicle speed sensor and detonation sensor -Altitude sensor, flow sensor. Throttle position sensors, solenoids, stepper motors, relays.

**MODULE II(18Hrs)**
**ELECTRONIC FUEL INJECTION AND IGNITION SYSTEMS**
Electronic fuel injection system: Types of gasoline fuel injection system, electrical fuel pump, electronically controlled fuel supply system, electronically controlled exhaust gas recirculation system, Electronic fuel supply system in diesel engines, Programmed Fuel Injection System (PGMFI) in petrol engines.
Ignition system: Types of ignition, magneto and coil ignition, constructional details, distributor, spark plugs, ignition coil, ignition timing, TAC (transistor assisted contact) ignition system, CD ignition system, Electronic /solid state ignition system, Microprocessor controlled ignition system, advantages, simplified operational diagram of a distributor less ignition system, DTS-i system.

**MODULE III(12 Hrs)**
**DIGITAL ENGINE CONTROL SYSTEM**
Open loop and closed loop control systems -Engine cranking and warm up control -Acceleration enrichment - Deceleration leaning and idle speed control. Distributor less ignition -Integrated engine control system, Exhaust emission control engineering.

**MODULE IV(11 Hrs)**
**VEHICLE MOTION CONTROL AND STABILIZATION SYSTEMS**
Vehicle motion control - Adaptive cruise control, Electronic transmission control. Vehicle stabilization system - Antilock braking system, Traction control system, Electronic stability program. Onboard diagnosis system.

**Text Books**

1. William B. Ribbens, *Understanding Automotive Electronics*, 5th Edition, Butterworth, Heinemann Woburn, 1998.
2. Tom Weather Jr and Cland C.Hunter, *Automotive Computers and Control system*, Prentice Hall Inc., New Jersey.
3. BOSCH, *Automotive Handbook*, 6th Edition, Bentley publishers.

**Reference Books**

1. Young. A.P. and Griffths.L, *Automobile Electrical Equipment*, English Language Book Society and New Press.
2. Crouse.W.H., *Automobile Electrical equipment*, McGraw Hill Book Co Inc., New York, 1955.
3. Robert N Brady., *Automotive Computers and Digital Instrumentation*, A Reston Book, Prentice Hall, Eagle Wood Cliffs, New Jersey, 1988.
4. Bechtold., *Understanding Automotive Electronics*, SAE, 1998.

**Internal Continuous Assessment** *(Maximum Marks-50)*

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

**University Examination Pattern**

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

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

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

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

*Maximum Total Marks: 100*

## MT14 802 OPERATIONS RESEARCH

**Teaching scheme** **Credits:** 4

3 hours lecture and 1 hour tutorial per week

**Objective**

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

**Module I (16 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 (13 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 (13 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 (12 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-50)*

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

**University Examination Pattern**

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

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

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

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

*Maximum Total Marks: 100*

# MT14 803 MODELING AND SIMULATION

**Teaching scheme** **Credits: 4**

3 hours lecture and 1 hour tutorial per week

**Objective**

- *To introduce the fundamentals of mathematical modeling of engineering systems and its simulation.*

## Module I (10 hours)

**INTRODUCTION**

Systems – discrete and continuous systems, general system theory, models of systems- variety of modeling approach, concept of simulation, simulation as a decision making tool, types of simulation, limitation of simulation, area of application.

**RANDOM NUMBERS**

Random Number Generation: Mid square The mid product method Constant multiplier method Additive congruential method Test for random numbers: the Chi-square test the Koimogrov Smimov test Runs test Gap test.

## Module II (8 hours)

**DESIGN OF SIMULATION EXPERIMENTS**

Random Variable Generation: Inverse transform technique Exponential distribution Poission distribution Uniform distribution Weibull distribution Empirical distribution Normal distribution Building and empirical distribution The Rejection method.

## Module III (10 hours)

**SIMULATION LANGUAGE**

Simulation of Systems: Simulation of continuous system Simulation of discrete system Simulation of an event occurrence using random number table. Simulation of component failures using random number table. Simulation of component failures using Exponential and weibull models.

## Module IV (8 hours)

**CASE STUDIES**

Simulation of single server queue and a two server queue. Simulation of inventory system Simulation of a network problem Simulation using Simulation languages / packages. Programming for discrete event simulation in GPSS, case studies.

**Text Books**

1. Bankds J. Carson. J.S. and Nelson B.L. *Discrete Event System Simulation*, Prentice Hall of India, New Delhi, 1996.
2. Gottfried B.S., *Elements of Stochastic Process Simulation*, Prentice Hall, London, 1984.
3. R.E. Shanol, *Systems Simulation*, the art and Science Prentice Hall, 1993.

**Reference Books**

1. Geofrey Gordon, *System Simulation*, Prentice Hall of India, 1984.
2. Narsingh Deo, *System simulation with Digital Computer*, Prentice Hall of India, 1979.

**Internal Continuous Assessment** *(Maximum Marks-50)*

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

**University Examination Pattern**

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

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

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

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

*Maximum Total Marks: 100*

## MT14 804(A) QUALITY ENGINEERING AND MANAGEMENT

**Teaching scheme** **Credits: 4**

3 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 : $\bar{X}$ , 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-50)*

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

**University Examination Pattern**

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

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

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

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

*Maximum Total Marks: 100*

# MT14 804 (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-50)*

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

**University Examination Pattern**

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

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

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

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

*Maximum Total Marks: 100*

## MT14 804 (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-50)*

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

**University Examination Pattern**

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

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

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

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

*Maximum Total Marks: 100*

# MT14 804 (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-50)*

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

**University Examination Pattern**

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

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

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

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

*Maximum Total Marks: 100*

## MT14 804 (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-50)*

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

**University Examination Pattern**

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

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

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

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

*Maximum Total Marks: 100*

# MT14 805 (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-50)*

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

**University Examination Pattern**

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

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

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

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

*Maximum Total Marks: 100*

## MT14 805 (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-50)*

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

**University Examination Pattern**

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

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

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

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

*Maximum Total Marks: 100*

# MT14 805(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-50)*

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

10% - Attendance and Regularity in the class

**University Examination Pattern**

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

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

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

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

*Maximum Total Marks: 100*

## MT14 805 (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-50)*

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

**University Examination Pattern**

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

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

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

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

*Maximum Total Marks: 100*

## MT 13 805(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-50)*

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

**University Examination Pattern**

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

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

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

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

*Maximum Total Marks: 100*

# MT14 806 (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

# MT14 807 (P) : PROJECT

**Teaching scheme** **Credits: 4**
7 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 $8^{th}$ 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 $8^{th}$ 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

Module I (12 hours)
Review of transformers – equivalent circuit – phasor diagram – voltage regulation – losses and efficiency – open circuit and short circuit test – Autotransformer – saving of copper – 3 phase transformer - Δ-Δ, Y-Y, Δ - Y, Y - Δ connections – applications.
Principle of indicating instruments – moving coil, moving iron and dynamometer type instruments - principle and working of induction type energy meter

Module II (15 hours)
Power semiconductor devices – symbol & static characteristics of SCR – turn-on by gate triggering – RC-firing circuit – comparison of SCR, power MOSFET & IGBT – Controlled rectifier – 1-phase fully controlled rectifier with R load & waveforms (load voltage & current only) – expression for average output voltage - 1-phase full-bridge inverter with R load & waveforms – expression for RMS output voltage - 1-phase full-wave ac voltage controller with R load & waveforms – expression for RMS output voltage – Step-down dc-dc converter with RL load & waveforms (output voltage & current only)
(Reference Book 1 or 2)
Electrical Drives – advantages of electric drives - parts of electrical drives – fundamental torque equation – four quadrant operation – components of load torque - friction, windage& load torques – steady state stability

Module III (14 hours)
Review of DC generators – DC generator on no load – open circuit characteristics –Armature reaction and commutation (basics only) - load characteristics of shunt, series and compound generators – Review of dc motors – performance characteristics of shunt, series and compound motors – starter – need of starter - 3 point starter –losses in DC machines – power flow diagram – efficiency – speed control – armature voltage control of a separately excited dc motor – 1-phase full converter drive. 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)
Review of 3-phase induction motor – slip – rotor frequency – equivalent circuit – phasor diagram – torque equation – torque-slip characteristics – losses and efficiency – power flow diagram – no-load and blocked rotor tests – starting of 3-phase induction motors – direct-on-line, auto transformer, star-delta and rotor resistance starting - 3-phase induction motor drives – stator voltage control by using a 3-phase AC voltage controller (concept only; no waveform analysis) – stator voltage & frequency control (block diagram approach)

Text Books

Reference Books
P.S. Bimbhra, Power Electronics, Khanna Publishers
A.K. Gupta, L.P. Singh &AkhileshUpadhyay, Power Electronics, DhanpatRai Publishing Co.
Dubey G.K., Fundamentals of Electrical Drives, Narosa Publishing House
VedamSubrahmanyam, Electric Drives – Concepts & Applications, Tata McGraw Hill Education
A. K. Sawhney, Electrical and Electronics measuring Instruments, DhanpatRai& Sons
Internal Continuous Assessment (Maximum Marks-50)

# AM13 808 (P) : VIVA VOCE

**Credits: 4**

**Objectives**

- *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