# SCHEME OF EXAMINATION

# and

# SYLLABI

# for

# Bachelor of Technology
# Mechatronics

## Offered by

## University School of Engineering and Technology

## 1st SEMESTER TO 8th SEMESTER

GURU GOBIND SINGH
INDRAPRASTHA
UNIVERSITY

## Guru Gobind Singh Indraprastha University
## Dwarka, Delhi – 110078 [INDIA]
## *www.ipu.ac.in*

**BACHELOR OF TECHNOLOGY**
**(COMMON TO ALL BRANCHES)**
**FIRST SEMESTER EXAMINATION**

| Code No. | Paper ID | Paper | L | T/P | Credits | Status |
|---|---|---|---|---|---|---|
| **THEORY PAPERS** | | | | | | |
| ETMA-101 | | Applied Mathematics-I | 3 | 1 | 4 | M |
| ETPH-103 | | Applied Physics-I | 2 | 1 | 3 | M |
| ETME-105 | | Manufacturing Processes | 3 | 0 | 3 | M |
| ETEE-107 | | Electrical Technology | 3 | 0 | 3 | M |
| ETHS-109 | | Human Values and Professional Ethics-I# | 1 | 1 | 1 | -- |
| ETCS-111 | | Fundamentals of Computing | 2 | 0 | 2 | -- |
| ETCH-113 | | Applied Chemistry | 2 | 1 | 3 | M |
| **PRACTICAL/VIVA VOCE** | | | | | | |
| ETPH-151 | | Applied Physics Lab-I | ------ | 2 | 1 | |
| ETEE-153 | | Electrical Technology Lab | ------ | 2 | 1 | M |
| ETME-155 | | Workshop Practice | ------ | 3 | 2 | M |
| ETME-157 | | Engineering Graphics Lab | ------ | 3 | 2 | |
| ETCS-157 | | Fundamentals of Computing Lab | ------ | 2 | 1 | -- |
| ETCH-161 | | Applied Chemistry Lab | ------ | 2 | 1 | -- |
| | | NCC/NSS*# | ------ | ------ | ------ | -- |
| **TOTAL** | | | **16** | **18** | **27** | |

M: Mandatory for award of degree

#NUES (Non University Examination System)

**#NCC/NSS can be completed in any semester from Semester 1 – Semester 4. It will be evaluated internally by the respective institute. The credit for this will be given after fourth Semester for the students enrolled from the session 2014-15 onwards. The camps/classes will be held either during Weekends/Holidays or Winter/Summer Vacations.*

**BACHELOR OF TECHNOLOGY**
**(COMMON TO ALL BRANCHES)**
**SECOND SEMESTER EXAMINATION**

| Code No. | Paper ID | Paper | L | T/P | Credits | Status |
|---|---|---|---|---|---|---|
| **THEORY PAPERS** | | | | | | |
| ETMA-102 | | Applied Mathematics-II | 3 | 1 | 4 | M |
| ETPH-104 | | Applied Physics-II | 2 | 1 | 3 | |
| ETEC-106 | | Electronic Devices | 3 | 0 | 3 | M |
| ETCS-108 | | Introduction to Programming | 3 | 0 | 3 | M |
| ETME-110 | | Engineering Mechanics | 2 | 1 | 3 | -- |
| ETHS-112 | | Communication Skills | 2 | 1 | 3 | -- |
| ETEN-114 | | Environmental Studies | 2 | 1 | 3 | -- |
| **PRACTICAL/VIVA VOCE** | | | | | | |
| ETPH-152 | | Applied Physics Lab-II | ------- | 2 | 1 | |
| ETCS-154 | | Programming Lab | ------- | 2 | 1 | M |
| ETEC-156 | | Electronic Devices Lab | ------ | 2 | 1 | M |
| ETME-158 | | Engineering Mechanics Lab | ------- | 2 | 1 | -- |
| ETEN-160 | | Environmental Studies Lab | ------- | 2 | 1 | -- |
| | | NCC/NSS*# | ------- | ------ | ------ | -- |
| **TOTAL** | | | **17** | **15** | **27** | |

M: Mandatory for award of degree
#NUES (Non University Examination System)
**#NCC/NSS can be completed in any semester from Semester 1 – Semester 4. It will be evaluated internally by the respective institute. The credit for this will be given after fourth Semester for the students enrolled from the session 2014-15 onwards. The camps/classes will be held either during Weekends/Holidays or Winter/Summer Vacations.*

**BACHELOR OF TECHNOLOGY**
**(MECHATRONICS )**
**THIRD SEMESTER EXAMINATION**

| Code No. | Paper ID | Paper | L | T/P | Credits | Status |
|---|---|---|---|---|---|---|
| **THEORY PAPERS** | | | | | | |
| ETEC 205 | | Switching Theory and Logic Design | 3 | 1 | 4 | M |
| ETMA-203 | | Numerical Analysis and Statistical Techniques | 3 | 1 | 4 | M |
| ETMT-205 | | Measurements and Instrumentation | 3 | 0 | 3 | |
| ETME-207 | | Material Science And Metallurgy | 3 | 0 | 3 | M |
| ETME-201 | | Fluid Mechanics | 3 | 1 | 4 | |
| ETTE-211 | | Mechanics of Solids | 3 | 1 | 4 | |
| **PRACTICAL/VIVA VOCE** | | | | | | |
| ETEC-253 | | Switching Theory and Logic Design Lab | 0 | 2 | 1 | |
| ETMA-253 | | Numerical analysis and Statistical Techniques Lab | 0 | 2 | 1 | |
| ETMT-255 | | Measurements and Instrumentation Lab | 0 | 2 | 1 | |
| ETTE-257 | | Mechanics of Solids and Fluid Lab | 0 | 2 | 1 | |
| | | NCC/NSS* | - | - | - | |
| **TOTAL** | | | **18** | **12** | **26** | |

*M: Mandatory for the award of degree.*
#NUES (Non University Examination System)
**#NCC/NSS can be completed in any semester from Semester 1 – Semester 4. It will be evaluated internally by the respective institute. The credit for this will be given after fourth Semester for the students enrolled from the session 2014-15 onwards.*

**BACHELOR OF TECHNOLOGY**
**(MECHATRONICS)**
**FOURTH SEMESTER EXAMINATION**

| Code No. | Paper ID | Paper | L | T/P | Credits | Status |
|---|---|---|---|---|---|---|
| **THEORY PAPERS** | | | | | | |
| ETMT-202 | | Organizational Behaviour | 3 | 0 | 3 | |
| ETMT-204 | | Kinematics and Dynamics of Machinery | 3 | 1 | 4 | M |
| ETMT-206 | | Signals and Systems | 3 | 1 | 4 | M |
| ETEE-212 | | Control Systems | 3 | 1 | 4 | M |
| ETTE-210 | | Thermal science | 3 | 1 | 4 | |
| ETMT-212 | | Hydraulics and Pneumatics | 3 | 1 | 4 | M |
| **PRACTICAL/VIVA VOCE** | | | | | | |
| ETMT-252 | | Kinematics and Dynamics of Machinery Lab | 0 | 2 | 1 | |
| ETMT-254 | | Signals and Systems Lab | 0 | 2 | 1 | |
| ETEE-260 | | Control Systems Lab | 0 | 2 | 1 | |
| ETMT-258 | | Hydraulics and Pneumatics Lab | 0 | 2 | 1 | |
| ETSS-250 | | NCC/NSS* | - | - | 1 | |
| **TOTAL** | | | **18** | **13** | **28** | |

*M: Mandatory for the award of degree.*

**NCC/NSS can be completed in any semester from Semester 1 – Semester 4. It will be evaluated internally by the respective institute. The credit for this will be given after fourth Semester for the students enrolled from the session 2014-15 onwards.*

**NOTE:** 4 weeks Industrial / In-house Workshop will be held after fourth semester. However, Viva-Voce will be conducted in the fifth semester (ETMT 361).

**BACHELOR OF TECHNOLOGY**
**(MECHATRONICS)**
**FIFTH SEMESTER EXAMINATION**

| Code No. | Paper ID | Paper | L | T/P | Credits | Status |
|---|---|---|---|---|---|---|
| **THEORY PAPERS** | | | | | | |
| ETHS-301 | | Communication Skills for Professionals | 2 | 0 | 1 | |
| ETMT-303 | | Machine Element Design. | 3 | 1 | 4 | M |
| ETMT-305 | | Metrology And Quality Control | 3 | 1 | 4 | |
| ETMT-307 | | Digital Signal Processing | 3 | 1 | 4 | M |
| ETMT-309 | | Sensors and Transducers | 3 | 1 | 4 | M |
| ETMT-311 | | Power Electronics and Drives | 3 | 0 | 3 | M |
| **PRACTICAL/VIVA VOCE** | | | | | | |
| ETHS-351 | | Communication Skills for Professionals Lab | 0 | 2 | 1 | |
| ETMT-353 | | Metrology And Quality Control Lab | 0 | 2 | 1 | |
| ETMT-355 | | Digital Signal Processing Lab | 0 | 2 | 1 | |
| ETMT-357 | | Sensors and Transducers Lab | 0 | 2 | 1 | |
| ETMT-359 | | Power Electronics and Drives Lab | 0 | 2 | 1 | |
| ETMT-361 | | Industrial Training*# | - | - | 1 | |
| **TOTAL** | | | **17** | **14** | **26** | |

*M: Mandatory for the award of degree.*
*#NUES (Non University Examination System)*
*Viva-Voce for evaluation of Industrial Training / In-house Workshop will be conducted in this semester.
**Note:** Minimum of 2 weeks of In-house training related to Mechatronics will be held after 5th semester; however, viva-voce will be conducted in 6th Semester (ETMT 360).

**BACHELOR OF TECHNOLOGY**
**(MECHATRONICS)**
**SIXTH SEMESTER EXAMINATION**

| Code No. | Paper ID | Paper | L | T/P | Credits | Status |
|---|---|---|---|---|---|---|
| **THEORY PAPERS** | | | | | | |
| ETMT-302 | | Management of Manufacturing System | 3 | 1 | 4 | |
| ETMT-304 | | Manufacturing Technology | 3 | 1 | 4 | |
| ETMT-306 | | Programmable Logic Controller and SCADA | 3 | 1 | 4 | M |
| ETMT-308 | | Computer Integrated Manufacturing | 3 | 1 | 4 | M |
| ETMT-310 | | Automotive Electronics | 3 | 1 | 4 | |
| ETMT-312 | | Microprocessors and Microcontrollers | 3 | 1 | 4 | M |
| **PRACTICAL/VIVA VOCE** | | | | | | |
| ETMT-352 | | Programmable Logic Controller and SCADA Lab | 0 | 2 | 1 | |
| ETMT-354 | | Computer Integrated Manufacturing Lab | 0 | 2 | 1 | |
| ETMT-356 | | Automotive Electronics Lab | 0 | 2 | 1 | |
| ETMT-358 | | Microprocessors and Microcontrollers Lab | 0 | 2 | 1 | |
| ETMT-360 | | In house Training/Industrial Training | 0 | 0 | 1 | |
| **TOTAL** | | | **18** | **14** | **29** | |

M: Mandatory for award of degree

**Note:** Minimum of 4-6 weeks of industrial training related to ME will be held after 6th semester; however, viva-voce will be conducted in 7th Semester (ETMT 459).

**Imp:-** Elective Paper will be floated in 7th Semester, if one-third of the total students opt for the same. It is advised that the decision about the elective subject for 7h Semester is done before the 15th April every year before end of 6th semester.

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**BACHELOR OF TECHNOLOGY**
**(MECHATRONICS)**
**SEVENTH SEMESTER EXAMINATION**

| Code No. | Paper ID | Paper | L | T/P | Credits |
|---|---|---|---|---|---|
| **THEORY PAPERS** | | | | | |
| ETAT-401 | | Computer Aided Design | 3 | 1 | 4 |
| ETMT-403 | | Micro Electro Mechanical System and Nano-Technology | 3 | 1 | 4 |
| ETMT-405 | | Mechatronics System Design | 3 | 0 | 3 |
| **ELECTIVE – I (CHOOSE ANY ONE)** | | | | | |
| ETMT-407 | | IC Engines | 3 | 0 | 3 |
| ETMT-409 | | Digital Image Processing | 3 | 0 | 3 |
| ETMT-411 | | Product Design and Costing | 3 | 0 | 3 |
| ETME-413 | | Non-Conventional manufacturing processes | 3 | 0 | 3 |
| ETMT-415 | | Process Modelling and Optimization Technique | 3 | 0 | 3 |
| ETME-401 | | Automobile Engineering | 3 | 0 | 3 |
| ETCS 425 | | Database Management Systems | 3 | 0 | 3 |
| **ELECTIVE – II (CHOOSE ANY ONE)** | | | | | |
| ETCS-429 | | Artificial Intelligence | 3 | 0 | 3 |
| ETMT-421 | | Waste and Heat Recovery Systems | 3 | 0 | 3 |
| ETME-421 | | Management Information System and ERP | 3 | 0 | 3 |
| ETMT-425 | | Fuzzy Logic and Neural Networks | 3 | 0 | 3 |
| ETMT-427 | | Operations Research | 3 | 0 | 3 |
| ETMT-429 | | Decision Science | 3 | 0 | 3 |
| ETEE-419 | | Renewable Energy Resources | 3 | 0 | 3 |
| ETME-423 | | Finite Element Method | 3 | 0 | 3 |
| ETHS-419 | | Sociology and Elements of Indian History for Engineers | 3 | 0 | 3 |
| **PRACTICAL/VIVA VOCE** | | | | | |
| ETAT-451 | | CAD Lab | 0 | 2 | 1 |
| ETMT-453 | | Lab based on Elective – I or II | 0 | 2 | 1 |
| ETMT-457 | | Seminar (topic should be linked to industrial training/ Soft skills learnt)# | 0 | 2 | 1 |
| ETMT-459 | | Industrial Training | 0 | 0 | 1 |
| ETMT-461 | | Minor Project+ | 0 | 6 | 3 |
| **TOTAL** | | | **15** | **14** | **24** |

**Imp:-** Elective Paper will be floated if one-third of the total students opt for the same. It is advised that the decision about the elective subject for 8th Semester is done before the 15th November every year before end of seventh semester. New Electives may be added as per requirement after getting it duly approved by BOS and AC respectively.

+ The student will submit a synopsis at the beginning of the semester for approval from the departmental committee in a specified format, thereafter he/she will have to present the progress of the work through seminars and progress reports.

#NUES (Non University Examination System)

**BACHELOR OF TECHNOLOGY**
**(MECHATRONICS)**
**EIGHTH SEMESTER EXAMINATION**

| Code No. | Paper ID | Paper | L | T/P | Credits |
|---|---|---|---|---|---|
| **THEORY PAPERS** | | | | | |
| ETMT-402 | | Robotics | 3 | 1 | 4 |
| ETMT-404 | | Embedded System | 3 | 1 | 4 |
| ETHS-402 | | Human Values and Professional Ethics-II | 1 | 0 | 1 |
| **#ELECTIVE – III (CHOOSE ANY ONE)** | | | | | |
| ETME-402 | | Engineering System Modelling and Simulation | 3 | 0 | 3 |
| ETMT-410 | | Facility and Layout Planning | 3 | 0 | 3 |
| ETCS-412 | | Object Oriented Software Engineering | 3 | 0 | 3 |
| ETMT-414 | | Factory Automation | 3 | 0 | 3 |
| ETMT-416 | | Refrigeration And Air Conditioning | 3 | 0 | 3 |
| ETIC-414 | | VLSI Design | 3 | 0 | 3 |
| ETEC-420 | | Data Communication and Networks | 3 | 0 | 3 |
| **#ELECTIVE – IV (CHOOSE ANY ONE)** | | | | | |
| ETEC-408 | | Consumer Electronics | 3 | 0 | 3 |
| ETTE-424 | | Supply Chain Management – Planning | 3 | 0 | 3 |
| ETMT-424 | | Intelligent and Smart Instrumentation | 3 | 0 | 3 |
| ETMT-426 | | Reliability and Maintenance Management | 3 | 0 | 3 |
| ETMT-428 | | Flexible Manufacturing System | 3 | 0 | 3 |
| ETMT-430 | | Engineering Economics and Cost Analysis | 3 | 0 | 3 |
| **PRACTICAL/VIVA VOCE** | | | | | |
| ETMT-452 | | Robotics Lab | 0 | 2 | 1 |
| ETMT-454 | | Embedded System Lab | 0 | 2 | 1 |
| ETMT-456 | | Lab based on Elective – III or IV | 0 | 2 | 1 |
| ETMT-458 | | Major Project* | 0 | 12 | 8 |
| **TOTAL** | | | **13** | **20** | **26** |

*The student will submit a synopsis at the beginning of the semester for approval from the departmental committee in a specified format, thereafter he/she will have to present the progress of the work through seminars and progress reports. Seminar related to major project should be delivered one month after staring of Semester. The progress will be monitored through seminars and progress reports.

#Elective Paper will be floated if one-third of the total students opt for the same. It is advised that the decision about the elective subject is done before 15th November every year before end of seventh semester. New Electives may be added as per requirement after getting it duly approved by BOS and AC respectively.

**NOTE:**

1. The total number of the credits of (Mechtronics) Programme = 213.
2. Each student shall be required to appear for examinations in all courses. However, for the award of the degree a student shall be required to earn minimum of 200 credits including Mandatory papers (M).

**FOR LATERAL ENTRY STUDENTS:**

1. The total number of the credits of the B.Tech. (Mechtronics) Programme = 159.
2. Each student shall be required to appear for examinations in all courses Third Semester onwards. However, for the award of the degree a student shall be required to earn the minimum of 150 credits, including mandatory papers (M).

## NOMENCLATURE OF CODES GIVEN IN THE SCHEME OF

## B.TECH AND M.TECH

1. **ET** stands for Engineering and Technology.
2. **PE** stands for Power Engineering.
3. **ME** stands for Mechanical Engineering.
4. **MT** stands for Mechatronics.
5. **AT** stands for Mechanical and Automation Engineering.
6. **EE** stands for Electrical and Electronics Engineering.
7. **EL** stands for Electrical Engineering.
8. **IT** stands for Information Technology
9. **CS** stands for Computer Science and Engineering
10. **CE** stands for Civil Engineering
11. **EC** stands for Electronics and Communications Engineering**.**
12. **EN** stands for Environmental Engineering
13. **TE** stands for Tool Engineering
14. **MA** stands for Mathematics
15. **HS** stands for Humanities and Social Sciences
16. **SS** stands for Social Services

## SWITCHING THEORY AND LOGIC DESIGN

| | | | |
|---|---|---|---|
| **Paper Code: ETEC-205** | **L** | **T/P** | **C** |
| **Paper: Switching Theory and Logic Design** | **3** | **1** | **4** |

**INSTRUCTIONS TO PAPER SETTERS:** **MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks.

***Objective****: The objective of the paper is to facilitate the student with the knowledge of Logic Systems and Circuits, thereby enabling the student to obtain the platform for studying Digital Systems and Computer Architecture.*

**UNIT- I**

**Number Systems and Codes**:- Decimal, Binary, Octal and Hexadecimal Number systems, Codes- BCD, Gray Code, Excess-3 Code, ASCII, EBCDIC, Conversion between various Codes.

**Switching Theory: -** Boolean Algebra- Postulates and Theorems, De' Morgan's Theorem, Switching Functions- Canonical Forms- Simplification of Switching Functions- Karnaugh Map and Quine Mc-Clusky Methods.

**Combinational Logic Circuits**:- Review of basic gates- Universal gates, Adder, Subtractor ,Serial Adder, Parallel Adder- Carry Propagate Adder, Carry Look-ahead Adder, Carry Save Adder, Comparators, Parity Generators, Decoder and Encoder, Multiplexer and De-multiplexer, ALU, PLA and PAL.

**[T2,T3][No. of Hrs. 14]**

**UNIT- II**

**Integrated circuits: -** TTL and CMOS logic families and their characteristics. Brief introduction to RAM and ROM.

**Sequential Logic Circuits**: - Latches and Flip Flops- SR, , D, T and MS-JK Flip Flops, Asynchronous Inputs.

**Counters and Shift Registers**:- Design of Synchronous and Asynchronous Counters:- Binary, BCD, Decade and Up/Down Counters , Shift Registers, Types of Shift Registers, Counters using Shift Registers- Ring Counter and Johnson Counter.

**[T2,T3][No. of hrs. 10]**

**UNIT- III**

**Synchronous Sequential Circuits**:- State Tables State Equations and State Diagrams, State Reduction and State Assignment, Design of Clocked Sequential Circuits using State Equations.

**Finite state machine-**capabilities and limitations, Mealy and Moore models-minimization of completely specified and incompletely specified sequential machines, Partition techniques and merger chart methods-concept of minimal cover table.

**[T1][No. of hrs. 10]**

**UNIT- IV**

**Algorithmic State Machine**: Representation of sequential circuits using ASM charts synthesis of output and next state functions, Data path control path partition-based design.

**Fault Detection and Location:** Fault models for combinational and sequential circuits, Fault detection in combinational circuits; Homing experiments, distinguishing experiments, machine identification and fault detection experiments in sequential circuits.

**[T1][No. of hrs. 10]**

**Text Book:**

[T1] Zyi Kohavi, "Switching & Finite Automata Theory", TMH, 2nd Edition
[T2] Morris Mano, Digital Logic and Computer Design", Pearson
[T3] R.P. Jain, "Modern Digital Electronics", TMH, 2nd Ed,

**Reference Books:**

[R1] A Anand Kumar, "Fundamentals of Digital Logic Circuits", PHI
[R2] Taub ,Helbert and Schilling, "Digital Integrated Electronics", TMH

## NUMERICAL ANALYSIS & STATISTICAL TECHNIQUES

| | | | |
|---|---|---|---|
| **Paper Code: ETMA-203** | **L** | **T/P** | **C** |
| **Paper: Numerical Analysis & Statistical Techniques** | **3** | **1** | **4** |

**INSTRUCTIONS TO PAPER SETTERS:** **MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks.

***Objective:*** *To develop numerical ability and to impart knowledge in Statistical methods and Probability theory and their applications in Engineering to enable them to apply that for solving real world problems.*

**UNIT I**

Probability Theory: conditional probability, Baye's theorem, Random variable: discrete probability distribution, continuous probability distribution, expectation, moments, moment generating function, skewness, kurtosis, binomial distribution, Poisson distribution, normal distribution, Curve Fitting: Principle of least square Method of least square and curve fitting for linear and parabolic curve .

**[T1,T2][No. of Hrs. 11]**

**UNIT II**

Correlation Coefficient, Rank correlation, line of regressions and properties of regression coefficients, ANOVA, Sampling distribution: Testing of hypothesis, level of significance, sampling distribution of mean and variance, Chi-square distribution, Student's T- distribution, F- distribution, Fisher's Z- distribution.

**[T1,T2][No. of Hrs. 11]**

**UNIT III**

Numerical Methods: Solution of algebraic and transcendental equations using bisection method, Regula-Falsi method and Newton – Raphson method. Solution of linear simultaneous equations using Gauss-Jacobi's iteration method and Gauss-Seidal's iteration methods. Finite differences: Forward differences, backward differences and Central differences. Interpolation: Newton's interpolation for equi-spaced values. Stirling's central difference interpolation formula, Divided differences and interpolation formula in terms of divided differences, Lagrange's interpolation formula for unequi-spaced values.

**[T1,T2][No. of Hrs. 11]**

**UNIT IV:**

Numerical Differentiation, maxima and minima of a tabulated function. Numerical Integration: Newton-Cote's quadrature formula, Trapezoidal rule, Simpson's one-third rule and Simpson's three-eighth rule .Numerical solution of ordinary differential equations: Picard's method, Taylor's method,Euler's method, modified Euler's method, Runge-Kutta method of fourth order.

**[T1,T2][No. of Hrs. 11]**

**Text Books:**

[T1] R.K. Jain and S.R.K. Iyengar," Numerical methods for Scientific and Engineering Computation", New Age.
[T2] N.M. Kapoor,"Fundamentals of Mathematical Statistics", Pitambar Publications

**References Books:**

[R1] E. kresyzig," Advance Engineering Mathematics", Wiley publications
[R2] P. B. Patil and U. P. Verma, " Numerical Computational Methods", Narosa
[R3]. Partial Differential Equations "Schaum's Outline Series", McGraw Hill.
[R4] Michael Greenberg, "Advance Engineering mathematics" , Pearson.
[R5] Schaum's Outline on Fourier Analysis with Applications to Boundary Value Problem, TMH
[R6] B.S. Grewal., "Numerical Methods in Engg. And Science", Khanna Publications
[R7] Miller and Freund, "Probability and statistics for Engineers" , PHI
[R8] Gupta and Kapoor, "Fundamentals of Mathematical Statistics" Sultan Chand and Sons

## MEASUREMENTS AND INSTRUMENTATION

| **Paper Code ETMT-205** | **L** | **T/P** | **C** |
|---|---|---|---|
| **Paper: Measurements and Instrumentation** | **3** | **0** | **3** |

**INSTRUCTIONS TO PAPER SETTERS:** **MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks.

*Objective: To provide the basic understanding regarding ac measurements and instrumentation, working principles of associated meters and instrumentation schemes.*

**UNIT-I**

**Introduction to Measurement:**

Significance of measurement, Different methods of measurement, Classification of measuring instruments, Application of measurement systems, typical measurement schemes.

**Units and Standards:**

MKS, SI units of engineering parameters, Details of different standards-mass, length, time, frequency, temperature, EMF, ampere, sub standards and lab standards .

**Performance Characteristics:**

Definition of range, span, accuracy, precision, drift, sensitivity, reproducibility, repeatability, dead zone, resolution, hysteresis, threshold, zero error, noise, linearity, loading effect, static characteristics.

**[T1][T2][No of Hrs: 10]**

**UNIT -II**

**Testing & Calibration of measurement setup:**

**Dynamic Characteristics:**

Dynamic response; Transient response; speed of response, fidelity, measuring lag etc, Linear approximation, Introduction to compensation techniques.

Significance of testing and calibration, Calibration curve, Standards for calibration, Different calibration procedures-primary, secondary, direct, indirect, routine calibration, Calibration setup:pressure gauge, level etc. Calibration of Ammeter, Voltmeter and Wattmeter, Energy meter.

**[T1][T2][No of Hrs: 12]**

**UNIT-III**

**Sensors and Transducers:** Transducer classification, Active and Passive Transducers, Potentiometric Transducers, Linear and non-linear potentiometer, Resistance/Bonded Type Strain Gauge.

**Displacement Measurement:Linear/ Angular displacement,** Pneumatic/Electric/Optical/ Ultrasonic/Magnetostrictive/Electronic Displacement Transducers, Proximity Sensors, Typical application schemes.

**[T1][T2][No of Hrs: 10]**

**UNIT -IV**

**Pressure Measurement:**Pressure Units, Force Summing Devices, Secondary Transducers, Vaccum Measurement, Torque Measurement, Tachogenerators.

**Temperature Measurement:**Electric Method, Change in Electrical Properties, Thermoelectricity, Thermocouples, Thermistors, Thermowells.

**Flow Measurement:**Reynold Number, Head type flowmeters, Velocity measurement type flowmeters, Mass flow measurement type flow meters.

**Level Measurements:** Importance, advantage and limitation of different instruments, visual level indicators, float type, Purge method of measuring level, Buoyancy method, Resistance and capcitance probes for level measurement, limit switches, level measurement in pressurized vessels, solid level measurement techniques, modern techniques for level measurements and their applications .

**[T1][T2][No of Hrs:12]**

**Text Books:**

[T1] K.L. Kishore,"Electronic Measurement and Instrumentation "Pearson .

[T2] A.K.Ghosh,"Introduction to Measurements and Instrumentation "4th Edition, PHI.

**Reference Books**:

[R1] B. C. Nakra., K. K. Chaudhry, "Instrumentation, Measurement and Analysis", 4th Edition, TMH.
[R2] W. D. Cooper, "Modern Electronics Instrumentation & Measurement Techniques", PHI.
[R3] John .P.Bentley, "Principles of Measurement Systems", Pearson

## MATERIAL SCIENCE & METALLURGY

| **Paper Code: ETME-207** | **L** | **T/P** | **C** |
|---|---|---|---|
| **Paper: Material Science & Metallurgy** | **3** | **0** | **3** |

**INSTRUCTIONS TO PAPER SETTERS:** **MAXIMUM MARKS: 75**

**1**. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.

2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks

*Objective: The objective of the paper is to introduce the student about knowledge of structure of materials and effect of deformation. This paper also provides understanding of heat treatment on materials and applications of different types of alloys and composite materials.*

**UNIT – I**

**Structure of metal**: Crystal structure (BCC, FCC and HCP, Packing factor and density calculation), X-ray diffraction, miller indices, lattices, imperfections, elementary treatment of point and line defects and their relation to mechanical properties**.**

**Diffusion**: Diffusion mechanisms, steady state and non steady state diffusion, factors affecting diffusion

**Deformation:** Slip, twinning, effect of cold and hot working on mechanical properties, principles of recovery, re-crystallization and gain growth.

**[T1,T2] [No. of Hrs. 11]**

**UNIT – II**

**Fracture:** Types of fracture ductile and brittle, fatigue

**Creep:** Basic consideration in the selection of material for high and low temperature service, creep curve, effect of material variables on creep properties, brittle failure at low temperature.

**Solidification:** Phases in metal system, lever rule, solidification of metal and alloys, solid solution, eutectic, eutectoid and inter-metallic compounds, Iron carbon equilibrium diagram, TTT-diagram. Effect of alloying elements on TTT diagram, S-N curve.

**[T1,T2][No. of Hrs. 13]**

**UNIT - III**

**Heat Treatment:** Principles and purpose of heat treatment of plain carbon steels, annealing, normalizing, hardening, tempering, isothermal treatment, case hardening – carburizing, nitriding etc, precipitating hardening of aluminum alloys. Hardenability: determination of hardenability Jominy end quench test.

**Materials:** Plain Carbon steels, effect of alloying elements, properties, uses, springs, and wear resisting steels, IS standards codes for steels.

**[T1,T3][No. of Hrs: 10]**

**UNIT - IV**

**Corrosion:** Types of corrosion, Galvanic cell, rusting of Iron, Methods of protection from corrosion.

**Fiber Reinforced Composites:** General characteristics, Applications, Introduction to Fibers – glass, carbon, Kevlar 49 fibers. Matrix – Polymeric, Metallic, Ceramic Matrix, Coupling agents and fillers.

**[T1,T3][No. of Hrs: 10]**

**Text Books:**

[T1] Callister "Materials Science and Engineering": An Introduction, 6th Edition
[T2] Parashivamurthy K.I "Material Science and Metallurgy", Pearson,
[T3] Sidney H Avner," Introduction to Physical Metallurgy", Tata McGraw-Hill,New Delhi-1997.

**Reference Books:**

[R1] Degarmo E. Paul et.al, "Materials & Processes in Manufacture", Prentice Hall India, New Delhi, 2001.
[R2] L. Krishna Reddi, "Principles of Engineering Metallurgy", New Age Publication, New Delhi, 2001.
[R3] Buduisky et al, "Engineering Materials & Properties", Prentice Hall India, New Delhi, 2004.
[R4] Peter Haasten, "Physical Metallurgy", Cambridge Univ. Press, 1996.
[R5] Raymond A Higgin., "Engineering Metallurgy Part 1", Prentice Hall India, New Delhi, 1998

## FLUID MECHANICS

| | | | |
|---|---|---|---|
| **Paper Code: ETME-201** | **L** | **T/P** | **C** |
| **Paper: Fluid Mechanics** | **3** | **1** | **4** |

**INSTRUCTIONS TO PAPER SETTERS** **MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks

***Objectives :****The objective of this subject to provide an understanding of the fundamentals of fluid mechanics, an appreciation of the design principles in fluid systems, the ability to analyses existing fluid systems and contribute to new designs.*

**UNIT- I**

**Fundamental Concepts of Fluid Flow**: Fundamental definitions, Fluid properties, classification of fluids, Flow characteristics, Foundations of flow analysis, Incompressible and compressible fluids, one, two and three dimensional flows,

**Pressure and its measurements**: Pascal's law, pressure variation in a fluid at rest, Classification of different manometers.

**Fluid Statics**: Fluid pressure, Forces on solid surfaces, Buoyant forces, Metacentre and Metacentric height. Stability of floating bodies,

**[T1, T2, R1, R2, R3][No. of Hrs-11]**

**UNIT- II**

**Kinematics of Fluid Flow**: Types of fluid flow, streamline, path line and streak line; continuity equation, Equations for acceleration, Irrotational and rotational flow, velocity potential and stream function, Vortex flow, Continuity equation.

**Dynamics of Fluid Flow:** Control volume analysis, Eulers equation of motion, Bernoulli's equation, Bernoulli's theorems from steady flow energy equation, Venturi meter; Pitot tube, Momentum equation .

**Laminar Flow:** Reynold's experiment, Critical velocity, Steady laminar flow through a circular tube, Measurement of viscosity.

**[T1, T2, R1, R2, R3][NO. of Hrs-11]**

**UNIT- III**

**Turbulent Flow**: Shear stress in turbulent flow. Hydro dynamically smooth & rough boundaries. Velocity distribution for turbulent flow in smooth and rough pipes.

**Boundary Layer Flow**: Boundary Layer Theory and Applications: Boundary Layer thickness, displacement, momentum and energy thickness, Flow separation, Drag and lift on immersed bodies.

**Pipe Flow Systems**: Darcy-Weisbach equation, Moody diagram, Energy losses in pipelines, concept of equivalent length, Flow between two reservoirs multiple pipe systems. Siphon.

**[T1, T2, R1, R2, R3][NO. of Hrs-11]**

**UNIT- IV**

**Dimensional Analysis and Principles of Similarity**: Buckingham's Theorem and its applications, Geometric, Kinematics and Dynamic similarity; Dimensionless numbers-Reynolds, Froude, Euler, Mach, Weber Number and their significance.

**Flow Measurements**:Measurement of flow using, orifice meter, nozzle ,Measurement of flow in open channels - rectangular, triangular, trapezoidal weir, Cipoeletti weir. Hot-wire anemometer.

**[T1, T2, R1, R2, R3][NO. of Hrs-11]**

**Text Books:**

**[T1]** R.K. Basal, "Fluid Mechanics & Hydraulic Machines", Laxmi Publications(P) Ltd.,2002.
**[T2]** D.S. Kumar, "Fluid Mechanics and Fluid Power Engineering", S.K. Kataria & Sons,2000.

**Reference Books:**

**[R1]** I.H. Shames, "Mechanics of Fluids", Tata McGraw Hill
**[R2]** V.L. Streeter and E.B. Wylie, "Fluid Mechanics", Tata McGraw Hill
**[R3]** Modi, P.N., and Seth, S.H., "Hydrualics and Fluid Machines", Standard Book House,
**[R4]** Vijay Gupta and S.K.Gupta, " Fluid Mechanics and its Applications", Wiley Eastern Ltd,
**[R5]** Som, S.K. & Biswas G. : Introduction of fluid mechanics & Fluid Machines, TMH, 2000**,**

## MECHANICS OF SOLIDS

| | | | |
|---|---|---|---|
| **Paper Code: ETTE-211** | **L** | **T/P** | **C** |
| **Paper: Mechanics of Solids** | **3** | **1** | **4** |

**INSTRUCTIONS TO PAPER SETTERS** **MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks

***Objectives:*** *The students in this course are required to analyse reasons for failure of different components and select the required materials for different applications. For this purpose, it is essential to teach them concepts, principles, applications and practices covering stress, strain, bending moment, shearing force, shafts, columns and springs. Hence this subject has been introduced. It is expected that efforts will be made to provide appropriate learning experiences in the use of basic principles to the solution of applied problems to develop the required competencies.*

**UNIT– I**

**Simple Stresses & strains**: Concept of stress at a point, Tensile, Compressive, shear and volumetric stresses and Strains, Young's modulus, modulus of rigidity, complementary shear stress, lateral strain and Poisson's ratio. Strain relationships.

**Compound bars and Temperature stresses**: Stresses in compound bars carrying axial loads and subjected to temperature stresses.

**[T1,T2][No. of Hrs. 10]**

**UNIT–II**

**Simple bending**: Shear force and bending moment diagrams of cantilevers, simply supported beams under concentrated, uniformly loaded and varying loads with and without overhangs. Stresses in beams and cantilevers under bending, beam of uniform strength, bending due to eccentric loads. Shear stress in beams, strain energy, Castigliano's theorem Slope and defection of cantilevers and beams under concentrated and uniformly distributed loads. Moment Area method, MaCaulay's method; principle of superposition.

**[T1,T2][No. of Hrs. 12]**

**UNIT – III**

**Columns**: Combined direct and bending stresses in columns, Euler's and Rankine Gordon equations.

**Torsion**: Stresses and strains in pure torsion of solid circular shafts and hollow circular shafts. Power transmitted by shafts; combined bending and torsion. Strain energy in torsion

**Complex stresses and strains:** Principle stress and strain due to combination of stresses, Mohr's circle,strain energy, theories of Failures.

**[T1, T2][No. of Hrs.12]**

**UNIT– IV**

**Springs**: Close-coiled springs, leaf springs.

**Cylinders**: Thin and thick cylinders, Lame's Theorem, compound cylinders, spherical vessels.

**[T1,T2][No. of Hrs.10]**

**Text Books:**

**[T1**] Dr. Sadhu Singh "Strength of Materials", Khanna Pub**.**
**[T2]** Hibbler R.C., "Mechanics of Materials", Prentice Hall, New Delhi, 1994.

**Reference Books:**

**[R1]** Sri Nath L.S. et.al., "Strength of Materials", McMillan, New Delhi,2001
**[R2]** Timoshenko S.P., Gere J "Elements of Strength of Materials", East-West affiliated, New Delhi, 2000
**[R2]** Bhavikatti S. S. Strength of Materials", Vikas Publishers
**[R3]** Popov Eger P., "Engg. Mechanics of solids", Prentice Hall, New Delhi, 1998
**[R4]** Fenner, Roger.T, "Mechanics of Solids", U.K. B.C. Publication, New Delhi, 1990

## SWITCHING THEORY AND LOGIC DESIGN LAB

| | | | |
|---|---|---|---|
| **Paper Code: ETEC-253** | **L** | **T/P** | **C** |
| **Paper: Switching Theory and Logic Design Lab** | **0** | **2** | **1** |

**List of Experiments:**

1. Realize all gates using NAND & NOR gates
2. Realize Half Adder, Full Adder, Half subtracter, Full subtracter
3. Realize a BCD adder
4. Realize a Serial Adder
5. Realize a four bit ALU
6. Realize Master-Save J K Flip-Flop, using NAND/NOR gates
7. Realize Universal Shift Register
8. Realize Self-Starting, Self Correcting Ring Counter
9. Realize Multiplexer and De-Multiplexer
10. Realize Carry Look ahead Adder / Priority Encoder
11. Simulation of PAL and PLA
12. Simulation Mealy and Moore State machines

**NOTE: - At least 8 Experiments out of the list must be done in the semester**

## NUMERICAL ANALYSIS & STATISTICAL TECHNIQUES LAB

| | | | |
|---|---|---|---|
| **Paper Code: ETMA-253** | **L** | **T/P** | **C** |
| **Paper: Numerical Analysis & Statistical Techniques Lab** | **0** | **2** | **1** |

**Based on theory courses ETMA 201 (10-12 experiments)**

1. Curve fitting using Method of Least squares.
2. Solution of algebraic and transcendental equation using Gauss- Seidal's iteration method.
3. Solution of algebraic and transcendental equation using Finite difference method.
4. Numerical integration using Trapezoidal Rule & Simpson's one third rule.
5. Solution of ordinary differential equations using Runge-Kutta method.
6. Calculation of probability using probability distributions.
7. Calculation of correlation coefficient.
8. Calculation of Numerical measures such as mean, variance, Skewness & Kurtosis.
9. Estimation of mean & variance using sampling & Hypothesis.
10. Calculation of Rank Correlation.
11. Analysis os samples using ANOVA.

**NOTE:- At least 8 Experiments out of the list must be done in the semester.**

## MEASUREMENTS AND INSTRUMENTATION LAB

| | L | T/P | C |
|---|---|---|---|
| **Paper Code: ETMT-255** | | | |
| **Paper: Measurements and Instrumentation Lab** | **0** | **2** | **1** |

**Measurements And Instrumentation Lab experiments based on syllabus (ETMT-205).**

**NOTE:- At least 8 Experiments from the syllabus must be done in the semester.**

## MECHANICS OF SOLIDS & FLUIDS LAB

| | | | |
|---|---|---|---|
| **Paper Code: ETTE-257** | **L** | **T/P** | **C** |
| **Paper: MECHANICS OF SOLIDS & FLUIDS LAB** | **0** | **2** | **1** |

**List of Experiment:**

1. To perform tensile test in ductile and brittle materials and to draw stress-strain curve and to determine various mechanical properties.
2. To perform compression test on C.I. and to determine ultimate compressive strength.
3. To perform shear test on different materials and determine ultimate shear strength.
4. To perform any one hardness test (Rockwell, Brinell & Vicker's test) and determine hardness of materials.
5. To perform impact test to determine impact strength.
6. To perform torsion test and to determine various mechanical properties.
7. Open Coil spring test.

**Fluid Mechanics Lab experiments based on syllabus (ETME-201).**

**NOTE: At least 8 Experiments out of the list must be done in the semester.**

## ORGANIZATIONAL BEHAVIOUR

| | | | |
|---|---|---|---|
| **Paper Code: ETMT-202** | **L** | **T/P** | **C** |
| **Paper: Organizational Behaviour** | **3** | **0** | **3** |

**INSTRUCTIONS TO PAPER SETTERS** **MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks

*Objective: The aim of this paper is to provide managerial skills in the students.*

**UNIT-I**

**Introduction:** Concept and nature of Organizational Behaviour; Contributing disciplines to the field of O.B.; O.B. Models; Need to understand human behaviour; Challenges and Opportunities**,** Management functions**,** Tasks and responsibilities of a professional manager; Managerial skills.

**[T1,T2][No of Hrs. 10]**

**UNIT-II**

Individual & Interpersonal Behaviour: Biographical Characteristics; Ability; Values; Attitudes-Formation, Theories, Organization related attitude, Relationship between attitude and behaviour; Personality – determinants and traits; Emotions; Learning-Theories and reinforcement schedules, Perception –Process and errors.

**[T1,T2][No of Hrs. 12]**

**UNIT-III**

Organization Structure and Process: Organizational climate and culture, Organizational Structure and Design, Managerial Communication, Motivation, Stress and its management, Decision Making: Organizational Context of Decisions, Decision Making Models; Problem Solving.

**[T1,T2][No of Hrs. 10]**

**UNIT-IV**

Interactive Aspects of Organizational Behaviour: Interpersonal Behaviour: Johari Window; Transactional Analysis – ego states, types of transactions, life positions, applications of T.A, Group Dynamics; Management of Organizational Conflicts; Leadership Styles.

**[T1,T2][No of Hrs. 12]**

**Text Books:**

[T1] Luthans Fred., "Organizational Behaviour", McGraw Hill, 2010, 12th ed.
[T2] Robbins & Judge (15th ed.), "Essentials of Organizational Behaviour", Pearson 2012.

**References:**

[R1] Stoner, R. James A.F., Edward Freeman Daniel R Gilbert Jr., Management 6TH Ed, PHI
[R2] George, J. M. & Jones, G.R. (2009). Understanding and Managing Organizational Behaviour, 5th Edition, Pearson Education.
[R3] Green Berg, J. and Baron, R.A. (2008), Behaviour in Organization. Prentice Hall of India.
[R4] Mcshane, S.L., Von Glinow, M.A., Sharma, R.R. (2006) Organizational Behaviour. Tata McGrawHill

## KINEMATICS AND DYNAMICS OF MACHINERY

| | L | T/P | C |
|---|---|---|---|
| **Paper Code: ETMT-204** | | | |
| **Paper: KINEMATICS AND DYNAMICS OF MACHINERY** | **3** | **1** | **4** |

**INSTRUCTIONS TO PAPER SETTERS** **MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks

***Objectives:*** *The objective of the subject is to expose the students to learn the fundamentals of various laws governing rigid bodies and its motions*

**UNIT – I**

**General concepts, Velocity and Acceleration Analysis:** Introduction of Simple mechanism, Different types of Kinematics pair, Grublers rule for degree of freedom, Grashof's Criterion for mobility determination Inversions of 3R-P, 2R-2P chains, Kinematic analysis of planar mechanism

**[T1,T2][No. of Hrs. 10]**

**UNIT – II**

**Cams:** Classification, Cams with uniform acceleration and retardation, SHM, Cylcloidal motion, oscillating followers.

**Gyroscopes:** Gyroscopic law, effect of gyroscopic couple on automobiles, ships, aircrafts.

**Dynamic Analysis:** Slider-crank mechanism, Klein's construction, turning moment computations.

**[T1,T2][No. of Hrs. 10]**

**UNIT – III**

**Gears:** Geometry of tooth profiles, Law of gearing, involute profile, cycloidal profile, interference, helical, spiral and worm gears, simple, compound gear trains. Epicyclic gear trains – Analysis by tabular and relative velocity method, fixing torque.

**Governors & Flywheel** : Hartnel, Porter governors – construction and working, Flywheel.

**[T1,T2][No. of Hrs. 10]**

**UNIT – IV**

**Balancing:** Static and Dynamic balancing- balancing of revolving masses, single and multi-cylinder engines. Reciprocating masses –single cylinder engine.

**Vibrations:** Vibration analysis of single degree of freedom, natural, damped forced vibrations, based-excited vibrations, and transmissibility ratio.

**[T1,T2][No. of Hrs. 10]**

**Text Books:**

[T1] S.S. Rattan, "Theory of Machines", Tata McGraw Hill,
[T2] Ghosh A & Malik A K "Theory of Mechanisms and Machines" Affiliated East West Press

**Reference Books:**

[R1] Shigley J E "Theory of Machines", Pearson
[R2] Thomas Beven, "The Theory of Machines", CBS Publishers,
[R3] Dr. V.P. Singh, "Theory of Machines", Dhanpat Rai & Co.(P)Ltd
[R4] Malhotra & Gupta, "The Theory of Machine", Satya Prakashan,.
[R5] P.L. Ballaney, "Theory of Machines & Mechanism", Khanna Publishers.

## SIGNALS AND SYSTEMS

| | | | |
|---|---|---|---|
| **Paper Code: ETMT-206** | **L** | **T/P** | **C** |
| **Paper: Signals and Systems** | **3** | **1** | **4** |

**INSTRUCTIONS TO PAPER SETTERS:** **Maximum Marks: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks.

*Objective: This is the first course for representation of various types of electronic signals and LTI systems. Applications of Fourier series, understanding of Fourier transforms and sampling of various signals. Analysis of various systems using the Z transforms, Laplace transforms.*

**UNIT- I**

**Continuous And Discrete Time Signals:** Definition of signal**,** Classification of Signals: Periodic and Aperiodic, Even and Odd, Energy and Power signals**,** Deterministic and Random signals**.**

**Singular Functions**: Unit impulse, unit step, unit ramp, complex and exponential, parabolic, Signum, Sinc etc. Properties of unit impulse in continuous and discrete domain, properties of basic functions w.r.t. orthogonality.

**Transformation in independent variable of signals**: Time scaling, Time shifting, Amplitude scaling. Representation of signals in terms of singular function and orthogonal functions.

**Systems:** Definition of system, types of systems: Linear and nonlinear, static and dynamic, causal and non-causal, time variant and invariant, invertible and non-invertible, stable and non-stable. System described by differential equation and difference equation.

**LTI System:** Properties of LTI System, impulse response, convolution and its properties in continuous and discrete domain with proof. Linear convolution in continuous and discrete domain using graphical method, using general formula and matrix method.

**[T1, T2] [No. of Hrs. 12]**

**UNIT- II**

**Fourier series:** Need and application of Fourier series. Fourier series representation of continuous time and discrete time signals using exponential method and trigonometric method. Magnitude and Phase spectrum of signals.

**Fourier Transform:** Properties of the Continuous time and discrete time Fourier Transform. Magnitude and Phase representations of frequency response of LTI systems Analysis and characterization of LTI systems using Differential Equations and Difference equation.

**[T1,T2][No. of Hrs. 11]**

**UNIT- III**

**Magnitude- Phase Representation of Frequency Response of LTI System:** Linear phase, concept of phase delay and group delay. All pass system.

**Laplace Transform:** Properties of Laplace transform, concept of ROC and its properties. Computation of impulse response & transfer function using Laplace transform. Inverse-Laplace transforms. Computation of impulse response, total response (zero state and zero input response) & transfer function using Laplace transform**.**

**[T1, T2] [No. of Hrs. 11]**

**UNIT- IV**

**Sampling:** Sampling of low pass signals, ideal sampling, Aliasing effect, Nyquist rate, reconstruction of signal. Sampling of discrete time signals**.**

**Z Transform:** Region of convergence – properties of ROC, Properties of Z-transform.

**Inverse Z-transform** using contour integration - Residue theorem, Power series expansion and partial fraction expansion. Relationship between Z-transform, Fourier transform and Laplace transform. Computation of impulse response, total response (Zero state and Zero input response) & Transfer function using Z-Transform. Stability of discrete-time LTI System.

**[T1, T2] [No. of Hrs. 10]**

**Text Books**:

[T1] AlanV.Oppenheim, Alan S.Willsky, S.Hamid Nawab, "Signals & Systems", 2nd edition, Pearson Education, 1997.

[T2**]** Simon Haykin and Barry Van Veen, "Signals and Systems", John Wiley, 1999.

**Reference Books:**

[R1] M.J.Roberts, "Signals and Systems Analysis using Transform Method and MATLAB", TMH 2003.
[R2] Tarun kumar rawat "signals and systems ", Oxford University Press, Incorporated, 2010
[R3] A. Anand kumar, "signals and systems" 3rd edition , PHI
[R4] Ramesh Babu and R.Anandanatrajan ,"Signals and system", 4th edition Sci Tech ,2013
[R5] Moman .H. Hays, "Digital Signal Processing", Schaum's outlines, Tata McGraw-Hill2004.
[R6] John G.Proakis and Dimitris G.Manolakis, "Digital Signal Processing, Principles, Algorithms and Applications", 3rd edition. PHI, 2000.

## CONTROL SYSTEMS

| | L | T/P | C |
|---|---|---|---|
| **Paper Code: ETEE-212** | | | |
| **Paper: Control Systems** | **3** | **1** | **4** |

**INSTRUCTIONS TO PAPER SETTERS:** **MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks.

***Objective****: To teach the fundamental concepts of Control systems and mathematical modeling of the system. To study the concept of time response and frequency response of the system. To teach the basics of stability analysis of the system*

**UNIT I : Control Systems - - Basics & Components**

Introduction to basic terms, classifications & types of Control Systems, block diagrams & signal flow graphs. Transfer function, determination of transfer function using block diagram reduction techniques and Mason's Gain formula. Control system components: Electrical/ Mechanical/Electronic/A.C./D.C. Servo Motors, Stepper Motors, Tacho Generators, Synchros, Magnetic Amplifiers, Servo Amplifiers,

**[T1,T2][No. of Hrs. : 11]**

**UNIT II : Time – Domain Analysis**

Time domain performance specifications, transient response of first & second order systems, steady state errors and static error constants in unity feedback control systems, response with P, PI and PID controllers, limitations of time domain analysis.

**[T1,T2][No. of Hrs. : 10]**

**UNIT III : Frequency Domain Analysis**

Polar and inverse polar plots, frequency domain specifications and performance of LTI systems, Logarithmic plots (Bode plots), gain and phase margins, relative stability. Correlation with time domain performance closes loop frequency responses from open loop response. Limitations of frequency domain analysis, minimum/non-minimum phase systems.

**[T1,T2][No. of Hrs. : 10]**

**UNIT IV : Stability & Compensation Techniques**

Concepts, absolute, asymptotic, conditional and marginal stability, Routh–Hurwitz and Nyquist stability criterion, Root locus technique and its application.

Concepts of compensation, series/parallel/ series-parallel/feedback compensation, Lag/Lead/Lag-Lead networks for compensation, compensation using P, PI, PID controllers.

**[T1,T2][No. of Hrs. : 11]**

**Text Books:**

[T1] B. C. Kuo, "Automatic control system", Prentice Hall of India, 7th edition 2001.
[T2] Nagraath Gopal "Control Systems Engineering -Principles and Design" New Age Publishers

**Reference Books:**

[R1] Norman S. Nise, "Control systems engineering" John Wiley & Sons (Asia) Singapore.
[R2] Raymond T. Stefani, Design of Feedback Control System, Oxford University Press.
[R3] K. Ogata, "Modern control engineering", Pearson 2002.
[R4] S. P.Eugene Xavier, "Modern control systems", S. Chand & Company.
[R5] M. Gopal "Control Systems-Principles and Design" TMH 4th Edition 2012

## THERMAL SCIENCE

| | | | |
|---|---|---|---|
| **Paper Code: ETTE-210** | **L** | **T/P** | **C** |
| **Paper: Thermal Science** | **3** | **1** | **4** |

**INSTRUCTION TO PAPER SETTERS:** **MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from question no. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks.

*Objective: The objective of the paper is to introduce basic concepts, thermodynamics and other concepts related to thermal science.*

**UNIT – I**

**Basic concepts**: Introduction to the Basic definitions of Engineering Thermodynamics. Thermodynamic systems : Closed, Open and Isolated systems. Microscopic and Macroscopic view. Intensive and Extensive properties. Zero$^{th}$ law of Thermodynamics. Phase, State, Process, Cycle. Point functions and Path functions. Gas Laws and Equation of State. Work and Heat.

**First Law of Thermodynamics:** Introduction to First Law of Thermodynamics, Internal energy. Non flow processes, p-*v* diagrams. Concept of Flow work, Enthalpy. Analysis of steady flow and unsteady flow processes and their applications. Throttling process.

**Second Law of Thermodynamics:** Limitations of First law and necessity of Second Law of Thermodynamics, Kelvin Planck statement and Claussius statement, Reversible and Irreversible processes. Carnot cycle, Reversed Carnot cycle. Carnot's Theorem, Clausius inequality. Entropy, Change in Entropy during various processes and representations on t-s diagrams, Entropy principle, Entropy Generation.

**[T1, T2, T3, R1, R2, R3] [No. of Hrs. 12]**

**UNIT – II**

**Availability and Irreversibility** : High grade and low grade energy. Available and unavailable energy. Dead state. Loss of available energy due to Heat transfer through a Finite temperature difference. Availability. Reversible work and Irreversibility. Availability in non flow systems and steady flow systems. Second law efficiency.

**Thermodynamic Property Relations:**. Maxwell Relations. Clapeyron Equation.

**Properties of a Pure Substance:** Phase equilibrium of a pure substance on t-*v* diagram. Normal boiling point of a Pure substance. Saturation states. Compressed liquid. p-v & p-t diagram of a pure substance. Saturated steam, Dry and saturated steam, Superheated steam. Use of Steam tables and Mollier diagram. Different processes of vapour on p-v and t-s diagrams. Measurement of Dryness fraction.

**[T1, T2, T3, R1, R2, R3] [No. of Hrs. 12]**

**UNIT - III:**

**Vapour Power Cycles :** Carnot cycle. Simple Rankine cycle. Effect of various parameters on the efficiency of Rankine cycle. Reheat and Regenerative cycles.

**[T1, T2, T3, R1, R2, R3] [No. of Hrs. 10]**

**UNIT – IV**

**Gas Power Cycles:** Carnot cycle, Otto cycle, Diesel cycle, Dual cycle, Stirling cycle, and Ericsson cycle.

**Gas Turbines:** Brayton cycle, Thermal refinements. Performance of Gas turbines, Combined cycle. Principles of Jet Propulsion. Turbojet and Turbo-prop engines, Rocket engines.

**[T1, T2, T3, R1, R2, R3] [No. of Hrs. 10]**

**Text Books:**

[T1] P.K. Nag, "Engineering Thermodynamics", 5$^{th}$ edition McGraw Hill
[T2] Y. A. Cengel & M. A Boles "Thermodynamics- An Engineering Approach ", 7th edition TMH
[T3] Gordon Rosers, &Yon Mahew; Engineering Thermodynamics", Pearson.

**Reference books:**

[R1] M.J. Moran & H.N. Shapiro "Fundamentals of Thermal Engineering" John Wiley & sons.
[R2] C. P. Arora " Thermodynamics", McGraw Hill
[R3] S L Somasundaram "Engineering Thermodynamics", New Age International Publishers.
[R4] R. K. Rajput, "Engineering Thermodynamics", Lakshmi Publications
[R5] Shiv Kumar, " Fundamentals of Thermal Engineering" Ane Books Pvt. Ltd.

## HYDRAULICS AND PNEUMATICS

| | | | |
|---|---|---|---|
| **Paper Code: ETMT-212** | **L** | **T/P** | **C** |
| **Paper: Hydraulics and Pneumatics** | **3** | **1** | **4** |

**INSTRUCTIONS TO PAPER SETTERS:** **MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from question no. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks.

*Objective: The objective of the paper is to facilitate the students with the working and applications of a large class of pneumatic and hydraulic instruments used in various plants and industries.*

**UNIT I**

**Hydraulic Systems**

Introduction to fluid power system, Advantage and Disadvantage of Fluid power, Hydraulic fluids- functions, fluid characteristics. Construction, operation, characteristics and graphical symbols of hydraulic components, Sources of hydraulic power, pump classification. Fluid power actuator, Fluid motors.

**Pneumatic Systems**

Introduction, comparison of pneumatic/ hydraulic and electrical systems, characteristics & symbols of pneumatic components. Air Compression system, Air preparation – principles and components.

**[T1, T2][No. of Hrs. 12]**

**UNIT II**

**Hydraulic Components & Hydraulic Circuits**

Introduction, function of control elements, direction control valve, check valve, pressure control valve, pressure reducing valve, flow control valves, sequence valve, electrical control solenoid valves, Accumulators – types of accumulators, applications and accumulator circuits, intensifier – application and circuits.

**[T1, T2][No. of Hrs. 11]**

**UNIT III**

**Pneumatic Components & Pneumatic Circuits**

Pneumatic Components- Filter, regulators, lubricators, pneumatic actuators, quick exhaust valve, pressure sequence valve, time delay valve, solenoid valve, electrical limit switch, proximity switch, speed control circuits, cascade method- sequential circuit design, synchronizing circuits, time delay circuits.

**[T1, T2][No. of Hrs. 11]**

**UNIT IV**

**Application, failure 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.

**[T1, T2][No. of Hrs. 10]**

**Text Books:**

[T1] Introduction to Hydraulics and Pneumatics, S Ilango,V.Soundarajan,PHI 2013.
[T2] Hydraulics and Pneumatic Controls, K Shanmuga Sundaram, S Chand, 2012.

**Reference Books:**

[R1] Pneumatic & Hydraulic, Andrew Parr PHI, 1999.
[R2] Industrial Hydraulics, McGraw, John Pippenger, Tyler Hicks, Hill International Edition, 1980.
[R3] Esposito A., “Fluid Power with Applications”, Pearson Education 2005.
[R4] Srinivasan.R, “Hydraulic and Pneumatic controls”, Vijay Nicole, 2006.
[R5] Michael J, Prinches and Ashby J. G, “Power Hydraulics”, Prentice Hall, 1989.

## KINEMATICS AND DYNAMICS OF MACHINERY LAB

| | | | |
|---|---|---|---|
| **Paper Code: ETMT-252** | **L** | **T/P** | **C** |
| **Paper: Kinematics and Dynamics of Machinery Lab** | **0** | **2** | **1** |

**List of Experiments:**

1. Draw velocity and acceleration diagram of engine mechanism using graphical methods including Klien's construction.
2. CAM Analysis - angle Vs displacement and jump phenomenon.
3. Determination of gear- train value of compound gear trains and Epicyclic gear trains.
4. To study various types of gears – Helical , cross helical worm, bevel gear.
5. To perform experiment on watt and Porel Governor to prepare performance characteristic Curves, and to find stability and sensitivity.
6. To analyse the motion of a motorized gyroscope when the couple is applied along its spin axis.
7. Static and Dynamic Balancing of rotating masses.
8. Dynamic Balancing of reciprocating masses ( IC engine).
9. To determine whirling speed of shaft theoretically and experimentally
10. To determine the natural frequency of un damped torsional vibration of two rotor shaft system.
11. To determine the frequency of undamped free vibration of an equivalent spring mass system.
12. To determine the frequency of damped force vibration of a spring mass system

**NOTE: At least 8 Experiments out of the list must be done in the semester.**

## SIGNALS AND SYSTEMS LAB

| | | | |
|---|---|---|---|
| **Paper Code: ETMT-254** | **L** | **T/P** | **C** |
| **Paper: Signals and Systems Lab** | **0** | **2** | **1** |

**List of Experiments:**

1. Introduction to MATLAB and its basic commands.
2. Plot unit step, unit impulse, unit ramp, exponential, parabolic functions and sinusoidal signals
3. Plot the linear convolution of two sequences.
4. Plot the correlation of two sequences.
5. Plot the magnitude and phase spectra of a signal using Fourier transforms.
6. Plot the magnitude and phase spectrum of signal using Fourier series.
7. Find out the Z transform of a signal and check the stability using pole zero location.
8. Plot the spectra of ideally sampled signal w.r.t. sampling of Discrete time signals.
9. Verification of few properties of Fourier transform.
10. Evaluate the DTFS coefficients of a signal and plot them.
11. Plot the step response for any impulse response entered by user.

**NOTE: - At least 8 Experiments out of the list must be done in the semester**

## CONTROL SYSTEMS LAB

| | | | |
|---|---|---|---|
| **Paper Code: ETEE-260** | **L** | **T/P** | **C** |
| **Paper: Control Systems Lab** | **0** | **2** | **1** |

**List of Experiments:**

1. Comparison of open loop & closed loop control in speed control of D.C. motor & to find the transfer function.
2. To study the characteristics of positional error detector by angular displacement of two servo potentiometers
    a. excited with dc
    b. excited with ac
3. To study synchro transmitter in terms of position v/s phase and voltage magnitude with respect to rotor voltage magnitude /phase.
4. To study remote position indicator systems using synchro transmitter/receiver.
5. To plot speed- torque curves for ac servomotor for different voltages.
6. To study ac motor position control system & to plot the dynamic response & calculate peak time, settling time, peak overshoot, damping frequency, steady state error etc.
7. To study the time response of simulated linear systems.
8. To study the performance of PID Controller.
9. Plot impulse response, unit step response, unit ramp response of any $2^{nd}$ order transfer function on same graph using MATLAB.
10. To draw the magnetization (Volt Amps) characteristics of the saturable core reactor used in the magnetic amplifier circuits.
11. Plot root locus for any $2^{nd}$ order system (with complex poles). For Mp=30%, find the value of K using MATLAB.
12. To design lead-lag compensator for the given process using Bode plots in MATLAB.

**NOTE:- At least 8 Experiments out of the list must be done in the semester.**

## HYDRAULICS AND PNEUMATICS LAB

| **Paper Code: ETMT-258** | **L** | **T/P** | **C** |
|---|---|---|---|
| **Paper: Hydraulics and Pneumatics Lab** | **0** | **2** | **1** |

**List of Experiments:**

1. Study of Graphical Symbol as per DIN-ISO: 1219.
2. To understand working and construction of hydraulic components and basic circuits using transparent model and cut out sections.
3. To study single acting and double acting pneumatic cylinder using D.C. Valve.
4. To understand use of Logic element 'OR' gate and 'AND' gate.
5. To understand use of Quick Exhaust & Flow control valve.
6. To study pressure sequence valve and time delay valve in pneumatic circuit.
7. Design and develop a sequential circuit using cascade methods for the following sequences A+ B+ A- B-.
8. Speed control of Hydraulic cylinder through Throttle valve.
9. Speed control of Hydraulic cylinder through The Flow control valve in Bypass.
10. Study of Meter-in & Meter-out circuits.
11. To understand use of accumulator in hydraulic circuit.
12. Electro Pneumatic circuit –Speed and Pressure control of double acting cylinder..

**NOTE:- At least 8 Experiments out of the list must be done in the semester.**

## COMMUNICATION SKILLS FOR PROFESSIONALS

| | | | |
|---|---|---|---|
| **Paper Code: ETHS–301** | **L** | **T/P** | **C** |
| **Paper: Communication Skills For Professionals** | **2** | **0** | **1** |

**INSTRUCTIONS TO PAPER SETTERS:** **MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks.

***Objective****: To develop communication competence in prospective engineers so that they are able to communicate information as well as their thoughts and ideas with clarity and precision. This course will also equip them with the basic skills required for a variety of practical applications of communication such as applying for a job, writing reports and proposals. Further, it will make them aware of the new developments in communication that have become part of business organisations today.*

**UNIT-I**

**Organizational Communication:** Meaning, importance and function of communication, Process of communication, Communication Cycle - message, sender, encoding, channel, receiver, decoding, feedback, Characteristics, Media and Types of communication, Formal and informal channels of communication, 7 C's of communication, Barriers to communication, Ethics of communication (plagiarism, language sensitivity)

**Soft Skills:** Personality Development, Self Analysis through SWOT, Johari Window, Interpersonal skills -Time management, Team building, Leadership skills. Emotional Intelligence. Self Development and Assessment- Self assessment, Awareness, Perception and Attitudes, Values and belief, Personal goal setting, Career planning, Self esteem.

**[T1,T2][No. of Hrs. 08]**

**UNIT-II**

**Introduction to Phonetics:** IPA system (as in Oxford Advanced Learner's Dictionary), Speech Mechanism, The Description of Speech Sounds, Phoneme, Diphthong, Syllable, Stress, Intonation, Prosodic Features; Pronunciation; Phonetic Transcription - Conversion of words to phonetic symbols and from phonetic symbols to words. British & American English (basic difference in vocabulary, spelling, pronunciation, structure)

**Non-Verbal Language**: Importance, characteristics, types – Paralanguage (voice, tone, volume, speed, pitch, effective pause), Body Language (posture, gesture, eye contact, facial expressions), Proxemics, Chronemics, Appearance, Symbols.

**[T1,T2][No. of Hrs. 08]**

**UNIT-III**

**Letters at the Workplace –** letter writing (hard copy and soft copy): request, sales, enquiry, order, complaint. Job Application -- resume and cover letter

**Meeting Documentation**-- notice, memo, circular, agenda and minutes of meeting.

**Report Writing** - Significance, purpose, characteristics, types of reports, planning, organizing and writing a report, structure of formal report. Writing an abstract, summary, Basics of formatting and style sheet (*IEEE Editorial Style Manual)*, development of thesis argument, data collection, inside citations, bibliography; Preparing a written report for presentation and submission. Writing a paper for conference presentation/journal submission.

**[T1,T2][No. of Hrs. 08]**

**UNIT-IV**

**Listening and Speaking Skills**: Importance, purpose and types of listening, process of listening, difference between hearing and listening, Barriers to effective listening, Traits of a good listener, Tips for effective listening. Analytical thinking; Speech, Rhetoric, Polemics; Audience analysis. Telephone Skills - making and receiving calls, leaving a message, asking and giving information, etiquettes.

**Presentations:** Mode, mean and purpose of presentation, organizing the contents, nuances of delivery, voice and body language in effective presentation, time dimension.

**Group Discussion:** Purpose, types of GDs, strategies for GDs, body language and guidelines for group discussion.

**Interview Skills:** Purpose, types of interviews, preparing for the interview, attending the interview, interview process, employers expectations, general etiquettes.

**[T1,T2][No. of Hrs. 07]**

**Text Books:**

[T1] Anna Dept. Of English. Mindscapes: English for Technologists & Engineers PB. New Delhi: Orient Blackswan.

[T2] Farhathullah, T. M. Communication Skills for Technical Students. Orient Blackswan, 2002.

**References Books:**

[R1] Masters, Ann and Harold R. Wallace. Personal Development for Life and Work, 10th Edition.Cengage Learning India, 2012.

[R2] Institute of Electrical and Electronics Engineers. IEEE Editorial Style Manual. IEEE, n.d. Web. 9 Sept. 2009.

[R3] Sethi and Dhamija. A Course in Phonetics and Spoken English. PHI Learning, 1999.

[R4] Khera, Shiv. You Can Win. New York: Macmillan, 2003.

## MACHINE ELEMENT DESIGN

| | | | |
|---|---|---|---|
| **Paper Code: ETMT-303** | **L** | **T/P** | **C** |
| **Paper: Machine Element Design** | **3** | **1** | **4** |

**INSTRUCTIONS TO PAPER SETTERS:** **MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks.

***Objectives:*** *The primary objective of this course is to demonstrate how engineering design uses the many principles learned in previous engineering science courses and to show how these principles are practically applied. The emphasis in this course is on machine design: the design and creation of devices that consist of interrelated components used to modify force and/or motion.*

**UNIT– I**

**Introduction:** Principles of mechanical design, systematic design process, aesthetic and ergonomic considerations in design, use of standards in design. Manufacturing consideration in design, casting, machining, forging, Dynamic and fluctuating stresses, fatigue failure and endurance limit, stress concentration, causes and remedies in design. Factor of safety Tolerances and types of fits as per BIS Selection of materials, designation of steels .Design of Cotter and knuckle joints.

**[T1,T2][No. of Hrs.10]**

**UNIT - II**

**Design of Elements**: screwed fastenings, bolted and riveted joints under direct and eccentric loads, initial tightening loads in bolts. Welded joints, strength of welded joints, eccentrically loaded joints, welded joints subjected to bending moment and torsion.

**Translation screws**: force analysis and design of various types of power screws,: screw jack, C- clamp, toggle screw jack.

**[T1,T2][No. of Hrs.10]**

**UNIT - III**

Shafts, keys and couplings –design of rigid and pin bushed flexible couplings. Levers design Springs, uses and design of close coiled helical springs shot peening of springs.

**[T1,T2][No. of Hrs. 12]**

**UNIT – IV**

Classification of Gears, spur gears, Lewis equation, subjected to dynamic and wear loads, gear failures.
Bearings - types of sliding bearing, design of sliding bearing using McKee's equation; types of lubrication
Types of Ball & Roller Bearings- selection of bearings from manufacturer's catalogue based on static & dynamic load carrying capacity, load-life relationships.

**[T1,T2][No. of Hrs. 12]**

**Text Books:**

**[T1]** Maleeve Hartman and O.P.Grover, "Machine Design", CBS Publication & Publishers
**[T2]** V.B. Bhandari, "Machine Design", Tata McGraw Hill

**Reference Book:**

**[R1]** Mahadevan, "Design Data Book", CBS Publishers & Distributors
**[R2]** J.E. Shigley & C.R. Mischke, "Mechanical Engineering Design", Tata McGraw Hill Co.Inc.
**[R3]** P.C. Sharma and D.K Aggarwal., "Machine Design", S.K. Kataria & Sons
**[R4]** Juvinal R C, Marshek K M, " Fundamentals of Machine component Design", Wiley India
**[R5]** Norton R. l. "Machine Design" Pearson

## METROLOGY AND QUALITY CONTROL

| **Paper Code: ETMT-305** | **L** | **T/P** | **C** |
|---|---|---|---|
| **Paper: Metrology and Quality Control** | **3** | **1** | **4** |

**INSTRUCTIONS TO PAPER SETTERS:** **MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks.

*Objective: The objective of the paper is to facilitate the student with techniques being adopted in industry for inspection and quality checks.*

**UNIT- I**

**Principles of measurement**: Definition of Metrology, difference between precision and accuracy. Sources of errors: Controllable and Random Errors, Effects of Environment and Temperature, Effects of support, alignment errors, errors in measurement of a quality which is function of other variables. Introduction to Coordinate Measuring Machine (**CMM**).

**Length Standards:** Line standards, end standards and wavelength standards, transfer from line standards to end standards. Numerical based on line standards. Slip gauges – its use and care, methods of building different heights using different sets of slip gauges.

**Limits, fits and Tolerances**: Different types of fits and methods to provide these fits. Numerical to calculate the limits, fits and tolerances as per IS 919-1963. ISO system of limits and fits; Gauges and its types, limit gauges – plug and ring gauges. Gauge Design – Taylor's Principle, wear allowance on gauges. Different methods of giving tolerances on gauges.

**[T1, T2][No. of Hrs. 12]**

**UNIT–II**

**Types of Inspection:-**Inspection by Gauging: limit gauging, plug gauges, Ring gauges, position gauges Inspection by Measurement: Direct measurement such as Vernier Caliper, Vernier Height gauge, Vernier Depth gauge Outside Micrometer, Inside Micrometer, Depth Micrometer, Slip gauges (gauge blocks), length bars , Bevel protractor etc. Indirect Measurement such as Mechanical, optical, & pneumatic comparators, Angular Measurements- Sine bar, angle gauges, precision levels, Introduction to Autocollimator, Interferometers, NPL Flatness Interferometer etc.

**[T1, T2][No. of Hrs. 11]**

**UNIT-III**

**Straightness and flatness**: Feature inspection such as flatness, roundness, straightness, parallelism, etc. Surface texture, different types of irregularities, Measurement of various surface roughness parameters. Tomlinson surface meter, Taylor-Hobson talysurf.

**Screw Thread Measurement**: Error in threads, Measurement of elements of screw threads –major dia, minor dia, pitch, flank angle and effective diameter. Various thread gauges.

**Gear Measurement**: Gear terminology, measurement of gear thickness, Gear tooth vernier caliper Parkinson gear tester.

**[T1, T2][ No. of Hrs. 11]**

**UNIT – IV**

**Introduction to Quality Assurance:** Need of quality, Aspects of quality, Quality specification, Quality function Shewhart's control charts for variables: X bar and R charts, operating characteristics curves, producer's risk, consumer's risk, Sampling inspection , single double and multiple sampling plan.

**[T3][ No. of Hrs. 10]**

**Text Books**:

[T1] R.K. Jain, "Engineering Metrology", Khanna Publishers, Delhi
[T2] I.C. Gupta, "Engineering Metrology", Dhanpat Rai Publications, Delhi
[T3] EL Grant & RS Leavenworth, "Statistical Quality Control", McGraw Hill & Co, 1988.

**Reference Books:**

[R1] F.W. Galyer & C.R. Shotbolt, "Metrology for Engineers", ELBS Edition
[R2] Beckwith, Buck, Lienhard, Mechanical Measurements, Pearson Education Asia.
[R3] Anand K Bewoor, Vinay A Kulkarni "Metrology and Measurement", TMH

## DIGITAL SIGNAL PROCESSING

| **Paper Code: ETMT-307** | **L** | **T/P** | **C** |
|---|---|---|---|
| **Paper: Digital Signal Processing** | **3** | **1** | **4** |

**INSTRUCTIONS TO PAPER SETTERS:** **MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks.

***Objectives:*** *The aim of this course is to provide in depth knowledge of various digital signal processing techniques and design of digital filters, learn the concept of DFT FFT algorithms, and design of digital filters using different approximations, DSP processor and architecture.*

**UNIT–I :**

**Frequency Domain Sampling:** The Discrete Fourier Transform, Properties of the DFT, Linear filtering methods based of the DFT.

**Efficient computation of the DFT:** Principal Of FFT, Fast Fourier Transform Algorithms, Applications of FFT Algorithms, A linear filtering approach to computation of the DFT.

Application of DFT, Design of Notch filter

**[T2,T1][No. of Hours: 11]**

**Unit–II :**

**Design & Structure of IIR filters from analog filters:** Impulse Invariance; Bilinear transformation and its use in design of Butterworth and Chebyshev IIR Filters; Frequency transformation in Digital Domain, Direct, Cascade, Parallel & transposed structure

**Design & structure of FIR filters:** Symmetric and anti-symmetric FIR filters; Design of Linear Phase FIR filters using windows, Frequency Sampling Method of FIR design, Direct, Cascade, Frequency Sampling, transposed structure

**[T1,T2] [No. of Hours: 11]**

**Unit–III:**

**Implementation of Discrete Time Systems:**

Lattice structures, Lattice and Lattice-Ladder Structures, Schur - Cohn stability Test for IIR filters; Discrete Hilbert Transform.

**Linear predictive Coding:**

Lattice filter design, Levension Darwin Technique, Schur Algorithm

**[T1,T2] [No. of Hours: 10]**

**Unit–IV:**

**Quantization Errors in Digital Signal Processing**: Representation of numbers, Quantization of filter coefficients, Round-off Effects in digital filters.

**Multirate Digital Signal Processing**: Decimation, Interpolation, Sampling rate conversion by a rational factor; Frequency domain characterization of Interpolator and Decimator; Polyphase decomposition.

**[T1, T2][No. of Hours: 10]**

**Text Books:**

[T1] Oppenheim & Schafer, Digital Signal Processing, PHI-latest edition.
[T2] Proakis and Manolakis, Digital Signal Processing, PHI Publication

**Reference Books:**

[R1] S. K. Mitra, Digital Signal Processing, TMH edition 2006
[R2] Johny. R. Johnson, Introduction to Digital Signal Processing, PHI-latest edition
[R3] R.Babu ,Digital Signal Processing , Scitech Publication.

## SENSORS AND TRANSDUCERS

| **Paper Code: ETMT-309** | **L** | **T/P** | **C** |
|---|---|---|---|
| **Paper: Sensors and Transducers** | **3** | **1** | **4** |

**INSTRUCTIONS TO PAPER SETTERS:** **MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks.

***Objective:*** *To provide the basic understanding about operational characteristics and applications of various sensors and transducers.*

**UNIT I**

**Introduction to Sensors:**

Definition and differences of sensors and transducers, Classification, static and dynamic characteristics, electrical characterization, mechanical and thermal characterization including bath-tub curve.

**Different Sensors:**

Mechanical & Electromechanical: Potentiometer, Strain gauges, Inductive sensors—Ferromagnetic type, Transformer type, Electromagnetic, Capacitive sensors— parallel plate, variable permittivity, electrostatic, piezoelectric, Introduction to PZT family

**[T1][T2] [No of Hrs 10]**

**UNIT-II**

**Thermal sensors:** Gas thermometric sensors, Dielectric constant, refractive index thermo-sensors, nuclear thermometers, resistance change type thermometric sensors, Thermoemf sensors.

**Magnetic sensors:** Basic working principles, Magnetostrictive, Hall effect, Eddy current type, SQUID sensors.

**Radiation sensors:** Photo-detectors, Photo-emissive, photomultiplier, scintillation detectors.

**[T1][T2] [No of Hrs 11]**

**UNIT-III**

**Electroanalytical sensors:** Electrochemical cell, SHE, Polarization, Reference electrode, Metal electrodes, Membrane electrodes, Electroceramics.

Advancement in Sensor technology: Introduction to smart sensors, Film sensors, Introduction to semiconductor IC technology and Micro Electro Mechanical System(MEMS ), Nano-sensors. Bio-Sensors.

**[T1][T2] [No of Hrs 11]**

**UNIT-IV**

**Different Transducers:**

LVDT, RTD, Thermistor, Wire anemometer, piezoresistors, Variable diaphragm capacitance transducers, Angular movement transducers, seismic mass transducer, interferometer transducer.

Feedback transducer system: Inverse transducer, Self-balancing transducer, Servo-operated manometer, Feedback pneumatic load cell, integrating servo.

**[T1][T2] [No of Hrs 12]**

**Text Books:**

[T1] D. Patranabis, "Sensors and Transducers", PHI Learning Pvt. Ltd., 2nd edition
[T2] D V S Murty, "Transducers and Instrumentation", PHI Learning Pvt. Ltd.

**Reference Book:**

[R1] E.O.Doebelin,Dhanesh N Manik, "Measurement Systems",6th Edition,Mcgraw Hill Edu.
[R2] John P. Bentely, "Principles of Measurement System", 4th Edition, Pearson Prentice Hall

## POWER ELECTRONICS AND DRIVES

| | | | |
|---|---|---|---|
| **Paper Code: ETMT-311** | **L** | **T/P** | **C** |
| **Paper: Power Electronics and Drives** | **3** | **0** | **3** |

**INSTRUCTIONS TO PAPER SETTERS:** **MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks.

*Objective: The objective of the paper is to facilitate the student with the basics of Power Electronics that are required for an engineering student.*

**UNIT- I**

**Introduction :** Characteristics and switching behaviour of Power Diode, SCR, UJT, TRIAC, DIAC, GTO, MOSFET, IGBT, MCT and power BJT, two-transistor analogy of SCR, firing circuits of SCR and TRIAC, SCR gate characteristics, SCR ratings. Protection of SCR against over current, over voltage, high dV/dt, high dI/dt, thermal protection, Snubber circuits, Methods of commutation, series and parallel operation of SCR, Driver circuits for BJT/MOSFET.

**[T1][No. of Hrs. 11]**

**UNIT- II**

**A.C. to D.C. Converter:** Classification of rectifiers, phase controlled rectifiers, fully controlled and half controlled rectifiers and their performance parameters, .three phase half wave, full wave and half controlled rectifiers and their performance parameters, effect of source impedance on the performance of single phase and three phase controlled rectifiers, single-phase and three phase dual converter.

**[T1][T2][No. of Hrs. 11]**

**UNIT- III**

**Dynamics of Electric Drives:** Types of loads, quadrant diagram of speed time characteristics, Basic and modified characteristics of dc and ac motors, equalization of load, steady state stability, calculation of time and energy loss, control of electric drives, modes of operation, speed control and drive classifications, closed loop control of drives, selection of motor power rating, class of duty, thermal considerations.

**[T1][T2][No. of Hrs. 11]**

**UNIT- IV**

**DC Motor Drives:** DC motor speed control, Methods of armature control, field weakening, semiconductor controlled drives, starting, braking, transient analysis, controlled rectifier fed dc drives, chopper controlled dc drives.

**[T1][T2] [No. of Hrs. 11]**

**Text:**

[T1] M.H. Rashid, "Power Electronics: Circuits, Devices and Applications" Pearson Publications.
[T2] Daniel W. Hart, "Power Electronics "Tata McGraw-Hill

**References**:

[R1] Singh, Kanchandani, "Power Electronics", Tata McGraw-Hill.
[R2] Ned Mohan, Tore M. Undeland and Robbins, "Power Electronics: Converters, Applications and Design" Wiley India Publication
[R3] V R Moorthi, "Power Electronics: Devices, Circuits and Industrial Applications", Oxford Publication.
[R4] Kassakian, Schlecht, Verghese, "Principles of Power Electronics" , Pearson Publications
[R5] M.S. Jamil Asghar, "Power Electronics" PHI Publication
[R6] P. S. Bimbhra "Power Electronics", Khanna Publishing.

## COMMUNICATION SKILLS FOR PROFESSIONALS LAB

| **Paper Code: ETHS-351** | **L** | **T/P** | **C** |
|---|---|---|---|
| **Paper: Communication Skills for Professionals Lab** | **0** | **2** | **1** |

***Objective:*** *To develop communication competence in prospective engineers so that they are able to communicate information as well as their thoughts and ideas with clarity and precision .These activities will enhance students' communication skills with a focus on improving their oral communication both in formal and informal situations. They will develop confidence in facing interviews and participating in group discussions which have become an integral part of placement procedures of most business organisations today.*

**Lab Activities to be conducted:**

1. **Listening and Comprehension Activities** – Listening to selected lectures, seminars, news (BBC, CNN, etc.). Writing a brief summary or answering questions on the material listened to.
2. **Reading Activities** -- Reading different types of texts for different purposes with focus on the sound structure and intonation patterns of English. Emphasis on correct pronunciation.
3. **Conversation Activities**-- Effective Conversation Skills; Formal/Informal Conversation; Addressing higher officials, colleagues, subordinates, a public gathering; Participating in a video conference.
4. **Making an Oral Presentation**–Planning and preparing a model presentation; Organizing the presentation to suit the audience and context; Connecting with the audience during presentation; Projecting a positive image while speaking; Emphasis on effective body language.
5. **Making a Power Point Presentation** -- Structure and format; Covering elements of an effective presentation; Body language dynamics.
6. **Making a Speech** -- Basics of public speaking; Preparing for a speech; Features of a good speech; Speaking with a microphone. Famous speeches may be played as model speeches for learning the art of public speaking. Some suggested speeches: Barack Obama, John F Kennedy, Nelson Mandela, Mahatma Gandhi, Jawahar Lal Nehru, Atal Bihari Vajpayee, Subhash Chandra Bose, Winston Churchill, Martin Luther King Jr.
7. **Participating in a Group Discussion** -- Structure and dynamics of a GD; Techniques of effective participation in group discussion; Preparing for group discussion; Accepting others' views / ideas; Arguing against others' views or ideas, etc.
8. **Participating in Mock Interviews** -- Job Interviews: purpose and process; How to prepare for an interview; Language and style to be used in an interview; Types of interview questions and how to answer them.

**Suggested Lab Activities:**

1. Interview through telephone/video-conferencing
2. Extempore, Story Telling, Poetry Recitation
3. Mock Situations and Role Play; Enacting a short skit
4. Debate (Developing an Argument), News Reading and Anchoring.

**Reference Books:**


1. Patnaik, Priyadarshi. *Group Discussion and Interview Skills*: *With VCD*. Cambridge University Press India (Foundation Books), 2012 edition.
2. Kaul,Asha. *Business Communication.* PHI Learning: 2009.
3. Hartman and Lemay. *Presentation Success: A Step-by-Step Approach*. Thomson Learning, 2000.


**Note:** The Communication Skills Lab should be equipped with computers, microphones, an internet connection, overhead projector, screen, sound system, audio/video recording facilities, and seating arrangement for GDs and mock interviews. The student activities may be recorded and students may replay them to analyse and improve their pronunciation, tone, expressions, body language, etc.

Traditional language lab softwares are not mandatory and may be used by students to practice and enhance their language competence. Such softwares are usually elementary in nature and are mostly based on British/American English (pronunciation, accent and expression). They should preferably be in Indian English.

## METROLOGY AND QUALITY CONTROL LAB

| | | | |
|---|---|---|---|
| **Paper Code: ETMT-353** | **L** | **T/P** | **C** |
| **Paper: Metrology and Quality Control Lab** | **0** | **2** | **1** |

**List of Experiments:**

1. Study & working of simple measuring instruments- Vernier calipers, micrometer, tachometer.
2. Measurement of effective diameter of a screw thread using 3 wire method.
3. Measurement of angle using sine bar & slip gauges. Study of limit gauges.
4. Study of angular measurement using level protector.
5. Adjustment of spark plug gap using feeler gauges.
6. Study of dial indicator & its constructional details.
7. Use of dial indicator to check a shape run use.
8. Study and understanding of limits, fits & tolerances
9. Study of Pressure and Temperature measuring equipment.
10. Speed measurement using stroboscope.
11. Flow measurement experiment
12. Vibration/work measuring experiment.
13. Determination of linear / Angular dimensions of a part using any other precision / non-precision measuring instruments.
14. Precision Angular measurement using Autocollimator / Angle Dekkor.
15. Machine Tool Alignment Test on any machine like-Lathe, Milling, Drilling.
16. Measurement of Screw Thread using Floating Carriage Micrometer.
17. Measurement of Gear Tooth Thickness by Gear Tooth vernier caliper/Constant Chord /Span Micrometer.
18. Measurement of Circularity / Roundness using Mechanical Comparator.
19. Calibration of Dial gauge using dial gauge Tester.
20. Study of Surfaces using optical flat.
21. Study and applications of profile projector and Tool Makers microscope.
22. Inspection of Production Job by statistical Process Control.

**NOTE: At least 8 Experiments out of the list must be done in the semester.**

## DIGITAL SIGNAL PROCESSING LAB

| **Paper Code: ETMT-355** | **L** | **T/P** | **C** |
|---|---|---|---|
| **Paper: Digital Signal Processing Lab** | **0** | **2** | **1** |

**List of Experiments:**

**Software Experiments:**

1. Generation of basic signals sine, cosine, ramp, step, impulse and exponential in continuous and discrete domains using user defined functions.
2. Write a MATLAB program to find convolution (linear/circular) and correlation of two discrete signals.
3. Perform linear convolution using circular convolution and vice versa.
4. Write a MATLAB program to
   a. Find 8 point DFT, its magnitude and phase plot and inverse DFT.
   b. Find 16 point DFT, its magnitude and phase plot and inverse DFT.
5. Perform the following properties of DFT-
   a. Circular shift of a sequence.
   b. Circular fold of a sequence.
6. Write a MATLAB Program to design FIR Low pass filter using
   a. Rectangular window
   b. Hanning window
   c. Hamming window
   d. Bartlett window
7. Write a MATLAB program to
   a. Implement a Low pass / High pass / Band pass / Band stop IIR Filter using Butterworth Approximation.
   b. Implement a Low pass / High pass / Band pass / Band stop IIR Filter using Chebyshev Approximation.

**Hardware Experiments using Texas Instruments Kits-DSK 6713:**

8. Introduction to Code composer Studio.
9. Write a program to generate a sine wave and see the output on CRO
10. Write a Program to Generate ECHO to give audio file.
11. Write a program to demonstrate Band Stop filter by FIR.

**Additional Experiments:**

12. Write a program to generate a cos wave and see the output on CRO
13. Write a program to blink the LED
14. Write a program to display a string on LCD.

**NOTE: At least 8 Experiments out of the list must be done in the semester.**

## SENSORS AND TRANSDUCERS LAB

| **Paper Code: ETMT-357** | **L** | **T/P** | **C** |
|---|---|---|---|
| **Paper: Sensors and Transducers Lab** | **0** | **2** | **1** |

**List of Experiments:**

1. Study of various sensors e.g. thermocouple, RTD, thermistor, magnetic sensorns, load cells,film sensors.
2. Characteristics of (Resistive and Thermo emf) temperature sensor
3. Measurement of displacement using LVDT
4. Measurement of strain and torque using strain gauges
5. Measurement of speed using photoelectric sensors, tachogenerators and stroboscope.
6. Calibaration and measurement of temperature using PRT.
7. Static and Dynamic Characteristics of sensors.
8. Liquid level measurement using capacitive measurement system.
9. Pressure measurement using load cell.
10. Study and operation of Electrochemical Cell.

**NOTE: At least 8 Experiments out of the list must be done in the semester.**

## POWER ELECTRONICS AND DRIVES LAB

| | | | |
|---|---|---|---|
| **Paper Code: ETMT-359** | **L** | **T/P** | **C** |
| **Paper: Power Electronics And Drives Lab** | **0** | **2** | **1** |

**List of Experiments:**

1. To study and analyze V-I characteristics of SCR and TRIAC.
2. To study the switching characteristics of MOSFET and IGBT.
3. To study R and RC and UJT based firing circuits using SCR.
4. To study single phase Semi-converter and Full converters feeding R and RL load.
5. To study A.C phase control using SCR (half and full wave) using DIAC and TRIAC for dimmer application.
6. To study single-phase cyclo-converter feeding R and RL loads.
7. Load equalization by flywheel for intermittent duty loads.
8. Comparison of various braking methods and their range of braking for induction motor.
9. Open loop AC voltage Control of single phase capacitor run induction motor.
10. Verification of linear relationship between duty cycle vs speed in open loop step down chopper controlled DC motor drive.
11. Single phase thyristorised full converter fed closed loop speed control of DC motor drive.
12. Closed loop speed control of 4 quadrant DC motor drive.

**NOTE: At least 8 Experiments out of the list must be done in the semester.**

## MANAGEMENT OF MANUFACTURING SYSTEMS

| | | | |
|---|---|---|---|
| **Paper Code: ETMT-302** | **L** | **T/P** | **C** |
| **Paper: Management of Manufacturing systems** | **3** | **1** | **4** |

**INSTRUCTIONS TO PAPER SETTERS:** **MAXIMUM MARKS: 75**

**1**. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.

2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks

*Objective: The objective of the paper is to facilitate the student with problems and solutions in managing factory operations.*

**UNIT I:**

**Introduction:** Production functions, Management systems, production and productivity.

**Plant Organization:** Principles of organization, Organization structure-line and staff organization.

**Plant Location, Layout:** Process layout, product layout and combination – methods of layout, economics of layout; group technology.

**[T1,T2][No. of Hrs. 11]**

**UNIT II:**

**Production Planning & Control**: Types of products, demand, demand forecasting, marketing strategies, scheduling and control of scheduling production control.

**Method Study:** Definition and concepts, method study procedures, symbols, advantages, Operation process chart, Flow process charts, Two hand process chart, Motion study, micro motion, SIMO charts, Systems Concepts, Classification analysis techniques, Principle of motion economics.

**Work Measurement**: Definition, objectives & techniques, Time study equipment, performance rating, allowances, standard time, work sampling, PMTS.

**[T1,T2][No. of Hrs. 11]**

**UNIT III:**

**Industrial Maintenance:** Types, organization for maintenance department, Breakdown and preventive maintenance and corrective maintenance.

**Inventory control and replacement analysis:** Introduction replacement policy and method adopted, EOQ.

**[T1,T2][No. of Hrs. 11]**

**UNIT IV:**

**Management Concepts:** Development of management principles, scientific management, human relation aspects.

**Production Cost Concepts**: Introduction, cost of production, cost centre and unit,
Classification and analysis of cost, break Even Analysis.

**[T1,T2][No. of Hrs. 11]**

**Text Books:**

[T1] Ravi Shankar, "Industrial Engg. & Management", Galgotia Publications
[T2] S.K. Sharma, "Industrial Engg. & Operation Management", S.K. Kataria & Sons.

**Reference Book**:

[R1] Joseph S. Martinich, "Production & Operation Management", John Wiley & Sons.
[R2] S. N. Chary," Production and operations management, TMH 4th edition
[R3] Harold T. Amrine, John A. Ritchey, Colin L. Moodie, Joseph F. Kmec "Manufacturing organization and Management" Pearson publication 6th edition
[R4] S. Anil Kumar, N. Suresh "Production and operations management", New age International, 2nd Ed.
[R5] M. Mahajan, "Industrial Engg. & Production Management", Dhanpat Rai & Co.

## MANUFACTURING TECHNOLOGY

| | | | |
|---|---|---|---|
| **Paper Code: ETMT-304** | **L** | **T/P** | **C** |
| **Paper: Manufacturing Technology** | **3** | **1** | **4** |

**INSTRUCTIONS TO PAPER SETTERS:** **MAXIMUM MARKS: 75**

**1**. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.

2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks

*Objective: The objective of the paper is to facilitate the student with conventional techniques being used in industry for production purposes.*

**UNIT - I**

**Moulding:** Introduction to sand moulding, Pattern design, Pattern layout and construction, testing of moulding sand. moulding and core making machines, $CO_2$ - Process, fluid sand process, shell moulding, cold curing process, hot-box method, flask less moulding, Design of metal moulds, Die Design for die Casting.

**[T1] [No. of Hrs: 10]**

**UNIT - II**

**Casting:** Directional principles, Solidification, types of gating systems, Pouring time and temperature. Design criteria of pouring basin, sprue, runner, gate and riser, gating ratio- related numerical problems, Use of chaplet, chills and padding, Selection of melting furnaces, Crucible furnaces, Electric furnaces, Induction furnace, Control of melt and Cupola charge calculations. Foundry mechanization and layout.

**[T1,T2] [No. of Hrs: 10]**

**UNIT - III**

**Welding:** Principle, advantages, limitations and applications, Tungsten Inert Gas welding, Metal Inert Gas welding, Electro - slag welding, Electro - Gas Welding, Explosive Welding, Ultrasonic Welding, Electron Bean Welding, Laser Beam Welding, Friction Welding, Cold Welding, Thermit Welding. Welding Defects-causes and remedies. Numerical problems on electric arc welding and resistance welding.

**[T1,T2][No. of Hrs: 11]**

**UNIT - IV**

**Metal Forming:** Introduction to Metal Forming, Elastic & plastic deformation, Hot working and cold working. Work required for forging, Hand, Power, Drop forging.

Analysis of wire drawing and maximum reduction. Tube drawing, Extrusion, types and its application. Rolling process, rolling mills & rolled-sections. Defects in metal forming processes. Sheet metal processes, shearing, calculation of punch force, shearing dies, stretch forming, Deep drawing and its analysis.

**[T1,T2] [No. of Hrs: 11]**

**Text Books**:

[T1] Manufacturing processes Vol. 1, by H.S. Shan, Pearson Education
[T2] Manufacturing Engineering & Technology by Kalpakjian, Pearson Publication

**Reference Books**:

[R1] Mikell P. Groover" Principles of Modern Manufacturing, 5th Edition SI Version , Wiley
[R2] Jain P.L., "Principles of Foundry Technology", Tata McGraw Hill, New Delhi, 1998.
[R3] Sharma P.C., "A Text Book of Production Engineering", Vol.1, S. Chand Publication, New Delhi, 2001.
[R4] Heine & Rosenthal, "Principle of Metal Casting", Tata McGraw Hills, New Delhi, 2003.
[R5] Little Richard L, "Welding & Welding Technology", Tata McGraw Hill, New Delhi, 2003.
[R6] Jain, R.K., "Production Technology", Khanna Publishers, 2001.
[R7] HMT Bangalore, "Production Technology", Tata McGraw Hill, 1980.
[R8] A.K. Chakrabarti "Casting Technology and cast alloys" 2011, PHI learning

## PROGRAMMABLE LOGIC CONTROLLER & SCADA

| | | | |
|---|---|---|---|
| **Paper Code: ETMT-306** | **L** | **T/P** | **C** |
| **Paper: Programmable Logic Controller & SCADA** | **3** | **1** | **4** |

**INSTRUCTIONS TO PAPER SETTERS:** **MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks.

*Objective: The objective of this paper is to introduce the students about the knowledge of programmable logic controller, principles of PLC and functions and SCADA and its elements and functions.*

**UNIT-I**

**Programmable Logic Controller (PLC) Basics**: Introduction, Parts of PLC, Principles of operation, PLC size and applications, PLC Advantages and Disadvantages, PLC Manufacturers, PLC hardware components, I/O section, Analog I/O modules, Digital I/O modules, CPU- Processor memory module, Programming devices, Devices which can be connected to I/O modules, Relay, Contactor, SPST, Push Buttons, NO/NC Concept

**[T1,T2] [No of Hrs 10]**

**UNIT-II**

**Programming of Programmable Logic Controller**: General PLC Programming Procedures, Contacts and Coils, Program SCAN, Programming Languages, Ladder Programming, Relay Instructions, Instruction Addressing, Concept of Latching, Branch Instructions, Contact and Coil I/O Programming Examples, Relation of Digital Gate Logic to Contact/Coil Logic.

**[T1,T2] [No of Hrs 12]**

**UNIT-III**

**Programmable Logic controller Functions:** Timer Instructions: ON DEAY Timer and OFF DELAY timer, Counter Instructions: UP/DOWN Counters, Timer and Counter Applications, Program Control Instructions: Master Control Reset, Jump and Subroutine,

Math Instructions- ADD, SUB. Data Handling: Data Move, Data Compare, Data Selection, Electro-pneumatic Sequential Circuits and Applications.

**[T1,T2] [No of Hrs 12]**

**UNIT-IV**

**SCADA:** Definition of SCADA, Applicable Processes, Elements of SCADA System, A Limited Two-Way System. Real Time Systems: Communication Access and Master-Slave determining scan interval. Introduction to Remote Control, Communications-A/D Conversion, Long Distance Communication, Communication System components in brief- Protocol, Modems, Synchronous/Asynchronous telephone cable/radio, Half Duplex, Full Duplex System, Brief introduction to RTU and MTU, Applications-Automatic Control, Advisory Applications.

**[R1] [No of Hrs 10]**

**Text Books:**

[T1] Frank D. Petruzella "Programmable Logic Controllers", McGraw-Hill Book Company.
[T2] John w. Webb and Ronald A. Reis, "Programmable Logic Controllers", PHI

**Reference Books:**

[R1] Stuart A.Boyer "Supervisors Control and Data Acquisition", ISA
[R2] William I. Fletcher "An Engineering Approach to Digital Design", PHI.
[R3] Simpson, Colin "Programmable Logic Controllers", Englewood Cliffs NJ PHI.
[R4] Gray Dunning, "Introduction to Programmable Logic Controllers", Delmar Thompson Learning
[R5] Stenerson, John "Fundamentals Logic Controllers Sensors, & Communications", Englewood Cliffs, NJ, 1993. Prentice Hall.
[R6] Programmable Logic Controllers, W.Bolton, Elsevier

## COMPUTER INTEGRATED MANUFACTURING

| | | | |
|---|---|---|---|
| **Paper Code: ETMT-308** | **L** | **T/P** | **C** |
| **Paper: COMPUTER INTEGRATED MANUFACTURING** | **3** | **1** | **4** |

**INSTRUCTIONS TO PAPER SETTERS:** **MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks.

*Objective: To study of application of CNC in Manufacturing & Computers in planning and scheduling in Manufacturing***.**

**UNIT-1**

**An overview of CNC machines**:

Need, benefits & limitations, classification of CNC machines, Constructional features of CNC machines, Design considerations of CNC machine tools, elements of CNC machine & systems, precision measuring & positioning of CNC, Function of MCU, Machining centre, Turning centre, CNC EDM, Ball screw, Bearings, Centralized lubrication systems.

**Manual part programming** - preparatory, miscellaneous functions- Fanuc, Sinumeric, Hass controls. Linear interpolation, circular interpolation, canned cycles, cycles of threading & grooving operations, tool compensation, sub-program, main program, part programming structure, work co-ordinate system, absolute & incremental commands, feed, program zero point , co-ordinate system, process planning & flow chart for part programming, scaling, rotating, mirroring, copy & special cycles for CNC lathe and milling.

**[T1][T2][T3][No. of Hrs 10]**

**UNIT- II**

**Functions and Components of CIM System:** Concept of CAD/CAM and CIMS; Software Technology for CIM System: Business Database System: File processing, Data Processing and Database Design, File Organization and Relational Analysis; Decision Support System, Personal / Distributed Computing and Local Area Network.

**Tooling for CNC machine:** introduction, cutting tool materials, types of cutting tools for NC machines, tool selection, ISO specification of cutting tools, different clamping system in tool holders, tooling for milling, angle plates, CNC vices, work holding devices, clamps, rotary tables.

**[T1] [T2] [T3][No. of Hrs 12]**

**UNIT-III**

**Planning and Scheduling Functions in CIM System:**

Aggregate Production Planning (APP), Master Production Schedule (MPS), Material Requirement Planning (MRP), Capacity Requirement Planning (CRP), Manufacturing Resource Planning (MRPII), Just-In-time Production Systems and Concept of Enterprise Resource Planning (ERP). CNC Program generation from CAD, CNC controller & motion control in CNC system. Application of CNC and recent advances in CNC machines, maintenance of CNC machine tools, CNC trainer, DNC.

**[T1][T2][T3][No. of Hrs 10]**

**UNIT-IV**

**Computer-Aided Process Planning:**

Approaches – Variant and Generative, Feature Classification and Recognition; Process Classifications and Selections, Machines and Tool Selection, Setting Process Parameters, Process Sheet Documentation. Programming;

**Automated Material Handling Systems and Advanced Manufacturing Systems:**

Industrial Robots, Conveyors, AGVs, Automatic Storage and Retrieval Systems**;** Lean Manufacturing Systems, Agile Manufacturing Systems, Reconfigurable Manufacturing Systems, Holonic Manufacturing Systems and Agent-Based Manufacturing Systems. Programming.

**[T1][T2][T3][No. of Hrs 10]**

**Text Books:**

[T1] T.K. Kundra, P. N.Rao & N.K.Tiwari, "Numerical Control and Computer Aided Manufacturing", TMH

[T2] Mikell P. Groover, "Automation, Production Systems and Computer- Integrated Manufacturing", 2nd Edition, Prentice Hall, 2001.

[T3] S.K. Sinha, "CNC Programming", Galgotia Publications 2003.

**Reference Books:**

[R1] P. Radhakrishnan, "Computer Numerical Control Machine & Computer Aided Manufacturing", New Academic Science Limited.

[R2] U.Rembold, "Computer Integrated Manufacturing and Engineering", Addison Wesley Publishers, 1993 edition

[R3] S. Kant Vajpayee, "Principles of Computer Integrated Manufacturing", PHI Learning Private Limited, New Delhi, 2012

[R4] M. Adithan, B.S. Pabla, "CNC Machines", New Age

[R5] Binit Kumar Jha, "CNC programming made Easy", Vikas Publications

## AUTOMOTIVE ELECTRONICS

| | | | |
|---|---|---|---|
| **Paper Code: ETMT-310** | **L** | **T/P** | **C** |
| **Paper: Automotive Electronics** | **3** | **1** | **4** |

**INSTRUCTIONS TO PAPER SETTERS:** **MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks.

*Objective: To study about the automotive engineering, basic and electrical systems, automotive components, sensor, controls, monitoring and diagnostics.*

**UNIT- I**

**FUNDAMENTALS OF AUTOMOTIVE ELECTRONICS**

Introduction to Automobile Engineering, Basic automotive system, Electrical systems, Evolution of electronics in automotive, Automotive Control Systems, Components for Electronic Engine Management, Electronic management of chassis system, Current trends in Automobiles.

**[T1,T2] [No. of Hrs 10]**

**UNIT - II**

**AUTOMOTIVE CONTROL SYSTEM APPLICATIONS OF SENSORS AND ACTUATORS**: Introduction, Basic sensor arrangement, Air flow rate sensor, Engine crankshaft angular position senor, Engine speed sensor, Timing sensor for ignition and fuel delivery, Throttle angle sensor, Pressure sensor, Temperature sensors, Exhaust gas oxygen sensors, Knock Sensor, Engine torque sensors, Automotive engine control actuators – Fuel injection, Exhaust gas recirculation actuator.

**[T1,T2][No of Hrs 11]**

**UNIT- III**

**AUTOMOTIVE ENGINE CONTROL SYSTEMS**: Engine Control Objectives, Spark Ignition Engines: Engine control functions, Engine control modes, Fuel delivery systems, MPFI, Ignition Systems, Diagnostics – Compression Ignition Engines – Emission control.

Automotive Transmission Control Systems : Transmission control, Cruise control system, Antilock braking system, Tire-slip controller, Traction control, Electronic Suspension system, Steering control, Stability control, Integrated engine control.

**[T1][No of Hrs 12]**

**UNIT- IV**

**AUTOMOTIVE MONITORING AND DIAGNOSTICS**: Electromagnetic Interference (EMI) Suppression, Electromagnetic Compatibility, Electronic Dashboard Instruments, Fundamentals of diagnostics, Diagnostics procedure and sequence, On board and off board Diagnostics in automotive, Security and warning Systems.

**[T1, T2][No of Hrs 11]**

**Text Books:**

[T1] William B.Ribbens, "Understanding Automotive, Elsevier.
[T2] Robert Bosch, Automotive Electronics Handbook, John Wiley and Sons.

**Reference Books:**

[R1] Tom Weather Jr and Cland C. Hunter, "Automotive Computers and Control System" Prentice Hall Inc., New Jersey.
[R2] Young A.P. and Griffths, L., Automobile Electrical Equipment "English Language Book Society and New Press.
[R3] Crouse, W.H. Automobile Electrical Equipment, McGraw Hill Book Co Inc., New York.
[R4] Robert N Brady, Automotive Computers and Digital Instrumentation, Areston Book Prentice Hall, Eagle Wood Cliffs, New Jersey..
[R5] R.K. Jurgen, Automotive Electronics Handbook, McGraw Hill 2nd Edition

## MICROPROCESSORS AND MICROCONTROLLERS

| | | | |
|---|---|---|---|
| **Paper Code: ETMT-312** | **L** | **T/P** | **C** |
| **Paper: Microprocessors and Microcontrollers** | **3** | **1** | **4** |

**INSTRUCTIONS TO PAPER SETTERS:** **MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks

*Objective: The objective of the paper is to facilitate the student with the knowledge of microprocessor systems and microcontroller.*

**UNIT- I**

**Introduction to Microprocessor Systems:** Architecture and PIN diagram of 8085, Timing Diagram, memory organization, Addressing modes, Interrupts. Assembly Language Programming.

**[T1][No. of hrs. 10]**

**UNIT- II**

**8086 Microprocessor:** 8086 Architecture, difference between 8085 and 8086 architecture, generation of physical address, PIN diagram of 8086, Minimum Mode and Maximum mode, Bus cycle, Memory Organization, Memory Interfacing, Addressing Modes, Assembler Directives, Instruction set of 8086, Assembly Language Programming, Hardware and Software Interrupts.

**[T2][No. of hrs. :12]**

**UNIT- III**

**Interfacing of 8086 with 8255, 8254/ 8253, 8251, 8259:** Introduction, Generation of I/O Ports, Programmable Peripheral Interface (PPI)-Intel 8255, Sample-and-Hold Circuit and Multiplexer, Keyboard and Display Interface, Keyboard and Display Controller (8279), Programmable Interval timers (Intel 8253/8254), USART (8251), PIC (8259), DAC, ADC, LCD, Stepper Motor.

**[T1][No. of hrs. :12]**

**UNIT-IV**

**Overview of Microcontroller 8051:** Introduction to 8051 Micro-controller, Architecture, Memory organization, Special function registers, Port Operation, Memory Interfacing, I/O Interfacing, Programming 8051 resources, interrupts, Programmer's model of 8051, Operand types, Operand addressing, Data transfer instructions, Arithmetic instructions, Logic instructions, Control transfer instructions, Timer & Counter Programming, Interrupt Programming.

**[T3][No. of hrs. 11]**

**Text Books:**

[T1] Muhammad Ali Mazidi, "Microprocessors and Microcontrollers", Pearson, 2006
[T2] Douglas V Hall, "Microprocessors and Interfacing, Programming and Hardware" Tata McGraw Hill, 2006.
[T3] Ramesh Gaonkar, "MicroProcessor Architecture, Programming and Applications with the 8085", PHI

**References Books:**

[R1] Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D. MCKinlay "The 8051 Microcontroller and Embedded Systems",2nd Edition, Pearson Education 2008.
[R2] Kenneth J. Ayala, "The 8086 Microprocessor: Programming & Interfacing The PC", Delmar Publishers, 2007.
[R3] A K Ray, K M Bhurchandi, "Advanced Microprocessors and Peripherals", Tata McGraw Hill, 2007.
[R4] Vaneet Singh, Gurmeet Singh, "Microprocessor and Interfacing", Satya Prakashan, 2007.

## PROGRAMMABLE LOGIC CONTROLLER & SCADA LAB

| | L | T/P | C |
|---|---|---|---|
| **Paper Code: ETMT-352** | | | |
| **Paper: Programmable Logic Controller & SCADA Lab** | **0** | **2** | **1** |

**Name of the Experiments**

1. To study about software components like contacts and coils.
2. Study of input and output of PLC with physical wiring.
3. To develop a ladder program for GO-DOWN Wiring and verify it on PLC using SPST Switches.
4. To develop a ladder program for STAIR-CASE Wiring and verify it on PLC using SPST Switches.
5. To develop a ladder program for START/STOP of a motor and verify it on PLC using Push Buttons.
6. To develop a ladder program for FORWARD/REVERSE of a motor and verify it on PLC using Push Buttons.
7. To study about software functional blocks like TIMERS and COUNTERS.
8. To develop a ladder program to generate a SQUARE WAVE and verify it on PLC using Timers.
9. To develop a ladder program to generate an RTC using timer and counter.
10. To develop a ladder program to generate a SEQUENTIAL SQUARE CYCLE(A+B+A-B-) for the movement of a piston using Mono-Stable and Bi-Stable Electro-Pneumatic valves.
11. PLC interfaced with SCADA and status read/ command transfer operation.
12. Parameter reading of PLC in SCADA.

**NOTE: At least 8 Experiments out of the list must be done in the semester.**

## COMPUTER INTEGRATED MANUFACTURING LAB

| | | | |
|---|---|---|---|
| **Paper Code: ETMT-354** | **L** | **T/P** | **C** |
| **Paper: Computer Integrated Manufacturing Lab** | **0** | **2** | **1** |

**List of Experiments:**

1. To study the characteristic features of CNC machine.
2. Part programming (in word address format) experiment for turning operation (including operations such as grooving and threading) and running on CNC machine.
3. Part programming (in word address format or ATP) experiment for drilling operation (point to point) and running on CNC machine.
4. Part programming (in word address format or ATP) experiment for milling operation (contouring) and running on CNC machine.
5. Experiment on Robot and programs.
6. Experiment on Transfer Line/Material Handling.
7. Experiment on difference between ordinary and NC machine, study or retrofitting.
8. Experiment on study of system devices such as motors and feedback devices.
9. Experiment on Mechatronics and Controls.

**NOTE: At least 8 Experiments out of the list must be done in the semester.**

## AUTOMOTIVE ELECTRONICS LAB

| | | | |
|---|---|---|---|
| **Paper Code: ETMT-356** | **L** | **T/P** | **C** |
| **Paper: Automotive Electronics Lab** | **0** | **2** | **1** |

**List of experiments:**

1. Study of automotive electrical system (Starting system, Ignition system, lighting system, wiring harness).
2. Study of SCR and IC timer.
3. Study of rectifiers and filters.
4. Study the function of solenoid switch and starting motors.
5. Study of different sensor used in modern automotive system.
6. Study of Electronic ignition system.
7. Study of Electronic fuel injection system.
8. Study the cruise control system.
9. Study of Electronic dash board instruments.
10. Study of security and warning system.

**NOTE: At least 8 Experiments out of the list must be done in the semester.**

## MICROPROCESSORS AND MICROCONTROLLERS LAB

| | L | T/P | C |
|---|---|---|---|
| **Paper Code: ETMT-358** | | | |
| **Paper: Microprocessors and Microcontrollers Lab** | **0** | **2** | **1** |

**List of Experiments:**

1. Write a program to add and subtract two 16-bit numbers with/ without carry using 8086.
2. Write a program to multiply two 8 bit numbers by repetitive addition method using 8086.
3. Write a Program to generate Fibonacci series.
4. Write a Program to generate Factorial of a number.
5. Write a Program to read 16 bit Data from a port and display the same in another port.
6. Write a Program to generate a square wave using 8254.
7. Write a Program to generate a square wave of 10 kHz using Timer 1 in mode 1(using 8051).
8. Write a Program to transfer data from external ROM to internal (using 8051).
9. Design a Minor project using 8086 Micro processor (Ex: Traffic light controller/temperature controller etc)
10. Design a Minor project using 8051 Micro controller

**NOTE: - At least 8 Experiments out of the list must be done in the semester.**

## COMPUTER AIDED DESIGN

| | | | |
|---|---|---|---|
| **Paper Code: ETAT-401** | **L** | **T/P** | **C** |
| **Paper: Computer Aided Design** | **3** | **1** | **4** |

**INSTRUCTIONS TO PAPER SETTERS:** **MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks.

*Objective: The objective of the paper is to introduce the students about the knowledge of CAD and CAD systems evaluation, 3D transformation, Curves and other geometric mapping and formulation.*

**UNIT- I**

**CAD: CAD Hardware:** Types of Systems, CAD Systems Evaluation Criteria, Input Devices, Output Devices; **CAD Software:** Standards, Basic Definitions – Data Structure, Database, DBMS, Database Coordinate System, Working Coordinate System, Screen Coordinate System, Modes of Operations, User Interface, Software Modules – OS Module, Applications Module, Programming Module, Communications Module, Modelling and Viewing.

**Mapping of Geometric Models:** Translation, Rotational, General, Changes of Coordinate System, Numerical problems.

**Three Dimensional Transformations:** Point representations, Transformation Matrices, Scaling, Translation, Rotation, Reflection.

**Projections:** Orthographic, Isometric, Perspective, Point at Infinity & Vanishing Point.

**[T1][T2][No. of Hrs: 11]**

**UNIT-II**

**Curves:** Representation of Space Curves, Cubic Spline, Normalized Cubic Splines, Bezier Curves, B-spline Curves, Numerical problems.

**Surface Generation:** Plane Surfaces, Ruled Surfaces, Surface of Revolution, Sweep Surface, Bezier Surface, Cubic Surface Patch, B-Spline Surface, Composite Surface, Numerical problem.

**[T1][T2][No. of Hrs: 11]**

**UNIT- III**

**Solid Modeling:** Set Theory, Boolean Operations, B-rep Modeling, CSG, Sweep Representations, Spatial Occupancy Enumeration Numerical problems.

**Geometric Property Formulation:** Curve Length, Surface Area, Volume Calculation, Mass Calculation, Centroid Calculation, Numerical problems.

**[T1][T2][No. of Hrs: 10]**

**UNIT-IV**

CAD/CAM Data Exchange: Introduction, IGES, PDS, Finite Element Methods: General Method for FEM, Finite Element Analysis, Numerical problems

**[T1][T2][No. of Hrs: 10]**

**Text Books:**

[T1] Ibrahim Zeid, "CAD/CAM Theory and Practice", Tata McGraw-Hill Publishing Company Limited. 2nd Edition.

[T2] David F. Rogers and J. Alan Adams, "Mathematical Elements for Computer Graphics, Prentice Hall India", Tata McGraw-Hill.

**Reference Book:**

[R1] Foley et. al., "Computer Graphics Principles & practice", Addison Wesley,1999.

[R2] Ibrahim Zeid, "Mastering CAD/CAM", Tata McGraw-Hill Publishing Company Limited.

## MICRO ELECTRO MECHANICAL SYSTEM & NANOTECHNOLOGY

| | | | |
|---|---|---|---|
| **Paper Code: ETMT-403** | **L** | **T/P** | **C** |
| **Paper: Micro Electro Mechanical System & Nanotechnology** | **3** | **1** | **4** |

**INSTRUCTIONS TO PAPER SETTERS:** **MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks.

*Objective: To introduce the student about the knowledge of sensors, actuators, micro-actuators and nanotechnology.*

**UNIT I**

**Introduction to MEMS:**

Production engineering, ultra precision engineering, ICs, micro sensors, micro actuators, microelectronic fabrication, micro machining, Mechanical MEMS, MOEMS. Magnetic MEMS, RF MEMS, micro fluidic systems, Bio and Chemo devices, Nano technology, modeling and simulation, MEMS packaging & design considerations, Micro instrumentation.

**[T1][No. of Hrs: 11]**

**UNIT II**

**Micro Machining:**

Photo lithography, structural and sacrificial materials, other lithography methods, Thin film deposition, impurity doping, Etching, problem with bulk micro machining. Surface micro machining, wafer bonding.

**System Modelling:**

System types, basic modelling elements in – Mechanical systems, electrical systems, fluid systems, thermal systems. Modeling hybrid systems.

**Passive Components And Systems:**

System on a chip, passive electronic systems, passive mechanical systems

**Mechanical Sensors and Actuators:**

Principle of sensing and actuating, beam and cantilever, micro plates, capacitive effect, piezoelectric material, strain measurement, pressure measurement, flow measurement, MEMS gyroscope, shear mode piezo-actuator, gripping piezo-actuator, inch worm technology.

**Thermal Sensors and Actuators:**

Heat transfer process, Thermistors, micro machined thermocouple probel, peltier effect heat pumps, thermal flow sensors, micro hotplate gas sensors, MEMS thermo vessels, pyro-electricity, shape memory alloys, Thermally actuated MEMS relay, Micro spring thermal actuator, data storage cantilever.

**[T1][No. of Hrs: 12]**

**UNIT III**

**Micro-Opto-Electromechanical Systems:**

Principle of MOEMS technology, properties of light, light modulators, beam splitters, micro lens, micro mirrors, light detectors, optical switch.

**CNT and Nano Technology:**

Introduction, nanotechnology materials, Fullerenes, Carbon Nano Tubes, development and application of CNTs, properties of CNTs, molecular machine components.

**[T1, T2][No. of Hrs: 11]**

**UNIT IV**

**Simulation Based Micro and Nano System Design:**

FEM, design flow using simulation tool, Ansys Multi-physics, Atomistic to continuum theory, Analytical theory and computational modeling, multi-scale concepts and methods, complexity of multi scale systems.,

**Nano Materials:**

Silicon carbide, Nano particles of Alumina and Zirconia, Mechanical, Magnetic, Electric and optical properties.

**[T1, T2][No. of Hrs: 11]**

**Text Books:**

[T1] Nitaigour Premchand Mahalik, MEMS, Mc Graw Hill.
[T2] A.K. Bandhopadhyay, Nano Materials, New Age

## MECHATRONICS SYSTEM DESIGN

| | | | |
|---|---|---|---|
| **Paper Code: ETMT-405** | **L** | **T/P** | **C** |
| **Paper: Mechatronics System Design** | **3** | **0** | **3** |

**INSTRUCTIONS TO PAPER SETTERS:** **MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks

*Objective: Mechatronics is the combination of mechanical and electronics automation and computers. Nowadays all the mechanical machines have been made computer controlled. The Subject details the basic hardware and software elements used for proper and successful operation of various equipments. The knowledge of this subject will be helpful to students while working in industries.*

**UNIT - I**

**Introduction:** Evolution of Mechatronics, origins, Multidisciplinary scenario.

**Signal Theory and Engineering Tools:** Signal nomenclature, Signal analysis and processing, Multi domain signal representation, Analysis and representation of periodic analog signals, discrete fourier transforms and fast fourier transform, analysis of signal in time frequency domain, Differential equation, Laplace transform, difference equation, Z- transform, power and energy of the signal.

**Electrical components and Electronic devices::** Introduction, Basics of electrical components, Basic of electronic devices.

**Basics of digital technology:** Number system, Gray codes, DNS architecture, Boolean Algebra, Logic states, logic functions, universal gates, combinational and sequential logic circuits, flip flops, Karnaugh maps, TTL & CMOS.

**[T1][T2][No. of Hrs: 12]**

**UNIT - II**

**Introduction to signal conditioning:** Signal Conditioning Processes, Inverting Amplifiers, Non Inverting Amplifiers, Summing, Integrating, Differential, Logarithmic Amplifiers, Comparators, Amplifiers Error, Filtering, Wheatstone Bridge, Temperature Compensation, Thermocouple Compensation, Modeling of Mechanical systems and Simulations

**[T1][T2][No. of Hrs: 10]**

**UNIT - III**

**Electrical Actuation Systems:** Switching Devices, Mechanical Switches – SPST, SPDT, DPDT, Debouncing keypads; Relays, Solid State Switches, Diodes, Thyristors, Transistors, Solenoid Type Devices: Solenoid Operated Hydraulic and Pneumatic Valves, Control of DC Motors, Permanent Magnet DC Motors, Bush less Permanent Magnet DC Motors, AC Motors and speed controls, Stepper Motors and Controls, Servo Motors.

**System Interfacing and data acquisition:**

Data acquisition systems, Data loggers, SCADA, Interfacing requirements, Buffers, Darlington Pair, Handshaking, Serial and Parallel Port Interfacing, Peripheral Interface Adapters, Analog to Digital Conversion, Digital To Analog Conversion, Sample and Hold Amplifiers, Multiplexers, Time Division Multiplexing, Digital Signal Processing, Pulse Modulation, Component Interconnection and Impedance Matching, Interfacing Motor drives. Electrical power supply and protection.

**[T1][T2][No. of Hrs: 10]**

**UNIT - IV**

**Programmable logic controllers:** Programmable logic controllers (PLC) Structure, Input / Output Processing, principles of operation, PLC versus computer, Programming Languages, programming using Ladder Diagrams, Logic Functions, Latching, Sequencing, Timers, Internal Relays And Counters, Shift Registers, Master and Jump Controls, Jumps, Data Movement, Code Conversion, Data handling and manipulation, selecting a PLC.

**Case Studies:** Mechatronic approach to design, Boat Auto pilot, high speed tilting train, automatic car park system, coin counter, engine management system, autonomous mobile system, antilock brake system control, Auto-Focus Camera, Printer, Domestic Washing Machine, Optical Mark Reader, Bar Code Reader and Pick and Place robot Arm, Using PLC for extending and retracting a pneumatic piston and two pneumatic pistons in different combinations, control of vibrating machine, control of process tank, control of conveyor motor, detecting, sorting and packaging unit.

**[T1][T2][No. of Hrs: 10]**

**text Book:**

[T1] W. Bolton, "Mechatronics – Electronic control systems in Mechanical & Electrical Engineering", Pearson Education Ltd., 2003.

[T2] Nitaigour Premchand Mahalik, Mechatronics principles, concepts and applications, Tata Mc Graw Hill.

**Reference Books:**

[R1] Joji P, Pneumatic Controls, Wiley.

[R2] Dan Necsulescu, Mechatronics, Pearson

[R3] David g Alciatore, Michael B Histand, "Introduction to Mechatronics and measurement systems", Mc Graw Hill Education.

[R4] A Smaili, F Mrad, "Mechatronics – Integrated Technologies for Intelligent Machines, Oxford Higher Education.

[R5] Nitaigour Premchand Mahalik, "Mechatronics Principles, Concepts & Application", Tata McGraw Hill Publishing Co.Ltd., 2003.

## I.C. ENGINES

| **Paper Code: ETMT-407** | **L** | **T/P** | **C** |
|---|---|---|---|
| **Paper: I.C. Engines** | **3** | **0** | **3** |

**INSTRUCTIONS TO PAPER SETTERS:** **MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from question no. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks.

*Objective: To introduce the students about the knowledge of SI and CI engines.*

**UNIT-I**

**Introduction:** Basic Engine components and Nomenclature, Classification of Engines, The working principle of Engines, Comparison of 2-Stroke and 4-Stroke Engines; CI, and SI Engines, Ideal and Actual Working Cycles and their analysis, Valve timing Diagram.

**Fuels:** Fossil fuels, Chemical structure of Petroleum, Properties of SI and CI Engine Fuels, Fuel Ratings; Octane Number, Cetane Number.

**[T1, R1, R2] [No. of Hrs. 10]**

**UNIT-II**

**Carburetors & Fuel Injection:** Air Fuel Mixture Requirements, Construction and Working of Simple Carburetor, Calculation of Air-Fuel Ratio, Parts of Carburetor.

Requirement of Injection Systems, Classification of Injection Systems, Fuel Feed pump, Injection Pumps, Working principles of Governors, Nozzles and Fuel Injector, Injection in SI and CI Engines.

**[T1, R1, R2] [No. of Hrs.10]**

**UNIT-III**

**Combustion and Ignition Systems in SI and CI Engines:** Normal and Abnormal Combustion in SI and CI Engines, Stages of Combustion, Detonation and Knocking.

**Performance parameters for IC Engines:** Engine Power, Engine Efficiencies, Performance Characteristics, Variables Effecting Performance Characteristics, Methods of Improving Engine Performance, Heat Balance.

**[T1, T2, R1][No. of Hrs. 10]**

**UNIT-IV**

**Modern Automotive Engines*:*** Changes in Fuel injection Methods in S.I and C.I engines, Common Rail Direct Injection System, Gasoline Direct Injection, Variable Valve Technology, A brief review of Design changes to achieve high efficiency.

**[T1, T2, R1, R2][No. of Hrs. 10]**

**Text Books**:

[T1] Ganesan V., "Internal Combustion Engines", Tata McGraw-Hill

[T2] K. K. Ramalingam, "Internal Combustion Engines" 2nd Ed, SCITECH Publications

**Reference Books:**

[R1] John B Heywood," Internal Combustion Engine Fundamentals", Tata McGraw-Hill.

[R2] E.T. Vincent "Theory & Design of Gas Turbine and jet engine" McGraw Hill.

## DIGITAL IMAGE PROCESSING

| **Paper Code: ETMT-409** | **L** | **T/P** | **C** |
|---|---|---|---|
| **Paper: Digital Image Processing** | **3** | **0** | **3** |

**INSTRUCTIONS TO PAPER SETTERS:** **MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from question no. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks.

*Objectives: The aim of this course is to provide digital image processing fundamentals, hardware and software, digitization, encoding, segmentation, feature extraction etc. It will enhance the ability of students to apply tools in image restoration, enhancement and compression and to apply the techniques in both the spatial and frequency domains. It will enhance the ability of students to identify the quality characteristics of medical images, differences between computer vision and image processing and help in studying the remote sensing images of the environmental studies.*

**UNIT- I :**

**Introduction and Digital Image Fundamentals:** The origins of Digital Image Processing, Examples of Fields that Use Digital Image Processing, Fundamentals Steps in Image Processing, Elements of Digital Image Processing Systems, Image Sampling and Quantization, Some basic relationships like Neighbors, Connectivity, Distance Measures between pixels, Linear and Non Linear Operations.

**Image Enhancement in the Spatial Domain:** Some basic Gray Level Transformations, Histogram Processing, Enhancement Using Arithmetic and Logic operations, Basics of Spatial Filters, Smoothening and Sharpening Spatial Filters, Combining Spatial Enhancement Methods**.**

**[T1, T2][No. of Hrs: 10]**

**UNIT- II:**

**Filtering in the Frequency Domain:** Introduction to Fourier Transform and the frequency Domain, Smoothing and Sharpening Frequency Domain Filters.

**Image Restoration:** A model of The Image Degradation / Restoration Process, Noise Models, Restoration in the presence of Noise Only Spatial Filtering, Periodic Noise Reduction by Frequency Domain Filtering, Estimation of Degradation Function, Inverse filtering, Wiener filtering, Constrained Least Square Filtering, Geometric Mean Filter, Geometric Transformations.

**[T1, T2][No. of Hrs. 12]**

**UNIT- III:**

**Image Compression**: fundamentals of compression, coding redundancy, Lossy and lossless compression, Spatial and temporal redundancy, Image compression models. Some basic compression methods

**Image Segmentation:** Detection of Discontinuities, Edge linking and boundary detection, Region Oriented Segmentation, Motion based segmentation.

**[T1, T2][No. of Hrs. 12]**

**UNIT- IV:**

**Representation and Description:** Representation, Boundary Descriptors, Regional Descriptors, Use of Principal Components for Description, Introduction to Morphology, Some basic Morphological Algorithms.

**Object Recognition:** Patterns and Pattern Classes, Decision-Theoretic Methods, Structural Methods.

**[T1, T2][No. of Hrs: 10]**

**Text Books:**

[T1] Rafael C. Gonzalez & Richard E. Woods, "Digital Image Processing", 3Rd edition, Pearson Education, 2002.

[T2] A.K. Jain, "Fundamental of Digital Image Processing", PHI, 1989.

**Reference Books:**

[R1] Bernd Jahne, "Digital Image Processing", 5th Ed., Springer, 2002.

[R2] William K Pratt, "Digital Image Processing: Piks Inside", John Wiley & Sons, 2001.

## PRODUCT DESIGN AND COSTING

| | | | |
|---|---|---|---|
| **Paper Code: ETMT-411** | **L** | **T/P** | **C** |
| **Paper: Product Design and Costing** | **3** | **0** | **3** |

**INSTRUCTIONS TO PAPER SETTERS:** **MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from question no. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks.

*Objectives: The focus of Product Design and costing is integration of the marketing, design, and manufacturing functions of the firm in creating a new product.*

**UNIT – I**

Introduction to Product Design, Engineering Design, Modern Product Development, Reverse Engineering development process,

**Product Development Process Tools**: Team and product planning, concept development, system level design, detail design, testing and refinement.

**Scoping Product Development**: Technical and Business.

**[T1, T2][No. of Hrs. 10]**

**UNIT – II**

**Identifying Customer Needs:** Gather raw data from customers, interpret raw data in terms of customer needs, organize the needs into a hierarchy, establish the relative importance of the needs and reflect on the results and the process.

**Concept Generation:** Process, Basic methods of information gathering and brain storming.

**Benchmarking and Establishing Engineering Specifications**: Benchmarking approach, product specification.

**[T1, T2][No. of Hrs. 11]**

**UNIT – III**

**Concept Selection:** Introduction, technical feasibility, Pugh concept selection chart

**Concept Embodiment**: Refining Geometry and Layout

**Design for manufacturing and Assembly**: design Guidelines.

[**T1, T2][No. of Hrs. 10]**

**UNIT – IV**

**Product Cost Analysis:** various types and elements of cost, cost of development, cost component of initial investment, cost of financing, manufacturing cost.

**Design for environment**: Environmental objectives, techniques to reduce environmental Impact.

**[T3][No. of Hrs. 10]**

**Text Books:**

[T1] Kevin Otto, Kristin Wood "Product Design" Pearson

[T2] Karl T. Ulrich and Steven D. Eppinger, "Product Design and Development", 5th Edition 2011

[T3] Khan, Siddiquee, Kumar "Engineering Economy" Pearson

**Reference Books:**

[R1] Magrab B. Edward, Gupta K.S, Mccluskey P.F "Integrated Product and Process Design and Development" CRC Press (Taylor & Francis group)

## NON-CONVENTIONAL MANUFACTURING PROCESSES

| | | | |
|---|---|---|---|
| **Paper Code: ETME-413** | **L** | **T/P** | **C** |
| **Paper: Non-Conventional Manufacturing Processes** | **3** | **0** | **3** |

**INSTRUCTIONS TO PAPER SETTERS:** **MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks.

*Objective: The objective of the paper is to facilitate the student with non conventional manufacturing processes.*

**UNIT - I**

**Introduction:** Limitations of conventional manufacturing processes need of unconventional manufacturing processes & its classification and its future possibilities.

**[T1][No. of Hrs. 06]**

**UNIT - II**

**Unconventional Machining Process:** Principle, Working, Process parameters and applications of unconventional machining process such as Electro-Discharge machining, WEDM, Chemical machining, Electro-chemical machining, Ultrasonic machining, Abrasive jet machining, Abrasive flow machining, Water jet machining, Laser beam machining, Electron beam machining, IBM and other advanced manufacturing processes.

**[T1][No. of Hrs. 15]**

**UNIT – III**

**Unconventional welding processes:** Explosive welding, Cladding etc. Under water welding, Metalizing, Plasma arc welding/cutting etc.

**[T1][No. of Hrs. 10]**

**UNIT-IV**

**Unconventional Forming processes:** Principle, working and applications of High energy forming processes such as Explosive Forming, Electromagnetic forming, Electro Discharge forming, water hammer forming, explosive compaction etc.

**Electronic-device Manufacturing:** Brief description of Diffusion and Photo- Lithography process for electronic-device manufacturing.

**[T1][No. of Hrs. 11]**

**Text Books:**

[T1] P.C. Pandey & H.S. Shan, "Modern Machining Process", Tata McGraw Hills, 2001

[T2] Amitabh Gosh and A.K. Mallik, "Manufacturing Science", Affiliated East-West Press Pvt. Ltd., 1985.

**Reference Books:**

[R1] J.T. Black, Ronald A. kosher DeGarmo's Materials and Processes in Manufacturing, 11th Edition , Wiley

[R2] Mikell P. Groover" Principles of Modern Manufacturing, 5th Edition SI Version, Wiley

## PROCESS MODELLING & OPTIMIZATION TECHNIQUES

| **Paper Code: ETMT-415** | **L** | **T** | **C** |
|---|---|---|---|
| **Paper: Process Modelling & Optimization Techniques** | **3** | **0** | **3** |

**INSTRUCTIONS TO PAPER SETTERS:** **MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks.

*Objective: The objective of the paper is to facilitate the students with the field concerned with the modeling and optimization techniques of various industrial processes.*

**UNIT - I**

Process modelling, SISO and MIMO processes, Coupled processes, Study of Biochemical reactors, CSTR, Steam drum level, surge vessel level control, Batch reactor and Biomedical systems.

**[T1, T2][No. of Hrs. 11]**

**UNIT - II**

Introduction to Control and optimization of Boiler, Cooling Tower, Distillation column, Reactors, Heat exchangers, condenser and evaporator.

**[T1, T2][No. of Hrs. 11]**

**UNIT - III**

Overview of optimisation techniques, Cost functions, supervised and unsupervised methods, Linear Optimisation–Least squares method, Recursive Least square, subset selection.

**[T1, T2][No. of Hrs. 11]**

**UNIT - IV**

Nonlinear Local optimisation- Direct search algorithms, general gradient based algorithms, constrained nonlinear optimisation. Nonlinear Global optimisation – Simulated annealing, Genetic algorithms, Ant colony optimisation, Process Modelling using soft computing methods.

**[T1, T2][No. of Hrs. 11]**

**Text Books:**

[T1] Oliver Nelles, "Process Nonlinear System Identification", Springer
[T2] Stephanopoulos G. "Chemical Process Control: An Introduction to Theory and Practice", PHI

**Reference Books:**

[R1] Bela G. Liptak, 'Process Control- Instrument Engineers' Handbook, Chilton Book Co.
[R2] Regina M Murphy, 'Introduction to Chemical Processes', McGraw Hill Education
[R3] John E. Hewson, "Process Instrumentation Manifolds", Instrumentation society of America.
[R4] W. L. Luben, "Process Modeling & Simulation Control for Chemical Engineers", McGraw Hill. 1995
[R5] B. Wayne Bequette, "Process Control- Modelling, Design and Simulation", PHI

## AUTOMOBILE ENGINEERING

| | | | |
|---|---|---|---|
| **Paper Code: ETME-401** | **L** | **T/P** | **C** |
| **Paper: Automobile Engineering** | **3** | **0** | **3** |

**INSTRUCTIONS TO PAPER SETTERS:** **MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from question no. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks

*Objective: The objective of the paper is to introduce the student about Power plant, Transmission Systems, Clutches and its principles of friction clutch, types of suspension, Mechanical and hydraulic brakes and other automobile s engineering functions.*

**UNIT – I**

**Power Plant**: Selection of power plant for automotive vehicle, requirements of vehicle. Characteristics of various power plants (Petrol engines, Diesel engines, CNG and LPG engine,); constructional details of C.I. and S.I. engines, crank shafts, connecting rods, pistons, piston pins, piston rings, valves mechanisms, manifolds, air cleaners, mufflers, radiators and oil filters.

**Vehicular Performance**: Load, air and grade resistance; matching of engine output and demand power, performance requirements of Passenger cars, heavy duty trucks. Performance characteristics of internal combustion engines, drive effectiveness for 2 wheel and 4 wheel drive vehicles.

**[T1, T2, T3] [No. of Hrs. 12]**

**UNIT II**

**Transmission Systems:** Transmission requirements, general arrangement of clutch, gear box and transmission, for various combinations of front wheel, rear wheel, front engine and rear engine for 2 wheels and 4 wheels drives De-Dion drive.

**Clutches**: Principle of friction clutch, single and multi-plate clutches, centrifugal clutch and related Numericals. Friction materials. Bonding materials. Fluid fly wheel clutch.

**[T1, T2, T3] [No. of Hrs. 11]**

**UNIT III**

**Transmission:** Description and working of manually operated gearboxes like sliding mesh, constant mesh, synchromesh. Hydraulic torque converter and its construction, working and performance. Analysis of Semi-automatic and Automatic transmission, overdrives, Differentials and Wilson Gear Box. Construction and working of Live axles.

**Steering System**: Steering terminologies and geometry. Davis and Ackermann steering. Power steering.

**[T1, T2, T3] [No. of Hrs. 11]**

**UNIT IV**

**Suspension**: Types of suspension systems, Dead Axle and Independent suspension;., air suspension, shock absorbers.

**Wheels, Tyres and Brakes**:, Mechanical and hydraulic brakes, shoe arrangements and analysis, disc brakes, braking effectiveness requirements. Concept of Anti lock brakes. Wheel and tyre requirements, Tyre dynamics.

[**T1, T2, T3] [No. of Hrs.12]**

**Text Books:**

[T1] N.K. Giri, "Automotive Mechanics", Khanna Publishers
[T2] R K Rajput," A text Book on Automobile Engineering", Laxmi publication
[T3] Kirpal Singh, "Automobile Engg.", Vol. .I & II, Standard Publishers, 2004

**Reference Books:**

[R1] Narang G.B.S., "Automobile Engg.", Khanna Publishers
[R2] Srinivasan, "Automotive Engines", Tata McGraw Hill
[R3] K.K. Jain & R.B. Asthana, "Automobile Engineering", Tata McGraw Hill
[R4] Joseph Haitner, "Automotive Mechanics", C.B.S. Publications

## DATABASE MANAGEMENT SYSTEMS

| **Paper Code: ETCS-425** | **L** | **T/P** | **C** |
|---|---|---|---|
| **Paper: Database Management Systems** | **3** | **0** | **3** |

**INSTRUCTIONS TO PAPER SETTERS:** **Maximum Marks: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks.

*Objective: The concepts related to database, database techniques, SQL and database operations are introduced in this subject. This creates strong foundation for application data design.*

**UNIT-I : Introductory Concepts of DBMS:** Introduction and application of DBMS, Data Independence, Database System Architecture – levels, Mapping, Database users and DBA, Entity – Relationship model, constraints, keys, Design issues, E-R Diagram, Extended E-R features- Generalization, Specialization, Aggregation, Translating E-R model into Relational model.

**[T1, T2][No. of Hrs. 10]**

**UNIT-II : Relational Model:** The relational Model, The catalog, Types, Keys, Relational Algebra, Fundamental operations, Additional Operations-, SQL fundamentals, DDL,DML,DCL PL/SQL Concepts, Cursors, Stored Procedures, Stored Functions, Database Integrity – Triggers.

**[T2, R3][No. of Hrs. 10]**

**UNIT-III:** Functional Dependencies, Non-loss Decomposition, First, Second, Third Normal Forms, Dependency Preservation, Boyce/Codd Normal Form, Multi-valued Dependencies and Fourth Normal Form, Join Dependencies and Fifth Normal Form.

**[T2, R1][No. of Hrs. 10]**

**UNIT-IV: Transaction Management:** ACID properties, serializability of Transaction, Testing for Serializability and concurrency control, Lock based concurrency control (2PL, Deadlocks), Time stamping methods, Database recovery management.

**Implementation Techniques:** Overview of Physical Storage Media, File Organization, Indexing and Hashing, B+ tree Index Files, Query Processing Overview, Catalog Information for Cost Estimation, Selection Operation, Sorting, Join Operation, Materialized views, Database Tuning.

**[T1, T2, R2][No. of Hrs. 12]**

**Text Books:**

[T1] Abraham Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", 5th Edition, Tata McGraw Hill, 2006

[T2] Elmsari and Navathe, "Fundamentals of Database Systems", 4th Ed., A. Wesley, 2004

**References Books:**

[R1] C.J.Date, A.Kannan, S.Swamynathan, "An Introduction to Database Systems", 8th Edition, Pearson Education, 2006.

[R2] J. D. Ullman, "Principles of Database Systems", 2nd Ed., Galgotia Publications, 1999.

## ARTIFICIAL INTELLIGENCE

| | | | |
|---|---|---|---|
| **Paper Code: ETCS-429** | **L** | **T/P** | **C** |
| **Paper: Artificial Intelligence** | **3** | **0** | **3** |

**INSTRUCTIONS TO PAPER SETTERS:** **MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks.

***Objective:*** To learn the basics of designing intelligent agents that can solve general purpose problems, represent and process knowledge, plan and act, reason under uncertainty and can learn from experiences

**UNIT-I**

**Introduction:** Introduction to intelligent agents

**Problem solving:** Problem formulation, uninformed search strategies, heuristics, informed search strategies, constraint satisfaction solving problems by searching, state space formulation, depth first and breadth first search, iterative deepening

**[T1, T2][No. of hrs. 12]**

**UNIT-II**

**Logical Reasoning:** Logical agents , propositional logic, inferences, first-order logic, inferences in first order logic, forward chaining, backward chaining, unification, resolution

**[T1, T2][No. of hrs. 10]**

**UNIT-III**

**Game Playing:** Scope of AI -Games, theorem proving, natural language processing, vision and speech processing, robotics, expert systems, AI techniques- search knowledge, abstraction

**[T1, T2][No. of hrs. 12]**

**UNIT-IV**

**Learning from observations:** Inductive learning, learning decision trees, computational learning theory, Explanation based learning

**Applications:** Environmental Science, Robotics, Aerospace, Medical Sciences etc.

**[T1, T2][No. of hrs. 10]**

**Text Book:**

[T1] Rich and Knight, “Artificial Intelligence”, Tata McGraw Hill, 1992
[T2] S. Russel and P. Norvig, “Artificial Intelligence – A Modern Approach”, Second Edition, Pearson Edu.

**Reference Books:**

[R1] KM Fu, "Neural Networks in Computer Intelligence", McGraw Hill
[R2] Russel and Norvig, "Artificial Intelligence: A modern approach", Pearson Education

## WASTE AND HEAT RECOVERY SYSTEMS

| | | | |
|---|---|---|---|
| **Paper Code: ETMT-421** | **L** | **T/P** | **C** |
| **Paper: Waste and Heat Recovery Systems** | **3** | **1** | **4** |

**INSTRUCTIONS TO PAPER SETTERS:** **MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from question no. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks.

*Objective: To introduce the students about the knowledge heat recovery equipments and their importance in power plants etc.*

**UNIT- I**

**Waste Heat Recovery:** Introduction - Principles of Thermodynamics and Second Law, Cogeneration system. Sources of waste heat and its potential applications, Waste heat survey and measurements, Data collection, Limitations and affecting factors Heat recovery equipment and systems.

**[T1, T2, R1, R2][No. of Hrs. 11]**

**UNIT- II**

**Waste Heat Recovery Systems:** Introduction, classification and design of Recuperators, Regenerators, and economizers.

**[T1, T2, R1, R2][No. of Hrs. 10]**

**UNIT- III**

**Waste Heat Boilers:** Classification, Location, Service Conditions, Design Considerations, Unfired combined Cycle, Supplementary fired combined cycle, fired combined cycle, Thermic fluid heaters.

**[T1, T2, R1, R2][No. of Hrs. 11]**

**UNIT- IV**

**Applications & Techno Economics of Waste Heat Recovery Systems:** Applications in industries, selection of waste heat recovery technologies - financial considerations - operations and investment costs of waste heat recovery. Introduction to tri-generation and quad-generation.

**[T1, T2, R1, R2][No. of Hrs. 11]**

**Text Books:**

[T1] Khartchenko N.V. Green Power: Eco-Friendly Energy Engineering, Tech Books New Delhi,
[T2] Boyce M.P. Cogeneration and Combined Cycle Power Plants, ASME Press, 2"d ed., 2010

**Reference Books:**

[R1] Khartchenko N.V. Advanced Energy Systems, Taylor and Francis, Washington DC, 1998
[R2] Institute of Fuel, London, Waste Heat Recovery, Chapman and Hall Publishers, London, 1963.

## MANAGEMENT INFORMATION SYSTEMS AND ERP

| | | | |
|---|---|---|---|
| **Paper Code: ETME-421** | **L** | **T/P** | **C** |
| **Paper: Management Information Systems and ERP** | **3** | **0** | **3** |

**INSTRUCTIONS TO PAPER SETTERS:** **MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Q. No. 1 rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks.

***Objectives:*** *The objective of this course is to expose the students to the managerial issues relating to information systems and help them identify and evaluate various options in this regard.*

**UNIT I**

Meaning and Role of Information Systems. Types of Information Systems: Operations Support Systems, Management Support Systems, Expert Systems, and Knowledge Management Systems. Information Systems for Strategic Management: Competitive Strategy Concepts, Strategic Role of Information Systems. Integrating Information Systems with Business Strategy, Value Chain Analysis, and Strategic Information Systems Framework.

**[T1,T2][No. of Hrs. 12]**

**UNIT II**

Planning for Information Systems: Identification of Applications, Business Planning Systems and Critical Success Factors, Method of Identifying Applications, Risks in Information Systems. Resource Requirements for Information Systems: Hardware and Capacity Planning, Software Needs, Procurement Options – Make or Buy decisions, Outsourcing as an Option.

**[T1,T2][No. of Hrs. 12]**

**UNIT III**

Systems design and Development Methodologies: SDLC Approach, Prototyping, Spiral Method, End User Development. Logical and Physical Design. Evaluation of Information Systems.

**[T1,T2][No. of Hrs. 10]**

**UNIT IV**

Emerging Concepts and Issues in Information Systems: Supply Chain Management, Customer Relationship Management, ERP. Introduction to Data Warehousing, Data Mining and its Applications.

**[T1,T2][No. of Hrs. 10]**

**Text Books:**

[T1] Kenneth Laudon and Jane Laudon (2013). Management Information Systems, Twelfth Edition, Pearson, New Delhi.

[T2] James O'Brien, George Marakas and Ramesh Behl (2014). Management Information Systems, Tenth Edition, McGraw Hill Education, New Delhi.

**References Books:**

[R1] Sahil Raj, "Management Information Systems", Pearson 2013

[R2] Girdhar Joshi (2013). Management Information Systems, Oxford University Press, New Delhi.

[R3] Effy Oz (2009). Management Information Systems, Sixth Edition, Cengage Learning, Delhi.

[R4] Nirmalya Bagchi (2014). Management Information Systems, Vikas Publishing House, New Delhi.

## FUZZY LOGIC AND NEURAL NETWORKS

| **Paper Code: ETMT-425** | **L** | **T/P** | **C** |
|---|---|---|---|
| **Paper: Fuzzy Logic and Neural Networks** | **3** | **0** | **3** |

**INSTRUCTIONS TO PAPER SETTERS:** **MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks.

*Objective: To impart knowledge of fuzzy logic and neural networks alongwith their techniques and applications in engineering systems.*

**UNIT -I**

**Neural Networks**: Fundamental of neural network, overview of biological Neuro-system, Mathematical Models of Neurons, ANN architecture, Learning Methods, Learning Paradigms-Supervised, Unsupervised and reinforcement Learning, ANN training Algorithms-perceptions, Training rules, Delta, Back Propagation Algorithm, Multilayer Perceptron Model, Radial Basis functions, Hopfield Networks, Associative Memories, Applications of Artificial Neural Networks.

**[T1, T2][No. of Hrs. 11]**

**UNIT-II**

Fuzzy sets: Introduction to Fuzzy Logic, Classical and Fuzzy Sets: Overview of Classical Sets, Operations on Fuzzy Sets: Compliment, Intersections, Unions, Combinations of Operations, Extension principle and fuzzy relationsFuzzy Logic: Fuzzification and defuzzification, Membership Function, Linguistic Variables, Linguistic hedges, Fuzzy rules and reasoning, lamda cut-sets. Arithmetic operations on Fuzzy numbers.

**[T1, T2][No. of Hrs. 10]**

**UNIT-III**

Fuzzy Inference System: Fuzzy Modeling, Mamdani Fuzzy model, TSK Fuzzy model, Fuzzy Controller, Industrial Applications.

Introduction of Neuro-Fuzzy Systems, Architecture of Neuro Fuzzy Networks, Hybrid learning algorithms, Neuro-fuzzy Control.

**[T1, T2][No. of Hrs. 11]**

**UNIT-IV**

Introduction to Evolutionary Techniques: Genetic Algorithm, Basic Concepts, Flow Chart of GA, Genetic representations (Encoding), Initialization and Selection, Genetic Operators, Mutation, Generational Cycle, Convergence of GA and Applications.

**[T1, T2][No. of Hrs. 10]**

**Text Books:**

[T1] S. Rajasekaran, "Neural Network, Fuzzy Logic and Genetic Algorithms", PHI Learning India 2011
[T2] S. N. Sivanandam, S.N. Deepa, "Principles of Soft Computing", Wiley India.

**References Books:**

[R1] Patricks Henry,Winston, "Artificial Intelligence", Pearson Education,2001
[R2] Nilsson, Morgon, "Artificial Intelligence", Kufmann 1998.
[R3] J.-S.R.Jung, c.T.Sun, "Neuro-Fuzzy and Soft Computing", PHI Learning India 2011
[R4] Hagan Demuth, Beale, "Neural Network Design", Cengage Learning 2013
[R5] S N Sivanandam, "Neural Network using Matlab" TMH 2013

## OPERATIONS RESEARCH

| | | | |
|---|---|---|---|
| **Paper Code: ETMT-427** | **L** | **T/P** | **C** |
| **Paper: Operations Research** | **3** | **0** | **3** |

**INSTRUCTIONS TO PAPER SETTERS:** **MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks.

*Objective: The objective of the paper is to acquaint the student with mathematical techniques being adopted in industry which help managers in decision taking.*

**UNIT-I**

**Linear Programming**: Formulation of LP Problem. Graphical method, Simplex method for maximization and minimization LP Problems. Duality in Simplex Problems,

**Queuing Theory**: Introduction to probability concept for queuing problems. Basic structure, Terminology, Classification, Birth and Death Process. Queuing Models.

**[T1][No. of Hrs. 11]**

**UNIT-II**

**Transportation Models:** MODI method for optimality check, North West Corner Method, Least-cost Method and Vogel's Approximation Method (VAM) for solving balanced and unbalanced transportation problems. Problems of degeneracy and maximization.

**Assignment Models**: Assignment model for maximization & minimization problems. Traveling Salesman Problems, Industrial Problems.

**[T2][No. of Hrs. 11]**

**UNIT-III**

**Sequencing Theory:** Processing of n-jobs through m-machines with each job having same processing order. Processing of two jobs through m-machines with each job having different processing order.

**Decision Theory:** Decision making under uncertainty and under risk, Multistage decision making, Multi criteria decision making.

**[T1][No. of Hrs. 11]**

**UNIT - IV**

**Network Models:** Introduction to PERT and CPM. Fundamental concept of Network models and construction of network diagrams. Activity time estimates. Critical path and project time duration. Probability of completing the project on or before specified time. Concept of Float and slack.

**Game Theory**: Two person zero-sum games. Minimax and Maximin principle. Arithmetic, Algebraic, Matrix Algebra method. Solution by Dominance, Subgame, Graphical method, linear programming method.

**[T2][No. of Hrs. 11]**

**Text Books:**

[T1] Hira and Gupta " Operation Research" S. Chand Publications
[T2] H.A. Taha, "Operations Research", Prentice-Hall India, 6th Edition, 2004.

**Reference Books:**

[R1] S.Kalavathy, "Operations Research", Vikas Publication, 4th Edition, 2013.
[R2] N.D. Vohra, "Operations Research", Tata McGraw Hill, 2004.
[R3] Richard Bronson, Govindasami Naadimuthu, "Operations Research", Tata McGraw Hill, 2004
[R4] A.P. Verma, "Operations Research", S.K. Kataria & Sons, 2004.
[R5] J.K. Sharma, "Operation Research", Macmillan India Ltd. 2005.

## DECISION SCIENCE

| | | | |
|---|---|---|---|
| **Paper Code: ETMT-429** | **L** | **T/P** | **C** |
| **Paper: Decision Science** | **3** | **0** | **3** |

**INSTRUCTIONS TO PAPER SETTERS:** **MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks

***Objective**: Skills acquired from this course will enable students to apply various decisions making and optimization techniques in solving problems pertaining to their respective areas of study.*

**UNIT- I**

Descriptive Statistics, Presentation of Data, Measures of Central Tendency and Variation, Probability-Concepts, Theorems, Bayes' Rule, Linear Programming, Formulation, Graphical and Simplex Method.

**[T1][R1] [No. of hrs. 10]**

**UNIT- II**

Decision Sciences & Role of quantitative techniques, Steps in decision making. Decision making under uncertainty, including optimism criterion, pessimism criterion, Laplace criterion, optimism criterion, Hurwicz criterion and Regret criterion. Decision making under risk, Multistage decision making, Multi criteria decision making. Posterior probabilities and Bayesian Analysis.

**[T1][T2][No. of hrs. 12]**

**UNIT- III**

**Game Theory:** Two person zero-sum games, concept of dominance, Pure & Mixed Strategy. Arithmetic, Algebraic, Matrix Algebra method. Solution by Dominance, Subgame and Linear programming method. Queuing Theory, Basic structure, Terminology, Classification, Birth and Death Process. Queuing Models upto 2 service stations.

**[T1][R1][No. of hrs. 11]**

**UNIT-IV**

Transportation Problems, Initial Basic Feasible Solution, Test for Optimality. Assignment problems. Network Analysis - PERT and CPM.

Network Models, Concept, Drawing network, identifying critical path**,** Calculating EST, LST, EFT, LFT, Slack & probability of project completion (CPM &PERT), Crashing of Network.

**[T1][R3][No. of hrs. 12]**

**Text Books:**

[T1] Ken Black (2009) Business Statistics: For Contemporary Decision Making, 5th edition, Wiley-India.

[T2] Barry Render, RM Stair, ME Hanna and TN Badri (2009) Quantitative Analysis for Management, 10th edition, Pearson Prentice Hall.

**References Book:**

[R1] Operations Research, H.A. Taha , Prentice-Hall India, 6th Edition, 2004

## RENEWABLE ENERGY RESOURCES

| | | | |
|---|---|---|---|
| **Paper Code: ETEE-419** | **L** | **T/P** | **C** |
| **Paper: Renewable Energy Resources** | **3** | **0** | **3** |

**INSTRUCTIONS TO PAPER SETTERS:** **MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Q. No. 1 rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks.

*Objective: The objective of the paper is to introduce the knowledge of upcoming and future promising area of renewable energy resources to the students, which is developing rapidly.*

**UNIT- I**

Solar Energy: radiation – extra terrestrial, spectral distribution, solar constant, solar radiation on earth, measurements; solar thermal system – solar thermal power and its conversion, solar collectors, flat plate, solar concentrating collectors, - types and applications; photovoltaic (PV) technology - photovoltaic effect, efficiency of solar cells, semi-conductor materials, solar PV system, standards and applications, tracking.

**[T1][No. of hrs. 10]**

**UNIT- II**

Wind and Small Hydropower Energy: wind data, properties, speed and power relation, power extracted, wind distribution and speed prediction, wind map of India; wind turbines and electric generators. fundamentals – types of machines and their characteristics, horizontal and vertical wind mills, elementary design principle, wind energy farms, off-shore plants; small, mini and micro hydro power plants and their resource assessment, plant layout with major components shown.

**[T2][No. of hrs. 10]**

**UNIT- III**

Other Non-conventional Energy Sources: biomass – photosynthesis and origin of biomass energy, resources, cultivated resources, waste to biomass, terms and definitions – incineration, wood and wood waste, harvesting super tree, energy forest, phyrolysis, thermo-chemical biomass conversion to energy, gasification, anaerobic digester, fermentation, gaseous fuel; geothermal – resources, hot spring, steam system, principle of working, site selection, associated problems in development; ocean and tidal energy – principle of ocean thermal energy conversion, wave energy conversion machines, problems and limitations, fundamentals of tidal power, conversion systems and limitations; hydrogen energy – properties of hydrogen, sources, production and storage, transportation, problems for use as fuel; fuel cells – introduction with types, principle of operation and advantages.

**[T1,R2][No. of hrs. 12]**

**UNIT-IV**

Grid Connectivity: wind power interconnection requirement - low-voltage ride through (LVRT), ramp-rate limitations, supply of ancillary services for frequency and voltage control, load following, reserve requirement, impact of connection on stead-state and dynamic performance of power system; interfacing dispersed generation of solar energy with the grid, protective relaying, islanding, voltage flicker and other power quality issues; role of non-conventional energy system in smart grid.

**[T2,R3][No. of hrs. 10]**

**Text Books:**

[T1] Tiwari and Ghosal, “Renewable Energy Resources: Basic Principle & Application”, Narosa Publication
[T2] S N Bhadra ,D, Kastha,’Wind Electrical Systems” Oxford Publication 2014

**References Books:**

[R2] John Twidell, “Renewable Energy Sources”, Taylor and Francis
[R3] Godfrey Boyle, “Renewable Energy: Power for a Sustainable Future”, Oxford University Press
[R4] Ewald F. Fuchs, “Power Conversion of Renewable Energy Systems”, Springer
[R5] B. H. Khan, “Non Conventional Energy”, Tata McGraw Hill
[R6] D P kothari ,”Wind energy System and applications” Narosa Pub 2014

## FINITE ELEMENT METHODS

| | | | |
|---|---|---|---|
| **Paper Code: ETME-423** | **L** | **T/P** | **C** |
| **Paper: Finite Element Methods** | **3** | **0** | **3** |

**INSTRUCTIONS TO PAPER SETTERS:** **MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Q. No. 1 rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks.

*Objectives: The objectives of the subject are to equip the students with the Finite Element Analysis fundamentals. The study of this subject is also enabling the students to formulate the design problems into FEA and introduce basic aspects of finite element technology.*

**UNIT – I**

**Basic of Finite Element Method, Variational calculus, Integral formulation, variational methods:** Methods of weighted residuals, Approximate solution using variational method, Modified Galerkin method, Boundary conditions

**Basic Finite Element Concepts:** Basic ideas in a finite element solution, General finite element solution procedure, Finite element equations using modified Galerkin method, Axis symmetric Problems

**[T1, T2][No. of Hrs. 11]**

**UNIT II**

**Discrete System:**

Axial spring element, Axial bars, Torsion bars, Application in Heat transfer and Solid Mechanic Problems, Plane truss problem, software application ANSYS etc

**Beam:** Euler Beam element and its application.

**[T1, T2][No. of Hrs. 11]**

**UNIT III**

**Eigen value problems:** Formulation and problems

**Single value problem in 2D:** Boundary value problem, axis symmetric problems

**[T1, T2][No. of Hrs. 11]**

**UNIT IV**

**Numerical on 2D Solid mechanics**

Interpolation function (triangular, Quadrilateral, serendipity elements), numerical integration and modelling consideration.

**[T1, T2][No. of Hrs. 11]**

**Text Books:**

[T1] J N Reddy "An Introduction to finite element method" Tata Mc Graw Hill 3rd edition
[T2] S.S. Rao, "Finite Element Method In Engineering", Pergaman Press

**Reference Books:**

[R1] O.C. ZienKiewicz, "The Finite Element Method", Tata McGraw Hill
[R2] Larry J. Segerlind, "Applied Finite-Element Analysis", John Wiley and Sons
[R3] Kenneth H. Huebner, "Finite Element Method for Engineers", John Wiley and Sons
[R4] Darell W. Pepper, J.C Heinrich "The Finite Element Method" CRC press
[R5] V.Ramamurti "Finite Element Method in Machine Design"Norosa Publishing House.

## SOCIOLOGY AND ELEMENTS OF INDIAN HISTORY FOR ENGINEERS

| | L | T/P | C |
|---|---|---|---|
| **Paper Code: ETHS-419** | | | |
| **Paper: Sociology and Elements of Indian History for Engineers** | **3** | **0** | **3** |

**INSTRUCTIONS TO PAPER SETTERS:** **MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks.

*Objective: The objective of this course is to familiarize the prospective engineers with elements of Indian history and sociological concepts and theories by which they could understand contemporary issues and problems in Indian society. The course would enable them to analyze critically the social processes of globalization, modernization and social change. All of this is a part of the quest to help the students imbibe such skills that will enhance them to be better citizens and human beings at their work place or in the family or in other social institutions.*

**UNIT I**

*Module 1A:* Introduction to Elements of Indian History: What is History? History Sources-Archaeology, Numismatics, Epigraphy & Archival research; Methods used in History; History & historiography.

[*3 Lectures*]

*Module 1B:* Introduction to sociological concepts-structure, system, organization, social institution, Culture social stratification (caste, class, gender, power). State & civil society.

[*7 Lectures*]

**[T1][No. of Hrs. 10]**

**UNIT II**

*Module 2A:* Indian history & periodization; evolution of urbanization process: first, second & third phase of urbanization; Evolution of polity; early states of empires; Understanding social structures-feudalism debate.

[*3 Lectures]*

*Module 2B:* Understanding social structure and social processes: Perspectives of Marx, Weber & Durkheim.

[*7 Lectures*]

**[T1][No. of Hrs. 10]**

**UNIT III**

*Module 3A:* From Feudalism to colonialism-the coming of British; Modernity & struggle for independence.

*[3 Lectures]*

*Module 3B:* Understanding social structure and social processes: Perspectives of Marx, Weber & Durkheim.

[9 *Lectures*]

**[T1][No. of Hrs. 12]**

**UNIT IV**

*Module 4A:* Issues & concerns in post-colonial India (upto 1991); Issues & concerns in post-colonial India 2nd phase (LPG decade post 1991).

[*3 Lectures*]

*Module 4B:* Social change in contemporary India: Modernization and globalization, Secularism and communalism, Nature of development, Processes of social exclusion and inclusion, Changing nature of work and organization.

[*10 Lectures*]

**[T1][No. of Hrs. 13]**

**Text Books:**

[T1] Desai, A.R. (2005), Social Background of Indian Nationalism, Popular Prakashan.
[T2] Giddens, A (2009), Sociology, Polity, 6th Edition

**Reference Books:**

[R1] Guha, Ramachandra (2007), India After Gandhi, Pan Macmillan
[R2] Haralambos M, RM Heald, M Holborn, (2000), Sociology, Collins

## CAD LAB

| Paper Code: ETAT-451 | L | T/P | C |
|---|---|---|---|
| Paper: CAD Lab | 0 | 2 | 1 |

## List of Experiments:

**CAD Experiments (Any 6 (six)):**

1. Use computer software such as: C / C++ / MATLAB / SCILAB / Java / any other to make programs for under mentioned:

1) Line(s) Drawing;
2) Drawing Bezier curve(s);
3) Drawing B-Spline curve(s);
4) Develop menu-bar and buttons for above;
5) Do geometric transformations for translation
6) Use menu-bar for rotation / mirror;
7) Use menu-bar for scaling;
8) Perform numerical calculations of any problem done in class and show its graphical manipulation on software.
9) Exposure to any 2D / 3D modeling commercially available software;

**NOTE:- At least 8 Experiments from the syllabus must be done in the semester.**

## DATABASE MANAGEMENT SYSTEMS LAB

| | | | |
|---|---|---|---|
| **Paper Code: ETMT-453(ELECTIVE)** | **L** | **T/P** | **C** |
| **Paper: Database Management Systems Lab** | **0** | **2** | **1** |

### LAB BASED ON DBMS

Lab includes implementation of DDL, DCL, DML i.e SQL in Oracle.

**List of Experiments:**

1. Design a Database and create required tables. For e.g. Bank, College Database
2. Apply the constraints like Primary Key, Foreign key, NOT NULL to the tables.
3. Write a SQL statement for implementing ALTER, UPDATE and DELETE
4. Write the queries to implement the joins
5. Write the queries for implementing the following functions: MAX (), MIN (),AVG (),COUNT ()
6. Write the queries to implement the concept of Integrity constrains
7. Write the queries to create the views
8. Perform the queries for triggers
9. Perform the following operation for demonstrating the insertion, updation and deletion using the referential integrity constraints

**TEXT BOOK:**

1. SQL/ PL/SQL, The programming language of Oracle, Ivan Bayross, 4th Edition BPB Publications

**NOTE:- At least 8 Experiments out of the list must be done in the semester.**

## NON-CONVENTIONAL MANUFACTURING PROCESSES LAB

| | | | |
|---|---|---|---|
| **Paper Code: ETMT-453(ELECTIVE)** | **L** | **T/P** | **C** |
| **Paper: Non-Conventional Manufacturing Processes Lab** | **0** | **2** | **1** |

**List of Experiments:**

1. Study of electric discharge machining process.
2. Determination of material removal rate on electric discharge machine (EDM).
3. Determination of surface roughness on EDM.
4. Study of electrochemical machining process.
5. Determination of material removal rate on electro chemical machine (ECM).
6. Determination of surface roughness on ECM.
7. Study of plasma arc welding(PAW) process
8. Determination of heat affected zone in plasma arc welding process.
9. Study the effect of current on material removal rate in EDM.
10. Study of the effect of different tool material on material removal rate in EDM.
11. Study the effect of current on surface finish rate in EDM.
12. Study of the effect of different tool surface finish on surface finish in EDM.

**NOTE:- At least 8 Experiments out of the list must be done in the semester.**

## AUTOMOBILE ENGINEERING LAB

| **Paper Code: ETMT-453(ELECTIVE)** | **L** | **T/P** | **C** |
|---|---|---|---|
| **Paper: Automobile Engineering Lab** | **0** | **2** | **1** |

**Automobile Engineering Lab experiments based on syllabus (ETME-401).**

**NOTE: - At least 8 Experiments from the syllabus must be done in the semester.**

## OPERATIONS RESEARCH LAB

| **Paper Code: ETMT-453(ELECTIVE)** | **L** | **T/P** | **C** |
|---|---|---|---|
| **Paper: Operations Research Lab** | **0** | **2** | **1** |

**List of Experiments:**

1. To study the working of TORA software package.
2. To solve the given Linear Programming Problem by simplex method manually and TORA software package.
3. To solve the given Transportation Problem manually and TORA software package.
4. To solve the given Problem of CPM and PERT by manually and TORA software package.
5. To solve the given Queuing Theory Problem manually and TORA software package.
6. Make a program in C++ for the Formulation of Linear Programming Problem.
7. Make a program in C++ to make the 1st Simplex Table for the given Linear Programming Problem.
8. Make a program in C++ for the conversion of Primal into Dual form of Linear Programming Problem.
9. Make a program in C++ to find the basic feasible solution of the given Transportation Problem using North West Corner Rules or by least cost method.
10. Make a program in C++ to find the optimal solution of the given Assignment Problem.
11. Make a program in C++ to solve the given Queuing Theory Problem of model 1.
12. Make a program in C++ to solve the given n job 2-machine sequencing problem.
13. Make a program in C++ to give the critical path for the given network problem.
14. Make a program in C++ to find the Saddle Point of the given game programming problem.

**NOTE:- At least 8 Experiments out of the list must be done in the semester.**

## ROBOTICS

| | | | |
|---|---|---|---|
| **Paper Code: ETMT-402** | **L** | **T/P** | **C** |
| **Paper: Robotics** | **3** | **1** | **4** |

**INSTRUCTIONS TO PAPER SETTERS:** **MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from question no. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks.

*Objective: To introduce the foundations of robotics. Also, a course on Robotics must use one or more software to not only visualize the motion and characteristics of robots but also to analyzer/synthesize/design robots for a given application.*

**UNIT - I**

**Fundamentals of Robot Technology**:

Robot definition, automation and robotics, Robot anatomy, Work volume, Drive systems. Control systems and dynamic performance. Accuracy and repeatability. Sensors and actuators used in robotics. Machine Vision, Robot configurations, Path control. Introduction to robot languages. Applications; Types (Mobile, Parallel); Serial: Cartesian, Cylindrical, etc.; Social Issues

**[T1,T2,T3][No. of Hrs: 11]**

**UNIT - II**

**Robot Kinematics**: Mapping, Homogeneous transformations, Rotation matrix, Forward Kinematics (DH Notation) and inverse kinematics: Closed form solution.

**Robot Differential Motion:** Linear and Angular velocity of rigid link, Velocity along link, Maipulator jacobian, Statics: Use of jacobian.

**[T1,T2,T3][No. of Hrs: 11]**

**UNIT – III**

**Robot Dynamics:** Lagrangian Mechanics, Lagrangian Formulation and numericals. Dynamics, Newton-Euler Recursive Algorithm, Simulation. Euler-Lagrange Equations of motion/Any one other formulation like using Decoupled Natural Orthogonal Complements (DeNOC)

**End effectors**: Mechanical and other types of grippers. Tools as end effectors. Robot and effector interface. Gripper selection and design.

**[T1,T2,T3][No. of Hrs: 12]**

**UNIT - IV**

**Applications for Manufacturing**. Flexible automation. Robot cell layouts. Machine interference. Other considerations in work cell design. Work cell control, interlocks. Robot cycle time analysis. Mechanical design of robot links.

Typical applications of robots in material transfer, machine loading/unloading; processing operations; assembly and inspection.

**[T1,T2,T3][No. of Hrs: 10]**

**Text Books:**


[T1] R.K. Mittal, I.J. Nagrath, "Robotics & Control", Tata McGraw & Hills, 2005.

[T2] Mikell P Groover , Mitchell Weiss "Industrial Robotics :Technology, Programming and Application" Tata McGraw & Hills, 2009.

[T3] Saha, S.K., Introduction to Robotics, 2nd Edition, McGraw-Hill Education, New Delhi, 2014


**Reference Books:**


[R1] John J.Craig; "Introduction to Robotics Mechanics & Control", Pearson Education, 2004.

[R2] Robert J. Schilling, "Fundamentals of Robotics, analysis & Control", Prentice Hall (I) P. Ltd., 2002

[R3] Mark W. Spong, Seth Hutchinson, M. Vidyasagar "Robot Modeling and Control" John Wiley 2nd Ed

[R4] J Srinivasan, R.V.Dukkipati, K. Ramji, "Robotics control & programming", Narosa.

[R5] Ghosal, Ashitava, "Robotics: Fundamental Concepts and Analysis," Oxford University Press, 2006

[R6] M. Murray, M., Li, Zexiang, Sastry, S.S., "A Mathematical Introduction to Robotic Manipulation," CRC Press, 1994

[R7] Tsai, L.W., "Robot Analysis: The Mechanics of Serial & Parallel Manipulators," Wiley 1999

[R8] Niku, S. B., "Introduction to Robotics: Analysis, Systems, Applications", Prentice Hall, 2001

## EMBEDDED SYSTEMS

| | | | |
|---|---|---|---|
| **Paper Code: ETMT-404** | **L** | **T/P** | **C** |
| **Paper: Embedded Systems** | **3** | **1** | **4** |

**INSTRUCTIONS TO PAPER SETTERS:** **MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks

*Objective: The objective of the paper is to enable a student to design an embedded system for specific tasks..*

**UNIT- I**

**Overview of Embedded Systems**: Characteristics of Embedded Systems. Comparison of Embedded Systems with general purpose processors. General architecture and functioning of micro controllers. 8051 micro controllers.

**PIC Microcontrollers:** Architecture, Registers, memory interfacing, interrupts, instructions, programming and peripherals.

**[T1][No. of hrs. 11]**

**UNIT- II**

**ARM Processors:** Comparison of ARM architecture with PIC micro controller, ARM 7 Data Path, Registers, Memory Organization, Instruction set, Programming, Exception programming, Interrupt Handling, Thumb mode Architecture.

Bus structure: Time multiplexing, serial, parallel communication bus structure. Bus arbitration, DMA, PCI, AMBA, I2C and SPI Buses.

**[T2][No. of hrs. 12]**

**UNIT- III**

Embedded Software, Concept of Real Time Systems, Software Quality Measurement, Compilers for Embedded System

**[T3][No. of hrs. 10]**

**UNIT-IV**

**RTOS:** Embedded Operating Systems, Multi Tasking, Multi Threading, Real-time Operating Systems, RT-Linux introduction, RTOS kernel, Real-Time Scheduling.

**[T3][No. of hrs. 10]**

**Text book:**

[T1] Design with PIC Microcontrollers, John B. Peatman, Pearson Education Asia, 2002
[T2] ARM System Developer's Guide: Designing and Optimizing System Software, Andrew N. Sloss, Dominic Symes, Chris Wright, , Morgan Kaufman Publication, 2004.
[T3] Computers as components: Principles of Embedded Computing System Design, Wayne Wolf, Morgan Kaufman Publication, 2000

**References Books:**

[R1] The Design of Small-Scale embedded systems, Tim Wilmshurst, Palgrave2003
[R2] Embedded System Design, Marwedel ,Peter , Kluwer Publishers , 2004.

## HUMAN VALUES & PROFESSIONAL ETHICS – II

| | | | |
|---|---|---|---|
| **Paper Code: ETHS-402** | **L** | **T** | **C** |
| **Paper : Human Values & Professional Ethics-II** | **1** | **0** | **1** |

**INSTRUCTIONS TO PAPER SETTERS:** **MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks.
3. Two internal sessional test of 10 marks each and one project report* carrying 5 marks.

*Objectives:*

1. *The main object of this paper is to inculcate the skills of ethical decision making and then to apply these skills to the real and current challenges of the engineering profession.*
2. *To enable student to understand the need and importance of value-education and education for Human Rights.*
3. *To acquaint students to the National and International values for Global development*

**UNIT I - Appraisal of Human Values and Professional Ethics:**

**Review of Universal Human Values:** Truth, Love, Peace, Right conduct, Non violence, Justice and Responsibility. Living in harmony with 'SELF', Family, Society and Nature. Indian pluralism - the way of life of Islam, Buddhism, Christianity, Jainism, Sikhism and Hinduism, Greek - Roman and Chinese cultural values.

Sensitization of Impact of Modern Education and Media on Values:

a) Impact of Science and Technology
b) Effects of Printed Media and Television on Values
c) Effects of computer aided media on Values (Internet, e-mail, Chat etc.)
d) Role of teacher in the preservation of tradition and culture.
e) Role of family, tradition & community prayers in value development.

**Review of Professional Ethics:** Accountability, Collegiality, Royalty, Responsibility and Ethics Living. Engineer as a role model for civil society, Living in harmony with 'NATURE', Four orders of living, their inter-correctness, Holistic technology (eco-friendly and sustainable technology).

**[T1] [T2] [R1] [R5] [R4][No. of Hrs. 03]**

**UNIT II – Engineers responsibility for safety:**

Safety and Risks, Risk and Cost, Risk benefit analysis, testing methods for safety. Engineer's Responsibility for Safety Social and Value dimensions of Technology - Technology Pessimism – The Perils of Technological Optimism – The

Promise of Technology – Computer Technology Privacy

**Some Case Studies:** Case Studies, BHOPAL Gas Tragedy, Nuclear Power Plant Disasters, Space Shuttle Challenger , Three Mile Island Accident, etc.

**[T1] [T2] [R4] [R2][No. of Hrs. 03]**

**UNIT III – Global Issues:**

**Globalization and MNCs:** International Trade, Issues,

**Case Studies**: Kelleg's, Satyam, Infosys Foundation, TATA Group of Companies

**Business Ethics**: Corporate Governance, Finance and Accounting, IPR.

**Corporate Social Responsibility (CSR)**: Definition, Concept, ISO, CSR.

**Environmental Ethics**: Sustainable Development, Eco-System, Ozone depletion, Pollution.

**Computer Ethics**: Cyber Crimes, Data Stealing, Hacking, Embezzlement.

**[T1] [T2] [R4][No. of Hrs. 05]**

**UNIT IV - Engineers Responsibilities and Rights and Ethical Codes:**

Collegiality and loyalty, Conflict of interests, confidentiality, occupational crimes, professional rights, responsibilities. To boost industrial production with excellent quality and efficiency, To enhance national economy, To boost team spirit, Work Culture and feeling of job satisfaction, National integration, Examples of some illustrious professionals.

Need for Ethical Codes, Study of some sample codes such as institution of Electrical and Electronics Engineers, Computer Society of India etc., Ethical Audit.

**Development and implementation of Codes:** Oath to be taken by Engineering graduates and its importance**,

**[T1] [T2] [R4][R2][No. of Hrs. 05]**

**Text Books:**

[T1] Professional Ethics, R. Subramanian, Oxford University Press.
[T2] Professional Ethics & Human Values: Prof. D.R. Kiran, TATA Mc Graw Hill Education.

**References Books:**

[R1] Human Values and Professional Ethics: R. R. Gaur, R. Sangal and G. P. Bagaria, Eecel Books (2010, New Delhi). Also, the Teachers‟ Manual by the same author
[R2] Fundamentals of Ethics, Edmond G. Seebauer & Robert L. Barry, Oxford University Press
[R3] Values Education: The paradigm shift, by Sri Satya Sai International Center for Human Values, New Delhi.
[R4] Professional Ethics and Human Values – M.Govindrajan, S.Natarajan and V.S. Senthil Kumar, PHI Learning Pvt. Ltd. Delhi
[R5] A Textbook on Professional Ethics and Human Values – R.S. Naagarazan – New Age International (P) Limited, Publishers New Delhi.
[R6] Human Values & Professional Ethics- S B Gogate- Vikas publishing house PVT LTD New Delhi.
[R7] Mike Martin and Roland Schinzinger, “Ethics in Engineering” McGraw Hill
[R8] Charles E Harris, Micheal J Rabins, “Engineering Ethics, Cengage Learning
[R9] PSR Murthy, “Indian Culture Values and Professional Ethics”, BS Publications
[R10] Caroline Whitback< Ethics in Engineering Practice and Research, Cambridgs University Press
[R11] Charles D Fleddermann, “Engineering Ethics”, Prentice Hall.
[R12] George Reynolds, “Ethics in Information Technology”, Cengage Learning
[R13] C, Sheshadri; The Source book of Value Education, NCERT
[R14] M. Shery; Bhartiya Sanskriti, Agra (Dayalbagh)

*Any topic related to the experience of the B.Tech student in the assimilation and implementation of human values and professional ethics during the past three years of his/her studies in the institute OR A rigorous ethical analysis of a recent case of violation of professional ethics particularly related to engineering profession.

**All students are required to take OATH in writing prior to submission of major project and the record of the same is to be maintained at the college level and/or, this oath may be administered by the head of the institutions during the graduation ceremonies. The draft for the same is available alongwith the scheme and syllabus.

## OATH TO BE TAKEN BY ENGINEERING GRADUATES

In a manner similar to the Hippocratic Oath taken by the medical graduates, Oath to be taken by the engineering graduates is as given below.

1. I solemnly pledge myself to consecrate my life to the service of humanity.
2. I will give my teacher the respect and gratitude, which is their due.
3. I will be loyal to the profession of engineering and be just and generous to its members.
4. Whatever project I undertake, it will be for the good of mankind.
5. I will exercise my profession solely for the benefit of humanity and perform no act for criminal purpose and not contrary to the laws of humanity.
6. I will keep away from wrong, corruption and avoid tempting others to vicious practices.
7. I will endeavor to avoid waste and consumption of non-renewable resources.
8. I will speak out against evil and unjust practices whenever and wherever I encounter them.
9. I will not permit considerations of religion, nationality, race, party politics or social standing to intervene between my duty and my work, even under threat.
10. I will practice my profession with conscience, dignity and uprightness.
11. I will respect the secrets, which are confided to me.

I make these promises solemnly, freely and upon my honor.

**(Name of the Student)**

**Correspondence Address: _____**

_____

_____

**Email: _____**

## ENGINEERING SYSTEM MODELLING AND SIMULATION

| **Paper Code: ETME-402** | **L** | **T/P** | **C** |
|---|---|---|---|
| **Paper: Engineering System Modeling and Simulation** | **3** | **0** | **3** |

**INSTRUCTIONS TO PAPER SETTERS:** **MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks.

*Objective: To introduce the students about the knowledge of basic and dynamic system models of engineering and simulation system.*

**UNIT - I**

**Basic System models:** Mathematical models, Mechanical system building blocks, Electrical system building block, fluid system building block, thermal system building block.

**System Models:** Engineering systems, Rotational translational systems, Electro-mechanical systems, linearity, Hydraulic Mechanical systems.

**Dynamic Response of Systems:**

Modelling dynamic systems, Terminology, First order systems, Second order systems, performance measure of second order systems, system identification.

**System Transfer Functions:**

The transfer function, first order systems, second order systems, systems in series, systems with feedback loops, effect of pole location on transient response.

**[T1][No. of Hrs. 12]**

**UNIT – II**

**Mechanical Event Simulation (Finite Element modelling and Analysis):**

Introduction, General procedure of finite element method, finite element analysis, iso-parametric evaluation of element matrices, finite element modelling, mesh generation, design and engineering applications. Introduction to Pro E software - Mechanica & dynamic simulation module.

**[T2][No. of Hrs. 12]**

**UNIT – III**

**System Simulation:**

Introduction, Review of probability and statistics, Managing the event calendar in a discrete event simulation model, Modelling input data.

**[T3][No. of Hrs. 10]**

**UNIT – IV**

Generation of random numbers and variates, generic features and introduction to Arena Software, Real world applications of simulation, Discrete continuous simulation, verification and validation of simulation models.

**[T3][No. of Hrs. 10]**

**Text Book:**

[T1] W. Bolton, "Mechatronics – Electronic control systems in Mechanical & Electrical Engineering", Pearson Education Ltd.
[T2] Ibrahim Zeid, "CAD/CAM Theory and Practice", Tata McGraw-Hill Publishing Company Limited.
[T3] Sankar Sengupta, System Simulation and modelling, Pearson.

**Reference Books:**

[R1] Deo, Narsingh, Millican Charles E.,"System Simulation With Digital Computer", PHI.
[R2] Gordon, Geoffrey, System Simulation, PHI.
[R3] P. Radhakrishnan, S Subramanyan, V. Raju, CAD/CAM/CIM, New Age International Publishers.

## FACILITY & LAYOUT PLANNING

| | | | |
|---|---|---|---|
| **Paper Code: ETMT-410** | **L** | **T/P** | **C** |
| **Paper title: Facility & Layout Planning** | **3** | **0** | **3** |

**INSTRUCTIONS TO PAPER SETTERS:** **MAXIMUM MARKS: 75**

**1**. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.

2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks

*Objective: The course objective is to develop an awareness of the need to use the systematic approach to facilities planning. Be able to identify the various factors in developing a facility design and to develop a working knowledge of the tools used to design an efficient, flexible facility design.*

**UNIT-I**

**Plant location:**

Concept and factors influencing plant location, theories of industrial locations, theory of maximum profit location, interdependence theory of location, linear programming technique, location analogue model, theory of least-cost location, Weber's theory of location, theory of location by Predohl.

**Plant Layout:**

Introduction, objective of plant Layout, types merits and demerits, process layout, product layout, combination layout, fixed position layout, principles of plant layout, symptoms of plant layout, advantages of plant layout, Construction of Layout Plans, Muther's Systematic Layout Planning (SLP) Procedure.

**[T1][No. of Hrs. 11]**

**UNIT-II**

**Material Handling:**

Scope of material handling, definition of material handling, material handling principles,designing material handling systems, Material Handling Equipment & Classifications Factors Affecting the Selection of Materials Handling Equipment Basic Layout Types , Nadler's Ideal Systems Approach ,iminer's Basic Steps.

**[T1][No. of Hrs. 10]**

**UNIT-III**

**Computer Programme:**

Introduction to Computer Programme, CRAFT (Computerized Relative Allocation of Facilities Technique), ALDEP (Automated Layout Design Program), CORELAP (Computerized Relationship Layout Planning), COFAD (Computerized Facilities and Design), PLANET (Plant Layout Evaluation Technique)

**Space determination and area allocation:**

Determination of space requirement, office facility planning, plant maintenance area allocation.

**[T1, T2][No. of Hrs. 11]**

**UNIT-IV**

**Quantitative approaches to facilities planning:**

Facility Location Models , Rectilinear Facility Location Problem, Single Facility Location Models , location Allocation Problems , Special Facility Layout Models, Quadratic Assignment Problem, Warehouse Layout Models, Conventional storage models , Block Stacking , Safety Stock, Automated Storage and Retrieval Systems, Fixed-Path Material Handling Models , Towline or Trolley Conveyors.

**[T1][No. of Hrs. 10]**

**Text Books:**

[T1] Chandershekhar Hiregoudar, Raghavendra Reddy "Facility Planning & Layout Design, an industrial perspective" Technical publications Pune.

**Reference Books:**

[R1] Tompkins, White, Bozer, Tanchoco "Facilities Planning" fourth edition John Wiley & Sons.

## OBJECT ORIENTED SOFTWARE ENGINEERING

| | | | |
|---|---|---|---|
| **Paper Code: ETCS-412** | **L** | **T/P** | **C** |
| **Paper: Object Oriented Software Engineering** | **3** | **0** | **3** |

**INSTRUCTIONS TO PAPER SETTERS:** **MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from question no. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks.

*Objective: To make the students well versed with current s/w developments in the industry.*

**UNIT I:**

**Introduction** – Overview of Object-Orientation; Basic Concepts of Object-Orientation: Data abstraction, Encapsulation, Inheritance, Aggregation, classes, objects, messages, inheritance, polymorphism. Importance of modeling, principles of modeling, Object oriented modeling.

**OO Life cycle** – Object Oriented analysis, modeling and design; Requirement Elicitation. Introduction to Object Oriented Methodologies, Overview of Requirements Elicitation, Requirements Model-Action & Use cases.

**[T1][R1][R2][No. of Hours: 10]**

**UNIT II:**

**Architecture:** Introduction, System development is model building, model architecture, requirement model, analysis model, design model, implementation model.

**Analysis:** Introduction, System development based on user requirement, Use case model, interface descriptions, Problem domain objects, interface objects, entity objects, control objects.

**Code Design Improvement:** Refactoring, Anti patterns, Visitor Patterns.

**[T1][R3][No. of Hours: 10]**

**UNIT III:**

**Construction:** Introduction, the design model, design model dimensions, block design, working with construction.

**Testing:** Introduction, Object Oriented testing process, testing of analysis and design model, testing of classes.

**[T1][R1][No. of Hours: 10]**

**UNIT IV:**

**Modelling with UML**: Basic Building Blocks of UML, A Conceptual Model of UML.

**Basic structural modelling**: Classes, interfaces, Dependency , generalization and association relationship, comparison of E-R diagram and UML class Diagram, forward and reverse engineering.

**Basic Behavioral Modeling**- Use case diagram-relationships between use cases- extend, include, and generalize. Activity diagram-Action state, Activity state, Transition (Fork, Merge, Join), State diagram-events, State Diagram states, transitions, Interaction diagrams: Sequence diagram, Collaboration diagram (iterations, conditional messaging, branching, object creation and destruction, time constraints, origin of links.)

**Architectural modelling**:

Deployment: Common Modelling technique; Modelling processors and devices, modelling distribution of artifacts.

Collaboration: Modeling roles, modelling the realization of a Use Case, modelling the realization of an operation, modelling a mechanism.

**[T1][R3][No. of Hours: 10]**

**Text Books:**

[T1] Ivar Jacobson, "Object Oriented Software Engineering", Pearson.
[T2] Grady Booch, James Runbaugh, Ivar Jacobson, "The UML User Guide", Pearson.

**Reference Books:**

[R1] Rumbaugh et. al, "Object Oriented Modeling and Design", Pearson.
[R2] Booch, Maksimchuk, Engle, Young, Conallen and Houstan, "Object Oriented Analysis and Design with Applications", Pearson Education.
[R3] Object-Oriented Analysis and Design: using UML Mike O'Docherty Wiley Publication.
[R4] Edwards Yourdon. Carl Argila,"Case Studies in object oriented analysis and design" Prentice Hall.

## FACTORY AUTOMATION

| | | | |
|---|---|---|---|
| **Paper Code: ETMT-414** | **L** | **T/P** | **C** |
| **Paper: Factory Automation** | **3** | **0** | **3** |

**INSTRUCTIONS TO PAPER SETTERS:** **MAXIMUM MARKS: 75**

**1**. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.

2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks

*Objective: To introduce the students about the knowledge of mechanical and electrical actuating systems and their automation in the industry or factory.*

**UNIT - I**

**Mechanical Actuating Systems:** Types of motion, Degrees of freedom, constraints, Kinematic Chains, Cam, Gear and gear trains, Ratchet and pawl Belt drive, chain drive, bearing, pre loading.

**Hydraulic & Pneumatic Actuation Systems:** Fluid power systems, hydraulic systems, Pneumatic systems, system structure and signal flow, hydraulic pumps and Pressure Control Valves and regulation, introduction to air compressors and treatment, Introduction to Cylinders, Direction Control Valves, Process control valves, Rotary Actuators, Accumulators, Amplifiers, and Pneumatic Sequencing Problems.

**Compressed air generation and contamination control**

Air compressor types, preparation, stages of reparation, after cooler, mail line filter, oil removal, dryer, Air receiver, air distribution system, secondary air treatment.

**Pneumatic Actuators:** Basic actuator functioning, thrust, cylinder air consumption, cylinder speed and its relation to flow rate, stroke length, construction details, seals, installation of cylinder, cylinder cushioning, diaphragm cylinders, cylinder and magnetic piston, cylinder with non rotational guiding, rod less cylinders, below actuators, pneumatic muscle, multi-position cylinder, hydro pneumatic feed unit, gripper, air motors, pneumatic tools.

**[T1, T2][No. of Hrs: 12]**

**UNIT - II**

**Electrical Actuation Systems:** Switching Devices, Mechanical Switches – SPST, SPDT, DPDT, keypads; Relays, Electronic sensors, Diodes, Thyristors, Transistors, solenoid operating Valve, Solenoid Operated Hydraulic and Pneumatic Valves, Electro-Pneumatic Sequencing Problems. Control of DC Motors, Permanent Magnet DC Motors, Bush less Permanent Magnet DC Motors, AC Motors and speed controls, Stepper Motors and Controls, Servo Motors.

Industrial control voltages, control devices, push button station, electric logic controls, memory function, operation of dominant Off circuit and dominant ON circuit, electronic sensors, read switch, proximity sensor, Time delay relay, two hand safety operations, electric counters, pressure switch, mounting methods and arrangement, modular valve technology, miniaturization, Modularity, integration and intelligence.

**[T1, T2][No. of Hrs: 12]**

**UNIT - III**

**Interfacing with PLC:**

Hard wired control systems, comparison of PLC and relays, PLC system components, structure, CPU memory areas, PLC hardware design, Modular PLC, software, Project structure, Hardware configuration, PLC bit logic operations, program contacts versus switching contacts,

**Programmable logic controllers:**

Programmable logic controllers (PLC) - Input / Output Processing, principles of operation, PLC versus computer, Programming Languages, programming using Ladder Diagrams, Logic Functions, Latching, Sequencing, Timers, Internal Relays And Counters, Shift Registers, Master and Jump Controls, Jumps, Data Movement, Code Conversion, Data handling and manipulation, selecting a PLC. Introduction to HMI and SCADA

**Case studies:**, Printer, Domestic Washing Machine, Optical Mark Reader, Bar Code Reader and Pick and Place robot Arm, Using PLC for extending and retracting a pneumatic piston and two pneumatic pistons in different combinations.

**[T1, T2][No. of Hrs: 11]**

**UNIT - IV**

**Maintenance, Trouble Shooting and Safety:**

Requirement of preventive maintenance, Definition of maintenance activities, preventive maintenance of pneumatic systems, system malfunctions, Maintenance tips, trouble shooting, General malfunctions, safety in pneumatic systems, Energy saving.

**[T2][No. of Hrs: 12]**

**Text Book:**

[T1] W. Bolton, "Mechatronics – Electronic Control Systems in Mechanical & Electrical Engineering", Pearson Education Ltd., 2003.

[T2] Joji P, Pneumatic Controls, Wiley;

**Reference Books:**

[R1] Dan Necsulescu, Mechatronics, Pearson

[R2] David g Alciatore, Michael B Histand, "Introduction to Mechatronics and Measurement Systems", Mc Graw Hill Education.

[R3] A Smaili, F Mrad, "Mechatronics – Integrated Technologies for Intelligent Machines, Oxford Higher Education.

[R4] Nitaigour Premchand Mahalik, "Mechatronics Principles, Concepts & Application", Tata McGraw Hill Publishing Co. Ltd., 2003.

## REFRIGERATION & AIR CONDITIONING

| **Paper Code: ETMT-416** | **L** | **T/P** | **C** |
|---|---|---|---|
| **Paper: Refrigeration & Air Conditioning** | **3** | **0** | **3** |

**INSTRUCTIONS TO PAPER SETTERS:** **MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from question no. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks.

*Objective: The objective of the paper is to facilitate the student with the basics of Refrigeration & Air conditioning that are required for an engineering student.*

**UNIT–I**

**Introduction to Refrigeration:** Brief history of refrigeration. Concepts of various refrigeration systems, Heat Pump COP, Unit of Refrigeration,

**Air Refrigeration systems:** Bell Coleman Cycle, Dense Air System, Open Air System, Analysis of Simple Air Refrigeration Cycle for Aircraft.

**Refrigerants:** ASHRAE Nomenclature. Eco Friendly Refrigerants, Properties of Refrigerants, Introduction to Azeotropic & Non Azeotropic Refrigerant Mixtures (NARM).

**[T1][T2][R3][No. of Hrs. 11]**

**UNIT–II**

**Vapour Compression Refrigeration System**: Simple Saturated Cycle. T-S, P-h diagrams. COP. Dry and Wet Compression. Effect of operating parameters. Liquid-Suction Heat Exchanger. Actual vapour compression cycle.

**Compound Vapour Compression System:** Concepts of (i) Liquid Flash cooler, (ii) Flash Inter cooler. (iii) Back pressure valves. (iv) Individual Expansion valves (v) Multiple expansion valves.

**Vapour Absorption Refrigeration System:** Vapour absorption refrigeration system for $NH_3$-$H_2O$ & LiBr-$H_2O$. Electrolux Refrigerator.

**[T1][T2][R3][No. of Hrs. 11]**

**UNIT III:**

**Instruments & Controls:** Sensing and Actuating Elements, H.P and L.P cut out, Thermostat, Solenoid valve, Rotameter, Humidistat, Anemometer etc.

**Components of Refrigeration System:** Classification of compressors, Reciprocating compressor, Clearance Volume and Volumetric efficiency, Need for Multistage Compression, Different types of Condensers, Expansion devices and Evaporators.

**[T1][T2][R2][No. of Hrs. 11]**

**UNIT IV:**

**Psychrometry:** Brief History of Air Conditioning. Working substance in Air Conditioning system. Dalton's Law of Partial Pressures. Psychometric Properties and Psychometric Chart. Psychometric Processes, Concept of Room Sensible Heat Factor, Grand Sensible Heat Factor, Apparatus Dew point, Effective Sensible Heat Factor. High Latent Heat Load applications, Human comfort, Summer & Winter Air Conditioning.

**Heat Load Estimation:** Inside and Outside design conditions. Solar heat gain through glass and structures. Occupancy load, Lighting load and miscellaneous loads. Infiltration and Ventilation. Summary of Heat Loads. Duct Design.

**[T1][T3][R3][No. of Hrs. 11]**

**Text Books:**

[T1] C.P. Arora, "Refrigeration & Air Conditioning", Tata McGraw Hill Publication.
[T2] R.C. Jordand & G.B. Prister, "Refrigeration & Air Conditioning", Prentice Hall of India Publication.

**References Books:**

[R1] W.F. Stocker & J.W. Jones, "Refrigeration & Air Conditioning", Tata McGraw Hill Publication.
[R2] Manohar Prasad, "Refrigeration & Air Conditioning", Wiley Eastern.
[R3] S. Domkundwar, "A Course in Refrigeration & Air Conditioning", Dhanpat Rai & Sons

## VLSI DESIGN

| **Paper Code: ETIC-414** | **L** | **T/P** | **C** |
|---|---|---|---|
| **Paper: VLSI Design** | **3** | **0** | **3** |

**INSTRUCTIONS TO PAPER SETTERS:** **MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks.

*Objective: The prerequisite are analog devices, STLD, Digital system design and micro-electronics. The students are introducing to MOS technology, design rules and some applications.*

**UNIT I**

Evolution of VLSI, MOS transistor theory, MOS structure, enhancement & depletion transistor, threshold voltage, MOS device design equations, MOSFET scaling and small geometry effects, MOSFET capacitances.
NMOS inverter, CMOS inverter, DC characteristics, static load MOS inverter, pull up/pull down ratio, static & dynamic power dissipation, CMOS & NMOS process technology – explanation of different stages in fabrication, body effect, latch up in CMOS.

**[T1,T2][No. of Hours: 11]**

**UNIT II**

Stick diagram and design rules, lambda based design rules, switching characteristics & inter connection effects: rise time, fall time delays, noise margin.
CMOS logic gate design: NAND, NOR, XOR and XNOR gates, Transistor sizing, combinational MOS logic circuits: pass transistor and transmission gate designs, Pseudo NMOS logic.

**[T1,T2][No. of Hours: 11]**

**UNIT III**

Sequential MOS logic circuits: SR latch, clocked latch and flip flop circuits, CMOS D latch and edge triggered flip flop, dynamic logic circuits; basic principle, non ideal effects, domino CMOS logic, high performance dynamic CMOS circuits, clocking issues, clock distribution.

**[T1,T2][No. of Hours: 11]**

**UNIT IV**

VLSI designing methodology, design flow, design Hierarchy, concept of regularity, modularity & locality, VLSI design style, Design quality, computer aided design technology, adder design and multiplier design examples. Low power design concepts using CMOS Technology.

**[T1,T2][No. of Hours: 11]**

**Text Books:**

[T1] Basic VLSI Design - Pucknell Douglas A., Eshraghian Kamran, PHI Learning Pvt Limited, 2013.
[T2] N. Weste and D. Harris, "CMOS VLSI Design: A Circuits and Systems Perspective - 4th Edition", Pearson Education, India.

**Reference Book:**

[R1] S. M. Kang, Y. Lebiebici, “CMOS digital integrated circuits analysis & design” Tata McGraw Hill, 3rd Edition.
[R2] Digital Integrated Circuit Design- Ken Martin, Oxford University Press
[R3] The MOS Transistor- Yaniiis Tsividis and Colin Mcandrew, Oxford University Press, 2013
[R4] J. M. Rabaey, “Digital Integrated Circuits” PHI Learning Pvt Limited, India
[R5] J. P. Uyemura, “Introduction to VLSI Circuits and Systems”, John Wiley & Sons, Inc., New York, NY
[R6] Neelam Sharma, "Digital Logic Design", Ashirwad Publication 2013-14

## DATA COMMUNICATION & NETWORKS

| **Paper Code: ETEC-420** | **L** | **T/P** | **C** |
|---|---|---|---|
| **Paper: Data Communication & Networks** | **3** | **0** | **3** |

**INSTRUCTIONS TO PAPER SETTERS:** **MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks.

*Objectives: The objective of the paper is to provide an introduction to the fundamental concepts on data communication and the design, deployment, and management of computer networks.*

**UNIT- I**

**Data Communications :** Components, protocols and standards, Network and Protocol Architecture, Reference Model ISO-OSI, TCP/IP-Overview ,topology, transmission mode, digital signals, digital to digital encoding, digital data transmission, DTE-DCE interface, interface standards, modems, cable modem, transmission media-guided and unguided, transmission impairment, Performance, wavelength and Shannon capacity. Review of Error Detection and Correction codes.

**Switching:** Circuit switching (space-division, time division and space-time division), packet switching (virtual circuit and Datagram approach), message switching.

**[T1, T2, R1, R4] [No. of Hours: 11]**

**UNIT- II**

**Data Link Layer:** Design issues, Data Link Control and Protocols: Flow and Error Control, Stop-and-wait ARQ. Sliding window protocol, Go-Back-N ARQ, Selective Repeat ARQ, HDLC, Point-to –Point Access: PPP Point –to- Point Protocol, PPP Stack,

**Medium Access Sub layer:** Channel allocation problem, Controlled Access, Channelization, multiple access protocols, IEEE standard 802.3 & 802.11 for LANS and WLAN, high-speed LANs, Token ring, Token Bus, FDDI based LAN, Network Devices-repeaters, hubs, switches bridges.

**[T1, T2,R1][No. of Hours: 11]**

**UNIT- III**

**Network Layer:** Design issues, Routing algorithms, Congestion control algorithms,
Host to Host Delivery: Internetworking, addressing and routing, IP addressing (class full & Classless), Subnet, Network Layer Protocols: ARP, IPV4, ICMP, IPV6 ad ICMPV6.

**[T1, T2,R1][No. of Hours: 11]**

**UNIT- IV**

**Transport Layer**: Process to Process Delivery: UDP; TCP, congestion control and Quality of service.

**Application Layer:** Client Server Model, Socket Interface, Domain Name System (DNS): Electronic Mail (SMTP), file transfer (FTP), HTTP and WWW.

**[T2, T1, R1, R4][No. of Hours: 11]**

**Text Books:**


[T1] A. S. Tannenbum, D. Wetherall, "Computer Networks", Prentice Hall, Pearson, 5th Ed

[T2] Behrouz A. Forouzan, "Data Communications and Networking", Tata McGraw-Hill, 4th Ed


**Reference Books:**


[R1] Fred Halsall, "Computer Networks", Addison – Wesley Pub. Co. 1996.

[R2] Larry L, Peterson and Bruce S. Davie, "Computer Networks: A system Approach", Elsevier, 4th Ed

[R3] Tomasi, "Introduction To Data Communications & Networking", Pearson 7th impression 2011

[R4] William Stallings, "Data and Computer Communications", Prentice Hall, Imprint of Pearson, 9th Ed.

[R5] Zheng , "Network for Computer Scientists & Engineers", Oxford University Press

[R6] Data Communications and Networking: White, Cengage Learning

## CONSUMER ELECTRONICS

| | L | T/P | C |
|---|---|---|---|
| **Paper Code: ETEC-408** | | | |
| **Paper: Consumer Electronics** | **3** | **0** | **3** |

**INSTRUCTIONS TO PAPER SETTERS:** **MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from question no. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks.

*Objective: The objective of teaching this subject is to give students in depth knowledge of various electronic audio and video devices and systems. Further this subject will introduce the students with working principles, block diagram, main features of consumer electronics gadgets/goods/devices like audio-systems, CD systems, TV, VCR and other items like fax machine washing machine, microwave ovens, digital camera & iPODS etc,. which in-turn will develop in them capabilities of assembling, fault diagnosis and rectification in a systematic way.*

**UNIT I**

**Audio System: Microphones, Construction, Working principles and applications of microphone:**
Carbon, Moving coil, velocity, crystal, condenser type, Cordless microphone, Dynamic & wireless microphone.
Loud Speakers: Direct radiating, horn loaded, woofer, tweeter and squeaker, baffles and enclosures.
Sound recording on magnetic tape its principles, block diagram and tape transport mechanism, Wow, Flutter & Rumble distortion. Relationship between gap width, tape speed and frequency. Optical recording and reproduction system, Blue ray technology,
VCD & DVD system, HI- Fi system, condition for good acoustic features, stereo amplifiers

**[T1, T2][No. of Hours: 11]**

**UNIT II**

**Television:** Monochrome TV Communication**:** Elements of TV communication system; Scanning – its need for picture transmission; Need synchronizing and blanking pulses; Progressive scanning, interlaced scanning, ell effect, resolution and band width requirement, Composite Video signal (CVS )at the end of even and odd fields, advantage & disadvantage of negative modulation, need of pre & post Equalizing pulses; Monochrome picture tube– construction and working, comparison of magnetic and electric of Construction and working of camera tube: vidicon and plumbicon, night vision camera.
**Block diagram of a TV receiver:** function of each block and wave form at the input and output of each block; Frequency range of various VHF bands and channels used in India, Major specification of the CCIR B standard.
Typical circuits of scanning and EHT stages of TV receiver, keyed AGC,SAW filter; trap circuit, Identification of faulty stage by analyzing the symptoms and basic idea of a few important faults and there remedies.

**[T1, T2][No. of Hours: 12]**

**UNIT III**

**Color TV:** Primary colors, trisimulus values, trichromitc coefficients, concepts of additive and subtracting mixing of colours, concepts of luminance, Hue and saturation, Compatibility of colour TV system with monochrome system. Block diagram of colour TV camera, Construction and working principles of Trinitron, delta gun and PIL types of colour picture tubes. Concepts of degaussing, purity, beam shifting; burst signal and its need, chrominance signal; analysis of G-Y signal is not transmitted, Block diagram of PAL TV receiver.

**[T1,T2] [No. of Hours: 11]**

**UNIT IV**

Comparison of digital TV LCD, LED, HDTV, Plasma TV &Three dimension TV.
Cable Television**:** Block diagram and principle of working of STB and DTH, Study of FAX machine,group-3 fax machine, Fuzzy logic washing machine, study of digital camera, RFID & Bluetooth technology, study of iPods,MP4 players & accessories, block diagram of microwave oven and its function of each block.

**[T1,T2] [No. of Hours: 11]**

**Text Books:**

[T1] R. R. Gulati, "Modern Television Practice" New Age International, 2nd Edition.
[T2] S. P. Bali, "Consumer Electronics" Pearson Education, 1st Edition.

**Reference Books:**

[R1] A. Dhake, "Television & Video Engineering" TMH – 2nd Edition.
[R2] R.R. Gulati, "Monochrome & Colour Television" New age International Publisher, 2nd Edition.
[R3] R.G. Gupta, "Audio & Video Systems" TMH – 2nd Edition.

## SUPPLY CHAIN MANAGEMENT - PLANNING

| | | | |
|---|---|---|---|
| **Paper Code: ETTE-424** | **L** | **T/P** | **C** |
| **Paper: Supply Chain Management - Planning** | **3** | **0** | **3** |

**INSTRUCTIONS TO PAPER SETTERS:** **MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks.

*Objectives: The objective of the course is to provide a comprehensive analysis of the principles and practices of supply chain management. It will help the student to understand the activities of SCM and provide grounding in this field.*

**UNIT-I**

Supply Chain Management - Concepts, Issues in Supply Chain Management; Demand Volatility and information distortion, Managing networks and relationships; Sourcing Internationally, Subcontracting within an International Dimension, The Architecture of Physical distribution network : Distribution Management: Types of Intermediaries, Channel Objectives and Constraints, Channel Selection and Management, Global Retailing, International Channel Innovation.

**[T1, T2][No. of Hrs. 10]**

**UNIT-II**

Logistics Framework – Concept, Objective and Scope; Transportation, Warehousing, Inventory Management; Packing and Unitization; Control and Communication, Role of Information Technology in Logistics, Logistics Service Firms and Third Party Logistics.

**[T1, T2][No. of Hrs. 10]**

**UNIT-III**

Logistics Network Design for Domestic/Global Operations: Logistics Network Configuration, Orienting International Facilities: Considerations and Framework, Trade-offs Associated with each Approach, Mapping the different Approaches, Capacity Expansion Issues; Information Management for Global Logistics: The Global LIS/LITS: Capabilities and Limitations, Characteristics of Logistics Information and Telecommunications Systems.

**[T1, T2][No. of Hrs. 12]**

**UNIT-IV**

Performance Measurement and Evaluation in Global Logistics: Operations and Logistics Control: Key Activities Performance Information, Measuring Performance in Functional Integration, Measuring Performance in Sectoral Integration; Measurements and improvements of SCM service quality and performance; Past, present and future of Supply Chain Management.

**[T1, T2][No. of Hrs. 10]**

**Text Books**

[T1] Christopher Martin. (2005). Logistics & Supply Chain Management Creating Value-adding Networks, 3rd Edition, Pearson Education..

[T2] S.K. Bhattacharyya (2010) Logistics Management, Definition, Dimensions and Functional Applications, S. Chand and Company, Delhi.

**Reference Books:**

[R1] Chopra Sunil and Peter Meindl (2009). Supply Chain Management, 4th Edition, Pearson Education.

[R2] Ballou, R. H. (2004). Business Logistic Management, 5th Edition, Prentice Hall, New Delhi.

[R3] Bowersox, D. J., David, J & Cooper (2002). Supply Chain Logistics Management, McGraw Hill.

## INTELLIGENT AND SMART INSTRUMENTATION

| | | | |
|---|---|---|---|
| **Paper Code ETMT-424** | **L** | **T/P** | **C** |
| **Paper: Intelligent and Smart Instrumentation** | **3** | **0** | **3** |

**INSTRUCTIONS TO PAPER SETTERS:** **MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks

*Objective:- To introduce modern devices and techniques used in instrumentations, especially in automation and critical applications.*

**UNIT-I**

**Recent Trends in Sensor Technologies:** Introduction**;** Film sensors (Thick film sensors, Thin film sensors)**;** Semiconductor IC technology – standard methods; Microelectro-mechanical systems (Micro-machining, some application examples)**;** Nano-sensors**.** Bulk Micromachining. Micromachining Surface Micromachining. Other Micromachining Techniques. (LIGA Process) Micromilling. Micromachined Materials, Digital transducers.

**[T1][T2][No. of Hrs. 12]**

**UNIT-II**

**Sensors:-** Primary sensors**;** Excitation**;** Amplification; Filters**;** Converters; Compensation (Nonlinearty**:** look up table method**,** polygon interpolation, polynomial interpolation**,** cubic spline interpolation, Approximation & regression; Noise & interference**;** Response time**;** Drift; Cross-sensitivity)**;** Information Coding/ Processing**;** Data Communication**;** Standards for smart sensor interface.

**[T1][T2][No. of Hrs. 11]**

**UNIT-III**

**VI and Data Acquisition:** Introduction to virtual Instrumentation, VI programming using LabVIEW, Signal Conditioning, DAQ Hardware Configuration, DAQ Hardware, DAQ Software Architecture, DAQ Assistant, Channel and Task configuration, Selecting and Configuring a DAQ device, Serial interfacing - RS 232C, RS 422, RS 423, RS 485.

**[T2][No. of Hrs. 12]**

**UNIT IV**

**Instrumentation Systems:-** Types of Instrumentation systems, Intelligent Instrumentation, Component of Intelligent Instrumentation System, Concept of real time system and its industrial application, realization of real time system using microcontroller and typical applications.

**[T2][No. of Hrs. 10]**

**Text Books:**

[T1] Mathivanan, "PC Based Instrumentation",1st Ed., PHI
[T2] D.Patranabis, "sensors and Transducers" 2nd Edition, PHI

**Reference Books:-**

[R1] J.Jerome, "Virtual Instrumentation using LabVIEW", PHI
[R2] P.Rai Choudhury, MEMS and MOEMS Technology and Application,PHI
[R3] Barney, " Intelligent Instrumentation, Microprocessor Applications in measurement and Control", PHI
[R4] M.Bhuyan, "Intelligent Instrumentation: Principles and Applications", CRC Press

## RELIABILITY AND MAINTENANCE MANAGEMENT

| **Paper Code: ETMT-426** | **L** | **T/P** | **C** |
|---|---|---|---|
| **Paper: Reliability and Maintenance Management** | **3** | **0** | **3** |

**INSTRUCTIONS TO PAPER SETTERS:** **MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks.

*Objective: To provide students with a comprehensive understanding on various maintenance management processes and understands the impact of maintenance management on reliability and cost effectiveness.*

**UNIT I**

**Reliability fundamentals:** Reliability Mathematics. Failure distributions. Causes of failures and their treatment. Reliability apportionment and prediction. Reliability data books. Data Recording and Corrective Action System (DRACAS).

**[T1, T2][No. of Hrs. 10]**

**UNIT II**

**Reliability analysis and modelling methods:** Fault tree analysis, Failure Mode Effects and Criticality Analysis (FMECA), Reliability block diagram, Reliability Growth Models – IBM and Duane Reliability Growth Modelling, Reliability testing. Monte Carlo Reliability Simulation. Weibull Analysis.

**[T1, T2][No. of Hrs. 10]**

**UNIT III**

**Maintenance Techniques and Tools:** Maintenance as an essential element for asset management. Reliability Centred Maintenance as a means for maintenance decision. Topics on conditioned based maintenance.

**[T1, T2][No. of Hrs. 10]**

**UNIT IV**

**Management for business performance:** Computerized Maintenance Management System – from planning to implementation. Alternative spare sourcing. Maintenance outsourcing management.

**[T1, T2][No. of Hrs. 10]**

**Text Books:**

[T1] J. Mouray, "Reliability Centred Maintenance", 2nd Edition, Industrial Press, 1997
[T2] C.E. Ebeling, "An Introduction to Reliability and Maintainability Engineering", TMH

**Reference Books:**

[R1] P. D. T. O'Connor, Practical Reliability Engineering, Wiley, 2006

## FLEXIBLE MANUFACTURING SYSTEM

| | | | |
|---|---|---|---|
| **Paper Code: ETMT-428** | **L** | **T/P** | **C** |
| **Paper: Flexible Manufacturing System** | **3** | **0** | **3** |

**INSTRUCTIONS TO PAPER SETTERS:** **MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from question no. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks.

*Objective: The objective of the paper is to acquaint the student with modern manufacturing environment having automation with CNC machines and robots.*

**UNIT I**

**Introduction and Definition:** Flexible Automation and Manufacturing Cell and Flexible Manufacturing System. Flexible Automation and Manufacturing systems and its productivity, History of FMS systems, definition, concept, benefits, problems in batch production, Types of FMS, Components of FMS, control of workstation, AGV systems, Functions of FMS, Scheduling and loading FMS, Layout configurations for FMS, communication in FMS, simulation in FMS, Installation and examples of FMS, optimization of FMS, typical layout of FMS, The FMS software. Feasibility report of FMS, advanced control cycle of FMS.

**[T1][T2][No. of Hrs. 11]**

**UNIT II**

**CIM System:** Introduction to CAD & CAM and its tools, Concept and origin of CIM, components of CIM, Emerging technologies of CIM, computer control system, sensing and identifying for manufacturing, CIMS data files, factors affecting performance, advantages and limitations, performance evaluation of a CIM system. Human centered CIM system, CIM technology in manufacturing environments, Factory information system, Sequential and concurrent engineering.

**[T1][T2][No. of Hrs. 11]**

**UNIT III**

**High Volume Production System:** Types of Automated assembly systems, Automated production or transfer lines, Equipment and arrangement of transfer lines, methods of work transport, transfer mechanisms, Assembly line balancing, numericals on line balancing, computerized line balancing methods.

**Automated Material Movement:** Function, Types of material movement systems, material movement through conveyors, material movement through robots, material movement through AGVs, automated guided vehicle operation and control, Advantages and limitations of AGVs, economic considerations.

Automatic tool changer (ATC), Storage and automated production line, Automated storage and retrieval system (ASRS), Carousel storage system, In-process storage system, communication with material in storage and in movement.

**[T2][No. of Hrs. 12]**

**UNIT IV**

Introduction to artificial intelligence in manufacturing automation, expert systems, AI programming for expert systems.

**Computer Aided Quality Control:** CNC 3D Coordinate Measuring machines, TQM, QC & CIM, Inspection and Testing, SPC, Role of computers in QC, Non contact inspection methods, Post process Metrology, Computer aided inspection using robots, integration of CAD / CAM with inspection system, Flexible Inspection system, Reverse Engineering.

**[T1,T2][No. of Hrs. 10]**

**Text Books:**

[T1] P Radhakrishnan, S subramanym, V Raju; CAD/CAM/CIM; New Age International Publishers.
[T2] K.C. Jain, Sanjay Jain, Principles of Automation and Advanced Manufacturing systems, Khanna Publications.

**Reference Books:**

[R1] Ibrahim Zeid, R Sivsubramanian, CAD/ CAM Theory & Practice, MCGraw Hill.

## ENGINEERING ECONOMICS & COST ANALYSIS

| | | | |
|---|---|---|---|
| **Paper Code: ETMT-430** | **L** | **T/P** | **C** |
| **Paper: Engineering Economics & Cost Analysis** | **3** | **0** | **3** |

**INSTRUCTIONS TO PAPER SETTERS:** **MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks

***Objective**: The objective of this course is to give the working engineer an overview of the economics principles often employed in effective engineering decisions as related to the designing, planning and implementation of successful civil engineering projects.*

**UNIT – I**

Engineering economics and its definition, Nature and scope, Overview of Indian Financial Scenario.
Utility, Theory of demand, law of demand and its exceptions, Elasticity of demand, Law of supply and elasticity of supply, Determination of equilibrium price under perfect competition.
Time value of money-Simple and Compound Interest, Cash Flow Diagram, Principle of Economic Equivalence Evaluation of Engineering projects, Concept of Internal rate of return (IRR).

**[T1,T2] [No. of Hrs: 10]**

**UNIT – II**

Cost Concepts, Elements of costs, Preparation of cost sheet, Segregation of costs into Fixed and variable costs, Break-even Analysis-Linear Approach.
Engineering Accounting, Manufacturing Cost, Manufacturing Cost Estimation, Preparing Financial Business Cases, Profit and loss A/c Balance sheet.
Asset Depreciation and its Impact on Economic Analyses, Depreciation Policy, Straight line method and declining balance method, Economic Justification of Asset Replacements.

**[T1,T2] [No. of Hrs. 12]**

**UNIT – III**

Types of business ownership: Private ownership- individual, Partnership, Joint stock companies, Co-operative societies, State ownership-government departmental organization, Public corporations, Government companies, Public Private Partnership (PPP) and its management.
Store keeping, Elements of Materials management and control polices.
Banking: Meaning and functions of commercial banks, Function of Reserve Bank of India.

**[T2,R4] [No. of Hrs. 12]**

**UNIT IV**

Asset Depreciation and its Impact on Economic Analyses, Depreciation Policy, Straight line method and declining balance method, Economic Justification of Asset Replacements.
Development of business case analyses for new product development projects and the impact of taxes on engineering economic decisions. Inflation and its impact on economy.

**[T1, R5][No. of Hours: 11]**

**Text Books**:

[T1] Sullivan, Wicks, Koelling, "Engineering Economy", Pearson Education
[T2] S.C. Sharma and T.R. Banga, "Industrial organization and engineering economics"

**References Books:**

[R1] Riggs, Bedworth and Randhwa, "Engineering Economics", McGraw Hill Education India.
[R2] C. T. Horngreen, "Cost Accounting", Pearson Education India.
[R3] R. R. Paul, "Money banking and International Trade", Kalyani Publuisher, New-Delhi.
[R4] Engineering Economics by Tahir Hussain, University Science Press, 2010
[R5] Engineering Economics by Dr. Rajan Mishra – University Science Press, 2009
[R6] H.L. Ahuja, "Principle of Economics", S. Chand
[R7] Khan, Siddiquee, Kumar, "Engineering Economy" Pearson Education

## ROBOTICS LAB

| **Paper Code: ETMT-452** | **L** | **T/P** | **C** |
|---|---|---|---|
| **Paper: Robotics Lab** | **0** | **2** | **1** |

**List of Experiments:**

1. Study of robotic arm, end effectors and its configuration and introduction to any software (such as workspace) used to simulate or program a robot;
2. Program / simulate a robot for moving on a path;
3. Program / simulate a robot for pick and place operation;
4. Program / simulate a robot for welding operation;
5. Program / simulate a robot for water jet machining;
6. Program / simulate a robot for saving it from striking any other object in workspace;
7. Program / simulate two robots working together;
8. Make a 3R robot and simulate its motion.
9. Use a microcontroller to program simple toy robot / model robot;
10. Micro controller program to use different sensors and further move toy robot(s) / model robot;
11. Use MATLAB / Scilab. Any other software to program numericals (Robot Arm kinematics) taught in class.
12. Use MATLAB / Scilab and other robot specific software like Robo-Analizer for the study of kinematic and dynamics of 3R robots.
13. Demos of a real robot; Introduce Virtual Robotics Lab. in ADAMS or SimMechanics of MATLAB.

**Note:**

a. Total Experiments are to be 12 (Twelve).
b. Experiments suggested by committee are given above- Choose any eight.
c. Rest (In above list / not in list) is liberty of respective institute to choose as per syllabus.
d. Suggested Software

A course on Robotics must use one or more software to not only visualize the motion and characteristics of robots but also to analyzer/synthesize/design robots for a given application (say, as class projects). Typical software which can be used are as follows:

- RoboAnalyzer (Developed by IIT Delhi; http://www.roboanalyzer.com)
- Virtual Labs. (Developed by IIT Kharagpur; http://vlabs.iitkgp.ernet.in/moodle/)
- MATLAB, its modules Simulink and SimMechanics (http://www.mathworks.com)
- Mathematica: Symbolic software (http://www.wolfram.com)
- Multi Bondgraph (http://bondgraph.org)
- ADAMS (by MSC software; http://www.mscsoftware.com)
- RerurDyn (by Function Bay, Korea; http://www.functionbay.co.kr)

e. **Other Aids**

- **Possible Class projects and presentations:** Kinematic/Dynamic modeling, programming, and analyses of a robotic arm (say, an RP manipulator); 2. Modeling of an AGV; 3. Building prototypes using, say, LEGO kits
- Video of practical applications
- Industry visits
- Robocon competitions: A national-level competition held every year during the 1st weekend of March

**NOTE:- At least 8 Experiments out of the list must be done in the semester.**

## EMBEDDED SYSTEMS LAB

| | | | |
|---|---|---|---|
| **Paper Code: ETMT-454** | **L** | **T/P** | **C** |
| **Paper: Embedded Systems Lab** | **0** | **2** | **1** |

**List of Experiments:**

1. Introduction to microcontroller and interfacing modules.
2. To interface the seven segment display with microcontroller 8051
3. To create a series of moving lights using PIC on LEDs.
4. To interface the stepper motor with microcontroller.
5. To display character 'A' on 8*8 LED Matrix.
6. Write an ALP to add 16 bits using ARM 7 Processor
7. Write an ALP for multiplying two 32 bit numbers using ARM Processor
8. Write an ALP to multiply two matrices using ARM processor

**NOTE:- At least 8 Experiments out of the list must be done in the semester.**

## ENGINEERING SYSTEM MODELLING AND SIMULATION LAB

| | | | |
|---|---|---|---|
| **Paper Code: ETMT-456(ELECTIVE)** | **L** | **T/P** | **C** |
| **Paper: Engineering System Modeling and Simulation Lab** | **0** | **2** | **1** |

**List of Experiments:**

**A. Mechanical Event Simulation:**

The students are exposed to simulating in CAD software in this lab ( software can be choice of institute – such as PROE - wildfire 5 / PROE -CREO / NX / Solid Edge / solid works / Catia / any other.

1. Study assembly module on CAD software;
2. Simulate movement of cam and follower mechanism on CAD software.
3. Simulation of Spring Mass Damper System and do dynamic analysis on CAD software.
4. Perform FEM Analysis (using a simple 3D tetrhedran element) on a Simple model with pressure loading and surface constraints;
5. Perform stress analysis of rectangular L bracket using Pro E / any other software and do global sensitivity analysis.

**B. System Simulation:**

The students are exposed to simulation software like Arena / any other.

1. Study modeling environment;
2. Study basic process panel;
3. Study basic process panel - more;
4. Study advanced process panel;
5. Study advanced process panel - more;
6. Study flow process panel;
7. Study flow process panel- more;

**NOTE:- At least 8 Experiments out of the list must be done in the semester.**

## OBJECT ORIENTED PROGRAMMING LAB

| | | | |
|---|---|---|---|
| **Paper Code: ETMT-456(ELECTIVE)** | **L** | **T/P** | **C** |
| **Paper: Object Oriented Programming Lab** | **0** | **2** | **1** |

## List of Experiment:

1. Write a program for multiplication of two matrices using OOP.
2. Write a program to perform addition of two complex numbers using constructor overloading. The first constructor which takes no argument is used to create objects which are not initialized, second which takes one argument is used to initialize real and imag parts to equal values and third which takes two argument is used to initialized real and imag to two different values.
3. Write a program to find the greatest of two given numbers in two different classes using friend function.
4. Implement a class string containing the following functions:
   - Overload + operator to carry out the concatenation of strings.
   - Overload = operator to carry out string copy.
   - Overload <= operator to carry out the comparison of strings.
   - Function to display the length of a string.
   - Function tolower( ) to convert upper case letters to lower case.
   - Function toupper( ) to convert lower case letters to upper case.
5. Create a class called LIST with two pure virtual function store() and retrieve().To store a value call store and to retrieve call retrieve function. Derive two classes stack and queue from it and override store and retrieve.
6. Write a program to define the function template for calculating the square of given numbers with different data types.
7. Write a program to demonstrate the use of special functions, constructor and destructor in the class template. The program is used to find the bigger of two entered numbers.
8. Write a program to perform the deletion of white spaces such as horizontal tab, vertical tab, space ,line feed ,new line and carriage return from a text file and store the contents of the file without the white spaces on another file.
9. Write a program to read the class object of student info such as name , age ,sex ,height and weight from the keyboard and to store them on a specified file using read() and write() functions. Again the same file is opened for reading and displaying the contents of the file on the screen.
10. Write a program to raise an exception if any attempt is made to refer to an element whose index is beyond the array size.

**NOTE:- At least 8 Experiments out of the list must be done in the semester.**

## FACTORY AUTOMATION LAB

| **Paper Code: ETMT-456(ELECTIVE)** | **L** | **T/P** | **C** |
|---|---|---|---|
| **Paper: Factory Automation Lab** | **0** | **2** | **1** |

**List of Experiments:**

1. Design and assembly of hydraulic / pneumatic circuit.
2. Demonstration and working of power steering mechanism
3. Study of reciprocating movement of double acting cylinder using pneumatic direction control valves
4. Use of direction control valve and pressure control valves clamping devices for jig and fixture
5. Study of robotic arm and its configuration
6. Study the robotic end effectors
7. Study of different types of hydraulic and pneumatic valves and develop circuits for pneumatic sequencing
8. Study of different types of hydraulic and pneumatic valves and develop circuits for electro-pneumatic sequencing

**NOTE:- At least 8 Experiments out of the list must be done in the semester.**

## DATA COMMUNICATION & NETWORKS LAB

| **Paper Code: ETMT-456(ELECTIVE)** | **L** | **T/P** | **C** |
|---|---|---|---|
| **Paper: Data Communication & Networks Lab** | **0** | **2** | **1** |

**List of Experiments:**

1. Introduction to Computer Network laboratory
   Introduction to Discrete Event Simulation
   Discrete Event Simulation Tools - ns2/ns3, Omnet++
2. Using Free Open Source Software tools for network simulation – I Preliminary usage of the tool ns3
   Simulate telnet and ftp between N sources - N sinks (N = 1, 2, 3). Evaluate the effect of increasing data rate on congestion.
3. Using Free Open Source Software tools for network simulation - II
   Advanced usage of the tool ns3
   Simulating the effect of queuing disciplines on network performance - Random Early Detection/Weighted RED / Adaptive RED (This can be used as a lead up to DiffServ / IntServ later).
4. Using Free Open Source Software tools for network simulation - III
   Advanced usage of the tool ns3 Simulate http, ftp and DBMS access in networks
5. Using Free Open Source Software tools for network simulation - IV
   Advanced usage of the tool ns3
   Effect of VLAN on network performance - multiple VLANs and single router.
6. Using Free Open Source Software tools for network simulation - IV
   Advanced usage of the tool ns3
   Effect of VLAN on network performance - multiple VLANs with separate multiple routers.
7. Using Free Open Source Software tools for network simulation - V
   Advanced usage of the tool ns3
   Simulating the effect of DiffServ / IntServ in routers on throughput enhancement.
8. Using Free Open Source Software tools for network simulation - VI
   Advanced usage of the tool ns3
   Simulating the performance of wireless networks
9. Case Study I : Evaluating the effect of Network Components on Network Performance
   To Design and Implement LAN With Various Topologies and To Evaluate Network Performance Parameters for DBMS etc)
10. Case Study II : Evaluating the effect of Network Components on Network Performance
    To Design and Implement LAN Using Switch/Hub/Router As Interconnecting Devices For Two Different LANs and To Evaluate Network Performance Parameters.
11. Mini project - one experiment to be styled as a project of duration 1 month (the last month)

**NOTE:- At least 8 Experiments out of the list must be done in the semester.**

## VLSI DESIGN LAB

| **Paper Code: ETMT-456(ELECTIVE)** | **L** | **T/P** | **C** |
|---|---|---|---|
| **Paper: VLSI Design Lab** | **0** | **2** | **1** |

**List of Experiments:**

1) To study the MOS characteristics and introduction to tanner EDA software tools.
2) To design and study the DC characteristics of PMOS and NMOS.
3) To design and study the DC characteristics of resistive inveter.
4) To design and study the transient and DC characteristics of CMOS inverter.
5) To design and study the characteristics of CMOS NAND and NOR gate.
6) To design and study the characteristics of CMOS multiplexer.
7) To design any Boolean function using transmission gates.
8) To design and study the characteristics of CMOS Full adder.
9) To design and study the characteristics of CMOS D Flip Flop.
10) To design and study the transient characteristics of CMOS XOR/XNOR.
11) To design and study the characteristics of Schmitt trigger circuit.

**NOTE:- At least 8 Experiments out of the list must be done in the semester.**

## FLEXIBLE MANUFACTURING SYSTEM LAB

| | | | |
|---|---|---|---|
| **Paper Code: ETMT-456(ELECTIVE)** | **L** | **T/P** | **C** |
| **Paper: Flexible Manufacturing System Lab** | **0** | **2** | **1** |

**List of Experiments:**

1. Develop programs on CNC lathe;
2. Develop programs on CNC milling;
3. Study and operate a Coordinated Measuring Machine and 6 axis robot;
4. Study working of a Flexible manufacturing system.
5. Operate FMS with automatic storage and retrieval, conveyor, lathe, robot milling machine.
6. Simulation of CIM and scheduling problem 1 on CIM Software (such as ER-Virtual / any other).
7. Simulation of CIM and scheduling problem 2 on CIM Software.
8. Simulation of CIM and scheduling problem 3 on CIM Software.

**NOTE:- At least 8 Experiments out of the list must be done in the semester.**