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
Dwarka, Delhi – 110078 [INDIA]
www.ipu.ac.in
# BACHELOR OF TECHNOLOGY
## (COMMON TO ALL BRANCHES)
### FIRST SEMESTER EXAMINATION

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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.

Scheme and Syllabi for B. Tech-Mechatronics, 1st year (Common to all branches) w.e.f batch 2014-15 and (2nd, 3rd & 4th years) w.e.f batch 2013-14 approved in the 22nd BOS of USET on 30th June, 2014 and approved in the 37th AC Sub Committee Meeting held on 10th July, 2014.
### BACHELOR OF TECHNOLOGY
**COMMON TO ALL BRANCHES**

**SECOND SEMESTER EXAMINATION**

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NUES (Non University Examination System)  
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BACHELOR OF TECHNOLOGY
(MECHATRONICS)
THIRD SEMESTER EXAMINATION

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**BACHELOR OF TECHNOLOGY**  
(**MECHATRONICS)**

**FOURTH SEMESTER EXAMINATION**

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**TOTAL**

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- **28** Credits
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- **1** NCC/NSS

*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

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* 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**

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<td>Microprocessors and Microcontrollers Lab</td>
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<tr>
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<td>In house Training/Industrial Training</td>
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<td><strong>TOTAL</strong></td>
<td>18</td>
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</table>

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 7th Semester is done before the 15th April every year before end of 6th semester.
### BACHELOR OF TECHNOLOGY (MECHATRONICS)

#### SEVENTH SEMESTER EXAMINATION

<table>
<thead>
<tr>
<th>Code No.</th>
<th>Paper ID</th>
<th>Paper</th>
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<th>Credits</th>
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<td></td>
<td><strong>THEORY PAPERS</strong></td>
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<tr>
<td>ETAT-401</td>
<td></td>
<td>Computer Aided Design</td>
<td>3</td>
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<tr>
<td>ETMT-403</td>
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<td>Micro Electro Mechanical System and Nano-Technology</td>
<td>3</td>
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<td>ETMT-405</td>
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<td>Mechatronics System Design</td>
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<td><strong>ELECTIVE – I (CHOOSE ANY ONE)</strong></td>
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<tr>
<td>ETMT-407</td>
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<td>IC Engines</td>
<td>3</td>
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<tr>
<td>ETMT-409</td>
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<td>Digital Image Processing</td>
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<td>ETMT-411</td>
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<td>Product Design and Costing</td>
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<tr>
<td>ETME-413</td>
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<td>Non-Conventional manufacturing processes</td>
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<td>Database Management Systems</td>
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<td><strong>ELECTIVE – II (CHOOSE ANY ONE)</strong></td>
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<tr>
<td>ETCS-429</td>
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<td>Artificial Intelligence</td>
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<td>ETMT-421</td>
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<tr>
<td>ETHS-419</td>
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<td>Sociology and Elements of Indian History for Engineers</td>
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<td>Seminar (topic should be linked to industrial training/ Soft skills learnt)</td>
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**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**

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<thead>
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<th>Credits</th>
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<td>ETHS-402</td>
<td>Human Values and Professional Ethics-II</td>
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<td>ETME-402</td>
<td>Engineering System Modelling and Simulation</td>
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<td>ETMT-410</td>
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<td>ETMT-430</td>
<td>Engineering Economics and Cost Analysis</td>
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<td>ETMT-452</td>
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<td>ETMT-458</td>
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**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 starting 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  
**Paper:** Switching Theory and Logic Design  
**L T/P C**  
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 MSJK 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:**


**Reference Books:**

- [R1] A Anand Kumar, “Fundamentals of Digital Logic Circuits”, PHI  
**NUMERICAL ANALYSIS & STATISTICAL TECHNIQUES**

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


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

### UNIT IV:


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

### Text Books:


### References Books:


[R5] Schaum’s Outline on Fourier Analysis with Applications to Boundary Value Problem, TMH


MEASUREMENTS AND INSTRUMENTATION

Paper Code ETMT-205
Paper: Measurements and Instrumentation

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INSTRUCTIONS TO PAPER SETTERS:

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.

MAXIMUM MARKS: 75

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.

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.

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.

UNIT -IV
Pressure Measurement:

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 capacitance probes for level measurement, limit switches, level measurement in pressurized vessels, solid level measurement techniques, modern techniques for level measurements and their applications.

Text Books:
Reference Books:
MATERIAL SCIENCE & METALLURGY

Paper Code: ETME-207
Paper: Material Science & Metallurgy

L T/P C
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.

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.

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

UNIT - IV
Corrosion: Types of corrosion, Galvanic cell, rusting of Iron, Methods of protection from corrosion.

Text Books:
[T2] Parashivamurthy K.I “Material Science and Metallurgy”, Pearson,

Reference Books:

Scheme and Syllabi for B. Tech-Mechatronics, 1st year (Common to all branches) w.e.f batch 2014-15 and (2nd, 3rd & 4th years) w.e.f batch 2013-14 approved in the 22nd BOS of USET on 30th June, 2014 and approved in the 37th AC Sub Committee Meeting held on 10th July, 2014.
FLUID MECHANICS

Paper Code: ETME-201

Paper: Fluid Mechanics

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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.

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, Euler’s 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.

UNIT- III


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


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.


Text Books:


Reference Books:

MECHANICS OF SOLIDS

Paper Code: ETTE-211
Paper: Mechanics of Solids

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INSTRUCTIONS TO PAPER SETTERS

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.

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 deflection of cantilevers and beams under concentrated and uniformly distributed loads. Moment Area method, Macaulay’s method; principle of superposition.

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.

UNIT– IV
Springs: Close-coiled springs, leaf springs.
Cylinders: Thin and thick cylinders, Lame’s Theorem, compound cylinders, spherical vessels.

Text Books:

Reference Books:
SWITCHING THEORY AND LOGIC DESIGN LAB

Paper Code: ETEC-253

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<th>Paper: Switching Theory and Logic Design Lab</th>
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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
Paper: Numerical Analysis & Statistical Techniques Lab

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

2. Solution of algebraic and transcendental equation using Gauss- Seidal’s iteration method.
3. Solution of algebraic and transcendental equation using Finite difference method.
6. Calculation of probability using probability distributions.
7. Calculation of correlation coefficient.
8. Calculation of Numerical measures such as mean, variance, Skewness & Kurtosis.
10. Calculation of Rank Correlation.
11. Analysis of samples using ANOVA.

NOTE: At least 8 Experiments out of the list must be done in the semester.
MEASUREMENTS AND INSTRUMENTATION LAB

Paper Code: ETMT-255
Paper: Measurements and Instrumentation Lab

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
Paper: MECHANICS OF SOLIDS & FLUIDS LAB

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.
ORNIGATIONAL BEHAVIOUR

Paper Code: ETMT-202
Paper: Organizational Behaviour

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.

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.

UNIT-III

UNIT-IV
INTERACTIVE ASPECTS OF ORGANIZATIONAL BEHAVIOUR: Interpersonal Behaviour: Johari Window; Transactional Analysis – egostates, types of transactions, life positions, applications of T.A, Group Dynamics; Management of Organizational Conflicts; Leadership Styles.

TEXT BOOKS:

REFERENCES:
[R1] Stoner, R. James A.F., Edward Freeman Daniel R Gilbert Jr., Management 6TH Ed, PHI
KINEMATICS AND DYNAMICS OF MACHINERY

Paper Code: ETMT-204
Paper: KINEMATICS AND DYNAMICS OF MACHINERY

L T/P C
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 pairs, Grubler’s rule for degree of freedom, Grashof’s Criterion for mobility determination Inversions of 3R-P, 2R-2P chains, Kinematic analysis of planar mechanism

UNIT – II
Cams: Classification, Cams with uniform acceleration and retardation, SHM, Cycloidal 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.

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.

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

Text Books:

Reference Books:
[R1] Shigley J E “Theory of Machines”, Pearson
[R2] Thomas Beven, “The Theory of Machines”, CBS Publishers,
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

Singular Functions: Unit impulse, unit step, unit ramp, complex and exponential, parabolic, Signum, Sinc etc.

Transformation in independent variable of signals: Time scaling, Time shifting, Amplitude scaling.

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.


UNIT- II


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


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


Text Books:
Reference Books:

CONTROL SYSTEMS

Paper Code: ETEE-212
Paper: Control Systems

L T/P C
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

[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

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

Text Books:


Reference Books:

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

UNIT – I


UNIT – II

Thermodynamic Property Relations: Maxwell Relations. Clapeyron Equation.


UNIT - III:

UNIT – IV
Gas Power Cycles: Carnot cycle, Otto cycle, Diesel cycle, Dual cycle. Sirling cycle, and Ericsson cycle.

Text Books:

Reference books:
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.

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.

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.

UNIT IV
Application, failure and trouble shooting

Text Books:

Reference Books:
KINEMATICS AND DYNAMICS OF MACHINERY LAB

Paper Code: ETMT-252
Paper: Kinematics and Dynamics of Machinery Lab

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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.
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 undamped 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
Paper: Signals and Systems Lab

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
Paper: Control Systems Lab
L T/P C
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 acservomotor 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 2nd 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 2nd 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:

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.
10. Study of Meter-in & Meter-out circuits.
11. To understand use of accumulator in hydraulic circuit.

NOTE:- At least 8 Experiments out of the list must be done in the semester.
COMMUNICATION SKILLS FOR PROFESSIONALS

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<td>Paper: Communication Skills For Professionals</td>
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**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)


**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.

**UNIT-III**


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


**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.
Text Books:

References Books:
MACHINE ELEMENT DESIGN

Paper Code: ETMT-303
Paper: Machine Element Design

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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.

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.

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.

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.

Text Books:

Reference Book:

INSTRUCTIONS TO PAPER SETTERS:  
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.
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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.

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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.

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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.

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.

Text Books:

Reference Book:
METROLOGY AND QUALITY CONTROL

Paper Code: ETMT-305
Paper: Metrology and Quality Control

L T/P C
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.

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.

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

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.

Text Books:

Reference Books:
[R2] Beckwith, Buck, Lienhard, Mechanical Measurements, Pearson Education Asia.
DIGITAL SIGNAL PROCESSING

Paper Code: ETMT-307

Paper: Digital Signal Processing

L  T/P  C
3  1   4

INSTRUCTIONS TO PAPER SETTERS:

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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.

MAXIMUM MARKS: 75

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, Levenson 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:
[T2]  Proakis and Manolakis, Digital Signal Processing, PHI Publication

Reference Books:
SENSEORS AND TRANSDUCERS

Paper Code: ETMT-309
Paper: Sensors and Transducers

L T/P C
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

UNIT-II
Thermal sensors: Gas thermometric sensors, Dielectric constant, refractive index thermo-sensors, nuclear thermometers, resistance change type thermometric sensors, Thermoelectric sensors.

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

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

UNIT-III
Electroanalytical sensors: Electrochemical cell, SHE, Polarization, Reference electrode, Metal electrodes, Membrane electrodes, Electroceramics.


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.

Text Books:

Reference Book:
POWER ELECTRONICS AND DRIVES

Paper Code: ETMT-311
Paper: Power Electronics and Drives

INSTRUCTIONS TO PAPER SETTERS:

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.

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.

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.

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.

Text:

References:
[R2] Ned Mohan, Tore M. Undeland and Robbins, “Power Electronics: Converters, Applications and Design” Wiley India Publication
[R5] M.S. Jamil Asghar, “Power Electronics” PHI Publication
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:

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

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List of Experiments:

1. Study & working of simple measuring instruments- Vernier calipers, micrometer, tachometer.
4. Study of angular measurement using level protector.
5. Adjustment of spark plug gap using feeler gauges.
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
14. Precision Angular measurement using Autocollimator / Angle Dekkor.
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
   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
Paper: Sensors and Transducers Lab

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List of Experiments:

1. Study of various sensors e.g. thermocouple, RTD, thermistor, magnetic sensors, 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. Calibration 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

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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.
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

Paper: Management of Manufacturing systems

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INSTRUCTIONS TO PAPER SETTERS:

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.

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.

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.

UNIT IV:

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

Text Books:


Reference Book:

MANUFACTURING TECHNOLOGY

Paper Code: ETMT-304
Paper: Manufacturing Technology

L T/P C
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, CO₂-process, fluid sand process, shell moulding, cold curing process, hot-box method, flaskless moulding, Design of metal moulds, Die Design for die Casting.

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.

UNIT - III

UNIT - IV

Text Books:

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

Reference Books:

PROGRAMMABLE LOGIC CONTROLLER & SCADA

Paper Code: ETMT-306
Paper: Programmable Logic Controller & SCADA

INSTRUCTIONS TO PAPER SETTERS:

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.

MAXIMUM MARKS: 75

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

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.

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.

UNIT-IV

Text Books:

Reference Books:
[R1] Stuart A.Boyer “Supervisors Control and Data Acquisition”, ISA
[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-I
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.

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.

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.

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.

Automated Material Handling Systems and Advanced Manufacturing Systems:

Text Books:
Reference Books:


AUTOMOTIVE ELECTRONICS

Paper Code: ETMT-310

Paper: Automotive Electronics

L     T/P  C
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

UNIT- II
AUTOMOTIVE CONTROL SYSTEM APPLICATIONS OF SENSORS AND ACTUATORS:

UNIT- III
AUTOMOTIVE ENGINE CONTROL SYSTEMS:

UNIT- IV
AUTOMOTIVE MONITORING AND DIAGNOSTICS:

Text Books:

Reference Books:

Scheme and Syllabi for B. Tech-Mechatronics, 1st year (Common to all branches) w.e.f batch 2014-15 and (2nd, 3rd & 4th years) w.e.f batch 2013-14 approved in the 22nd BOS of USET on 30th June, 2014 and approved in the 37th AC Sub Committee Meeting held on 10th July, 2014.
MICROPROCESSORS AND MICROCONTROLLERS

Paper Code: ETMT-312
Paper: Microprocessors and Microcontrollers

INSTRUCTIONS TO PAPER SETTERS:

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.

MAXIMUM MARKS: 75

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

UNIT- I

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.

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.

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.

Text Books:
[T3] Ramesh Gaonkar, “MicroProcessor Architecture, Programming and Applications with the 8085”, PHI

References Books:
PROGRAMMABLE LOGIC CONTROLLER & SCADA LAB

Paper Code: ETMT-352        L    T/P    C
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
Paper: Computer Integrated Manufacturing Lab

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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

Paper: Automotive Electronics Lab

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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.
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

Paper Code: ETMT-358
Paper: Microprocessors and Microcontrollers Lab

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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  
Paper: Computer Aided Design

L  T/P  C

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


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

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

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


UNIT-III


UNIT-IV

Text Books:

Reference Book:
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.

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 probe, 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.

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.

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.

Text Books:
MECHATRONICS SYSTEM DESIGN

Paper Code: ETMT-405  
Paper: Mechatronics System Design  
L T/P C  
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.

UNIT - II

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, Brush 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.

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.
text Book:

Reference Books:
[R2] Dan Necsulescu, Mechatronics, Pearson
L.C. ENGINES

Paper Code: ETMT-407
Paper: L.C. Engines

L T/P C
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.

UNIT-II

UNIT-III

UNIT-IV

Text Books:

Reference Books:
DIGITAL IMAGE PROCESSING

Paper Code: ETMT-409
Paper: Digital Image Processing

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MAXIMUM MARKS: 75

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:


[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.


[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:


Reference Books:


Scheme and Syllabi for B. Tech-Mechatronics, 1st year (Common to all branches) w.e.f batch 2014-15 and (2nd, 3rd & 4th years) w.e.f batch 2013-14 approved in the 22nd BOS of USET on 30th June, 2014 and approved in the 37th AC Sub Committee Meeting held on 10th July, 2014.
# PRODUCT DESIGN AND COSTING

**Paper Code:** ETMT-411  
**Paper:** Product Design and Costing

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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.  

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

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

**UNIT – III**  
**Concept Selection:** Introduction, technical feasibility, Pugh concept selection chart  
**Concept Embodiment:** Refining Geometry and Layout  
**Design for manufacturing and Assembly:** design Guidelines.

**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.

**Text Books:**

- [T3] Khan, Siddiquee, Kumar “Engineering Economy” Pearson

**Reference Books:**

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
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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

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.

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

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.


Text Books:

Reference Books:
# PROCESS MODELLING & OPTIMIZATION TECHNIQUES

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


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

### Text Books:


[T2] Stephanopoulos G. “Chemical Process Control: An Introduction to Theory and Practice”, PHI

### Reference Books:


AUTOMOBILE ENGINEERING

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

INSTRUCTIONS TO PAPER SETTERS:
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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.

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.

UNIT III

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.

Text Books:
[T2] R K Rajput,” A text Book on Automobile Engineering”; Laxmi publication

Reference Books:

INSTRUCTIONS TO PAPER SETTERS: MAXIMUM MARKS: 75
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Text Books:
[T2] R K Rajput,” A text Book on Automobile Engineering”; Laxmi publication

Reference Books:
DATABASE MANAGEMENT SYSTEMS

Paper Code: ETCS-425  
Paper: Database Management Systems  

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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-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.

Text Books:

References Books:
ARTIFICIAL INTELLIGENCE

Paper Code: ETCS-429
Paper: Artificial Intelligence

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INSTRUCTIONS TO PAPER SETTERS:

MAXIMUM MARKS: 75

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**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

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

**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

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

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

**Text Book:**

**Reference Books:**
[R1] KM Fu, "Neural Networks in Computer Intelligence", McGraw Hill
WASTE AND HEAT RECOVERY SYSTEMS

Paper Code: ETMT-421
Paper: Waste and Heat Recovery Systems

INSTRUCTIONS TO PAPER SETTERS:

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.

Maximum Marks: 75

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

UNIT-I

[No. of Hrs. 11]

UNIT-II

[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.

[No. of Hrs. 11]

UNIT-IV

[No. of Hrs. 11]

Text Books:
[T1] Khartchenko N.V. Green Power: Eco-Friendly Energy Engineering, Tech Books New Delhi,

Reference Books:
MANAGEMENT INFORMATION SYSTEMS AND ERP

Paper Code: ETME-421
Paper: Management Information Systems and ERP

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

UNIT II

UNIT III

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.

Text Books:

References Books:
### FUZZY LOGIC AND NEURAL NETWORKS

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

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**Objective:** To impart knowledge of fuzzy logic and neural networks along with 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 relations


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

**UNIT-III**  
**Fuzzy Inference System:** Fuzzy Modeling, Mamdani Fuzzy model, TSK Fuzzy model, Fuzzy Controller, Industrial Applications.


[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:**

**References Books:**
- [R5] S N Sivanandam, “Neural Network using Matlab” TMH 2013
OPERATIONS RESEARCH

Paper Code: ETMT-427

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MAXIMUM MARKS: 75

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


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

[©][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.


[©][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.

[©][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.


[©][No. of Hrs. 11]

Text Books:


Reference Books:


DECISION SCIENCE

Paper Code: ETMT-429

Paper: Decision Science

L  T/P  C
3  0  3

INSTRUCTIONS TO PAPER SETTERS:

MAXIMUM MARKS: 75

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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


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.

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.

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.

Text Books:

References Book:
RENEWABLE ENERGY RESOURCES

Paper Code: ETEE-419
Paper: Renewable Energy Resources

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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.

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.

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, 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.

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 steady-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.

Text Books:

References Books:
FINITE ELEMENT METHODS

Paper Code: ETME-423
Paper: Finite Element Methods

### INSTRUCTIONS TO PAPER SETTERS:

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

**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

**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

**UNIT III**

**Eigen value problems:**
- Formulation and problems
- Single value problem in 2D: Boundary value problem, axis symmetric problems

**UNIT IV**

**Numerical on 2D Solid mechanics:**
- Interpolation function (triangular, Quadrilateral, serendipity elements)
- Numerical integration and modelling consideration

**Text Books:**

**Reference Books:**
- [R2] Larry J. Segerlind, “Applied Finite-Element Analysis”, John Wiley and Sons
### SOCIOMETRY AND ELEMENTS OF INDIAN HISTORY FOR ENGINEERS

**Paper Code:** ETHS-419  
**Paper:** Sociology and Elements of Indian History for Engineers  
**L T/P C**  
3 0 3

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**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.

**Module 1B:** Introduction to sociological concepts-structure, system, organization, social institution; Culture social stratification (caste, class, gender, power). State & civil society.

---

**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.

**Module 2B:** Understanding social structure and social processes: Perspectives of Marx, Weber & Durkheim.

---

**UNIT III**

**Module 3A:** From Feudalism to colonialism-the coming of British; Modernity & struggle for independence.

**Module 3B:** Understanding social structure and social processes: Perspectives of Marx, Weber & Durkheim.

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**UNIT IV**

**Module 4A:** Issues & concerns in post-colonial India (upto 1991); Issues & concerns in post-colonial India 2nd phase (LPG decade post 1991).

**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.

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**Text Books:**


**Reference Books:**

- [R1] Guha, Ramachandra (2007), India After Gandhi, Pan Macmillan

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Scheme and Syllabi for B. Tech-Mechatronics, 1st year (Common to all branches) **w.e.f batch 2014-15** and (2nd, 3rd & 4th years) **w.e.f batch 2013-14** approved in the 22nd BOS of USET on 30th June, 2014 and approved in the 37th AC Sub Committee Meeting held on 10th July, 2014.
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:

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) \[\text{L} \quad \text{T/P} \quad \text{C}\]

**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

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<td>Paper: Automobile Engineering Lab</td>
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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 find the basic feasible solution of the given Transportation Problem using North West Corner Rules or by least cost method.
12. Make a program in C++ to solve the given Queuing Theory Problem of model 1.
13. Make a program in C++ to solve the given Assignment Problem.
14. Make a program in C++ to give the critical path for the given network problem.
15. 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
Paper: Robotics

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 analyze/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

**UNIT - II**
Robot Kinematics: Mapping, Homogeneous transformations, Rotation matrix, Forward Kinematics (DH Notation) and inverse kinematics; Closed form solution.

**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)

**UNIT - IV**

**Text Books:**

**Reference Books:**

Guru Gobind Singh Indraprastha University

Scheme and Syllabi for B. Tech-Mechatronics, 1st year (Common to all branches) w.e.f batch 2014-15 and (2nd, 3rd & 4th years) w.e.f batch 2013-14 approved in the 22nd BOS of USET on 30th June, 2014 and approved in the 37th AC Sub Committee Meeting held on 10th July, 2014.
Objective: The objective of the paper is to enable a student to design an embedded system for specific tasks.

UNIT- I

PIC Microcontrollers: Architecture, registers, memory interfacing, interrupts, instructions, programming and peripherals.

UNIT- II
ARM Processors: Comparison of ARM architecture with PIC microcontroller, 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, PCl, AMBA, I2C and SPI Buses.

UNIT- III
Embedded Software, Concept of Real Time Systems, Software Quality Measurement, Compilers for Embedded System

UNIT-IV

Text book:
[T1] Design with PIC Microcontrollers, John B. Peatman, Pearson Education Asia, 2002

References Books:
[R1] The Design of Small-Scale embedded systems, Tim Wilmhurst, Palgrave2003
HUMAN VALUES & PROFESSIONAL ETHICS – II

Paper Code: ETHS-402
Paper: Human Values & Professional Ethics-II

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:
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.


UNIT II – Engineers responsibility for safety:

Some Case Studies: Case Studies, BHOPAL Gas Tragedy, Nuclear Power Plant Disasters, Space Shuttle Challenger, Three Mile Island Accident, etc.

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

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**.

INSTRUCTIONS TO PAPER SETTERS:

MAXIMUM MARKS: 75

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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**.
Text Books:
[T1] Professional Ethics, R. Subramanian, Oxford University Press.

References Books:
[R9] PSR Murthy, “Indian Culture Values and Professional Ethics”, BS Publications
[R10] Caroline Whitback< Ethics in Engineering Practice and Research, Cambridgs University Press
[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

**Paper:** Engineering System Modeling and Simulation

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**INSTRUCTIONS TO PAPER SETTERS:**

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.

**UNIT – II**

**Mechanical Event Simulation (Finite Element modelling and Analysis):**

**UNIT – III**

**System Simulation:**
Introduction, Review of probability and statistics, Managing the event calendar in a discrete event simulation model, Modelling input data.

**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.

**Text Book:**

**T1** W. Bolton, “Mechatronics – Electronic control systems in Mechanical & Electrical Engineering”, Pearson Education Ltd.


**T3** Sankar Sengupta, System Simulation and modelling, Pearson.

**Reference Books:**

**R1** Deo, Narsingh, Milcian Charles E., “System Simulation With Digital Computer”, PHI.

**R2** Gordon, Geoffrey, System Simulation, PHI.

FACILITY & LAYOUT PLANNING

Paper Code: ETMT-410
Paper title: Facility & Layout Planning

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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:

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, inner’s Basic Steps.

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.

UNIT-IV
Quantitative approaches to facilities planning:

Text Books:

Reference Books:
OBJECT ORIENTED SOFTWARE ENGINEERING

Paper Code: ETCS-412
Paper: Object Oriented Software Engineering

INSTRUCTIONS TO PAPER SETTERS:

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.

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.

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.

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.

Text Books:

Reference Books:
[R2] Booch, Maksimchuk, Engle, Young, Conallen and Houston, “Object Oriented Analysis and Design with Applications”, Pearson Education.
FACTORY AUTOMATION

Paper Code: ETMT-414  
Paper: Factory Automation

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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.
Compressed air generation and contamination control
Air compressor types, preparation, stages of repairation, 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.

Text Book:

| T2 | Joji P, Pneumatic Controls, Wiley; |

Reference Books:

| R1 | Dan Necsulescu, Mechatronics, Pearson |
REFRIGERATION & AIR CONDITIONING

Paper Code: ETMT-416  
Paper: Refrigeration & Air Conditioning  
L  T/P  C  
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
Air Refrigeration systems: Bell Coleman Cycle, Dense Air System, Open Air System, Analysis of Simple Air Refrigeration Cycle for Aircraft.

UNIT II
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.

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.

UNIT IV:

Text Books:

References Books:
VLSI DESIGN

Paper Code: ETIC-414
Paper: VLSI Design

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MAXIMUM MARKS: 75

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.

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.

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.

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.

Text Books:

Reference Book:
DATA COMMUNICATION & NETWORKS

Paper Code: ETEC-420
Paper: Data Communication & Networks

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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

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

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:

Reference Books:
CONSUMER ELECTRONICS

Paper Code: ETEC-408
Paper: Consumer Electronics

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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.

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, 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.

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.

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.

Text Books:
Reference Books:

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

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.

UNIT-III

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.

Text Books

Reference Books:
INTELLIGENT AND SMART INSTRUMENTATION

Paper Code ETMT-424
Paper: Intelligent and Smart Instrumentation

INSTRUCTIONS TO PAPER SETTERS:

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.

MAXIMUM MARKS: 75

Objective:- To introduce modern devices and techniques used in instrumentations, especially in automation and critical applications.

UNIT-I

UNIT-II
Sensors:- Primary sensors; Excitation; Amplification; Filters; Converters; Compensation (Nonlinearity: 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.

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.

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.

Text Books:

Reference Books:-
[R2] P.Rai Choudhury, MEMS and MOEMS Technology and Application, PHI
[R3] Barney, “ Intelligent Instrumentation, Microprocessor Applications in measurement and Control”, PHI

Scheme and Syllabi for B. Tech-Mechatronics, 1st year (Common to all branches) w.e.f batch 2014-15 and (2nd, 3rd & 4th years) w.e.f batch 2013-14 approved in the 22nd BOS of USET on 30th June, 2014 and approved in the 37th AC Sub Committee Meeting held on 10th July, 2014.
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


UNIT II


UNIT III


UNIT IV


Text Books:


Reference Books:

FLEXIBLE MANUFACTURING SYSTEM

Paper Code: ETMT-428
Paper: Flexible Manufacturing System

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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, Installation and examples of FMS, optimization of FMS, typical layout of FMS, The FMS software. Feasibility report of FMS, advanced control cycle of FMS.

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.

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.

UNIT IV

Text Books:

Reference Books:
ENGINEERING ECONOMICS & COST ANALYSIS

Paper Code: ETMT-430
Paper: Engineering Economics & Cost Analysis

L T/P C
3 0 3

INSTRUCTIONS TO PAPER SETTERS:

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

MAXIMUM MARKS: 75

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.

UNIT – II
Cost Concepts, Elements of costs, Preparation of cost sheet, Segregation of costs into Fixed and variable costs, Break-even Analysis-Linear Approach.

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.

UNIT IV
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.

Text Books:
[T1] Sullivan, Wicks, Koelling, “Engineering Economy”, Pearson Education

References Books:
[R7] Khan, Siddiquee, Kumar, “Engineering Economy” Pearson Education
ROBOTICS LAB

Paper Code: ETMT-452
Paper: Robotics Lab

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 analyze/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)
- ReurlDyn (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
Paper: Embedded Systems Lab

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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 bit 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 tethedran element) on a Simple model with pressure loading and surface constraints;

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)  
**Paper:** VLSI Design Lab  
**L T/P C**  
0 2 1

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<td>1) To study the MOS characteristics and introduction to Tanner EDA software tools.</td>
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<td>2) To design and study the DC characteristics of PMOS and NMOS.</td>
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<tr>
<td>3) To design and study the DC characteristics of resistive inverter.</td>
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<tr>
<td>4) To design and study the transient and DC characteristics of CMOS inverter.</td>
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<td>5) To design and study the characteristics of CMOS NAND and NOR gate.</td>
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<td>6) To design and study the characteristics of CMOS multiplexer.</td>
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<td>7) To design any Boolean function using transmission gates.</td>
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<td>8) To design and study the characteristics of CMOS Full adder.</td>
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<td>9) To design and study the characteristics of CMOS D Flip Flop.</td>
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<td>10) To design and study the transient characteristics of CMOS XOR/XNOR.</td>
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<td>11) To design and study the characteristics of Schmitt trigger circuit.</td>
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**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.