B.TECH

IN

MECHATRONICS ENGINEERING

Regulations, Curriculum and Syllabus

2019 - 2020 ONWARDS
BACHELOR OF TECHNOLOGY PROGRAMME

IN

MECHATRONICS ENGINEERING

(EIGHT SEMESTERS)

REGULATIONS

1. Conditions for Admission:

(a) Candidates for admission to the first semester of the eight semester B. Tech Degree programme should be required to have passed:

The higher Secondary Examination of the (10+2) curriculum (Academic Stream) prescribed by the Government of Tamil Nadu or any other examination equivalent there to with minimum of 45% marks (40% marks for OBC and SC/ST candidates) in aggregate of subjects – Mathematics, Physics and any one of the following optional subjects: Chemistry / Biotechnology/ computer Science / Biology (Botany & Zoology) or an Examination of any University or Authority recognized by the Executive Council of the Pondicherry University as equivalent thereto.

(b) For Lateral entry in to third semester of the eight semester B.Tech Degree programme:

The minimum qualification for admission is a pass in three year diploma or four years sandwich diploma course in engineering / technology from an AICTE approved institution with at least 45% marks (40% marks for OBC and SC/ST candidates) in aggregate in the subjects covered from 3rd to final semester or a pass in B.Sc. degree from a recognized university as defined by UGC with at least 45% marks (40% marks for OBC and SC/ST candidates) and passed XII standard with mathematics as one of the subject.

Provided that in case of students belonging to B.Sc. stream shall clear the subjects of Engineering Graphics and Engineering mechatronics of the first year Engineering program along with the second year subjects.

Provided further that, the students belonging to B.Sc. stream shall be considered only after filling the supernumerary seats in this category with students belonging to the Diploma stream.

The list of diploma programs approved for admission for each of the degree programs is given in Annexure A.
2. Age limit:

The candidate should not have completed 21 years of age as on 1\textsuperscript{st} July of the academic year under consideration. For lateral entry admission to second year of degree programme, there is no age limit. For SC/ST candidates, age limit is relaxable by 3 years.

3. Duration of Programme:

The Bachelor of Technology degree programme shall extend over a period of 8 consecutive semesters spread over 4 academic years – two semesters constituting one academic year. The duration of each semester shall normally be 15 weeks excluding examinations.

4. Eligibility for the award of Degree:

No candidate shall be eligible for the award of the degree of Bachelor of Technology, unless he/she has undergone the course for a period of 8 semesters (4 academic years) / 6 semesters (3 academic years for Lateral Entry candidates) in the faculty of Engineering and has passed the prescribed examinations in all the semesters.

5. Branches of study:

- Branch I : Civil Engineering
- Branch II : Mechanical Engineering
- Branch III : Electronics and Communication Engineering
- Branch IV : Computer Science and Engineering
- Branch V : Electrical and Electronics Engineering
- Branch VI : Chemical Engineering
- Branch VII : Electronics and Instrumentation Engineering
- Branch VIII : Information Technology
- Branch IX : Instrumentation and Control Engineering
- Branch X : Biomedical Engineering
- Branch XI : Mechatronics Engineering

or any other branches of study as and when offered. The branch allocation shall be ordinarily done at the time of admission of the candidate to the first semester.

6. Subjects of study:

The subjects of study shall include theory and practical courses as given in the curriculum and shall be in accordance with the prescribed syllabus. The subjects of study for the first two semesters shall be common for all branches of study.
7. Examinations:

The theory and practical examination shall comprise continuous assessment throughout the semester in all subjects as well as university examinations conducted by Pondicherry University at the end of the semester (November / December (or) April / May)

(a) **Theory courses for which there is a written paper of 75 marks in the university examination.**

The Internal assessment marks of 25 has to be distributed as 10 marks each for two class tests and 5 marks for class attendance in the particular subject. The distribution of marks for attendance is as follows.

- 5 marks for 95% and above
- 4 marks for 90% and above but below 95%
- 3 marks for 85% and above but below 90%
- 2 marks for 80% and above but below 85%
- 1 mark for 75% and above but below 80%

In total, three tests are to be conducted and the better two are to be considered for assessment.

(b) **Practical courses for which there is a university practical examination of 50 marks:**

The internal assessment marks of 50 has to be distributed as 20 marks for the periodic practical works and records submitted thereof, 15 marks for an internal practical examination, 5 marks for an internal viva voce, and 10 marks for class attendance in the particular subject. The distribution of marks is as given below.

- 10 marks for 95% and above
- 8 marks for 90% and above but below 95%
- 6 marks for 85% and above but below 90%
- 4 marks for 80% and above but below 85%
- 2 marks for 75% and above but below 80%

8. **Requirement for appearing for University Examination:**

A candidate shall be permitted to appear for university examination at the end of any semester only if:

(i) He / She secures not less than 75% overall attendance arrived at by taking into account the total number of periods in all subjects put together offered by the institution for the semester under consideration.

(Candidates who secure overall attendance greater than 60% and less than 75% have to pay a condonation fee as prescribed by University along with a medical certificate obtained from a medical officer not below the rank of Asst. Director).
(ii) He / She earn a progress certificate from the Head of the institution for having satisfactorily completed the course of study in all the subjects pertaining to that semester.

(iii) His / Her conduct is found to be satisfactory as certified by the Head of the institution. A candidate who has satisfied the requirement (i) to (iii) shall be deemed to have satisfied the course requirements for the semester.

9. Procedure for completing the course:

A candidate can join the course of study of any semester only at the time of its normal commencement and only if he/she has satisfied the course requirements for the previous semester and further has registered for the university examinations of the previous semester in all the subjects as well as all arrear subjects, if any.

However, the entire course should be completed within 14 consecutive semesters (12 consecutive semester for students admitted under lateral entry).

10. Passing Minimum:

(a) A candidate shall be declared to have passed the examination in a subject of study only if he/she secures not less than 50% of the total marks (Internal assessment plus University examination marks) and not less than 40% of the marks in University examination.

(b) A candidate who has been declared “Failed” in a particular subject may reappear for that subject during the subsequent semester and secure a pass. However, there is a provision for revaluation of failed subjects provided he/she fulfills the following norms for revaluation.

1. Applications for revaluation should be filed within 4 weeks from the date of declaration of results (or) 15 days from the date of receipt of marks card whichever is earlier.
2. The candidate should have attended all the college examinations as well as university examinations.
3. If a candidate has failed in more than two papers in the current university examination, his/her representation for revaluation will not be considered.
4. The request for revaluation must be made in the format prescribed and duly recommended by the Head of the Institution along with the revaluation fee prescribed by the university.

Further, the University examination marks obtained in the latest attempt shall alone remain valid in total suppression of the University examination marks obtained by the candidate in earlier attempts.
11. Award of Letter Grades:

The assessment of a course will be done on absolute marks basis. However, for the purpose of reporting the performance of a candidate, letter grades, each carrying certain points, will be awarded as per the range of total marks (out of 100) obtained by the candidate, as detailed below:

<table>
<thead>
<tr>
<th>Range of Total Marks</th>
<th>Letter Grade</th>
<th>Grade Points</th>
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<tbody>
<tr>
<td>90 to 100</td>
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<td>80 to 89</td>
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<tr>
<td>70 to 79</td>
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<tr>
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<td>FA</td>
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</table>

‘F’ denotes failure in the course. ‘FA’ denotes absent / detained as per clause 8.

After results are declared, grade sheets will be issued to the students. The grade sheets will contain the following details:

(a) The college in which the candidate has studied.
(b) The list of course enrolled during the semester and the grades scored.
(c) The Grade Point Average (GPA) for the semester and the cumulative Grade Point Average (CGPA) of all enrolled subjects from first semester onwards.
(d) GPA is the ratio of sum of the products of the number of credits (C) of courses registered and the corresponding grade points (GP) scored in those courses, taken for all the courses and sum of the number of credits of all the courses.

\[
GPA = \frac{\text{Sum of } (C \times GP)}{\text{Sum of Credit}}
\]

CGPA will be calculated in a similar manner, considering all the courses enrolled from first semester. FA grades are to be excluded for calculating GPA and CGPA. The conversion of CGPA into percentage marks is as given below.

\[
MARKS = (\text{CGPA} - 0.5) \times 10
\]
12. Award of Class and Rank:

1. A candidate who satisfies the course requirements for all semesters and who passes all the examinations prescribed for all the eight semesters (six semesters for lateral entry candidates) within a maximum period of 7 years (6 years for lateral entry candidates) reckoned from the commencement of the first semester to which the candidate was admitted shall be declared to have qualified for the award of degree.

2. A candidate who qualifies for the award of the degree passing in all subjects pertaining to semesters 3 to 8 in his/her first appearance within 6 consecutive semesters (3 academic years) and in addition secures a CGPA of 8.50 and above for the semesters 3 to 8 shall be declared to have passed the examination in FIRST CLASS with DISTINCTION.

3. A candidate who qualifies for the award of the degree by passing in all subjects relating to semesters 3 to 8 within a maximum period of eight semesters after his/her commencement of study in the third semester and in addition secures CGPA not less than 6.5 shall declared to have passed the examination in FIRST CLASS.

4. All other candidates who qualify for the award of degree shall be declared to have passed the examination in SECOND CLASS.

5. For the Award of University ranks and Gold Medal for each branch of study, the CGPA secured from 1st to 8th semester alone should be considered and it is mandatory that the candidate should have passed all the subjects from 1st to 8th semester in the first attempt. Rank certificates would be issued to the first ten candidates in each branch of study.

13. Provision for withdrawal:

A candidate may, for valid reasons, and on the recommendation of the Head of the Institution, be granted permission by the University to withdraw from writing the entire semester examination as one Unit. The withdrawal application shall be valid only if it is made earlier than the commencement of the last theory examination pertaining to that semester. Withdrawal shall be permitted only once during the entire course. Other conditions being satisfactory, candidates who withdraw are also eligible to be awarded DISTINCTION whereas they are not eligible to be awarded a rank.
14. Discontinuation of course:

If a candidate wishes to temporarily discontinue the course for valid reasons, he/she shall apply through the Head of the Institution in advance and obtain a written order from the University permitting discontinuance. A candidate after temporary discontinuance may re-join the course only at the commencement of the semester at which he/she discontinued, provided he/she pays the prescribed fees to the University. The total period of completion of the course reckoned from the commencement of the first semester to which the candidate was admitted shall not in any case, exceed 7 years, including of the period of discontinuance.

15. Revision of Regulations and Curriculum:

The University may from time to time revise, amend (or) change the regulations of curriculum and syllabus as and when found necessary.
## ANNEXURE-A

<table>
<thead>
<tr>
<th>B.Tech courses in which admission is sought</th>
<th>Diploma courses eligible for admission</th>
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<tbody>
<tr>
<td><strong>Civil Engineering</strong></td>
<td>Civil Engineering</td>
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<td></td>
<td>Civil and Rural Engineering</td>
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<tr>
<td></td>
<td>Architectural Assistantship Architecture</td>
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<td>Agricultural Engineering</td>
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<tr>
<td><strong>Mechanical Engineering</strong></td>
<td>Mechanical Engineering</td>
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<td>Automobile Engineering</td>
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<tr>
<td></td>
<td>Agricultural Engineering</td>
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<tr>
<td></td>
<td>Mechanical and Rural Engineering</td>
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<td></td>
<td>Refrigeration and Air-conditioning</td>
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<td></td>
<td>Agricultural Engineering &amp; Farm Equipment Technology</td>
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<tr>
<td></td>
<td>Metallurgy</td>
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<td></td>
<td>Production Engineering</td>
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<td></td>
<td>Machine Design &amp; Drafting</td>
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<td></td>
<td>Machine Tool Maintenance and Repairs</td>
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<td></td>
<td>Printing Technology / Engineering</td>
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<td></td>
<td>Textile Engineering / Technology</td>
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<td>Tool Engineering</td>
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<tr>
<td></td>
<td>Mechatronics</td>
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<tr>
<td></td>
<td>Plastics and Moulding Technology</td>
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<tr>
<td><strong>Electrical and electronics Engineering</strong></td>
<td>Electrical Engineering</td>
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<td><strong>Electronics &amp; communication Engineering</strong></td>
<td>Electrical and Electronics Engineering</td>
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<td><strong>Electronic and instrumentation Engineering</strong></td>
<td>Electronics and Instrumentation Engineering</td>
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<td><strong>Instrumentation and control Engineering</strong></td>
<td>Instrumentation Engineering / Technology</td>
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### I Semester

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* I and II Semester Curriculum Common to all Branches- Existing Syllabus
III Semester

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IV Semester

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<td>Linear differential equations of higher order – with constant coefficients, the operator D, Euler’s linear equation of higher order with variable coefficients, simultaneous linear differential equations, solution by variation of parameters method – simple application to electric circuits.</td>
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</table>
### Text Books


### References

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<th>T102</th>
<th>PHYSICS</th>
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**Objectives:**
- To understand the concepts of physics and its significant contributions in the advancement of technology and invention of new products that dramatically transformed modern-day society.
- To expose the students to different areas of physics which have direct relevance and applications to different Engineering disciplines.
- To understand the concepts and applications of Ultrasonic, optics and some optical devices, Laser and Fiber optics, Nuclear energy sources and wave mechanics.

**Outcomes:**
- The students will gain knowledge on the basics of properties of matter and its applications.
- The students will acquire knowledge on the concepts of waves and optical devices and their applications in fibre optics.
- The students will have adequate knowledge on the concepts of thermal properties of materials and their applications in expansion joints and heat exchangers.
- The students will get knowledge on advanced physics concepts of quantum theory and its applications in tunneling microscopes.
- The students will get knowledge on nuclear energy.

**Unit I  Acoustics & NDT**

*Ultrasonic’s* – Ultrasonic Waves productions (piezoelectric & Magnetostriction method) - Detections (Acoustic Grating) NDT applications – Ultrasonic pulse echo Method - liquid penetrant Method

**Acoustics** - Factors affecting Acoustic of buildings (Reverberation, Loudness, Focusing, Echo, Echelon Effect and Resonance) and their Remedies – Sabine’s formula for Reverberation Time – Doppler effect and its applications to Radars. (elementary ideas)

**Unit II  Optics**

**Interference** - Air wedge – Michelson’s Interferometer - wavelength determination – Interference Filter – Antireflection Coatings

**Diffraction** - Diffraction Grating – Dispersive power of grating – Resolving power of grating & Prism

**Polarization** - Basic concepts of double refraction – Huygens Theory of Double Refraction – Quarter and Half Wave Plates – Specific Rotary Power – Laurent Half Shade Polari meter

**Unit III  Lasers & Fiber Optics**


**Fiber Optics** - Principle and Propagation of light in optical fiber – Numerical aperture and acceptance angle – Types of optical fibers (material, refractive index, mode) – applications to sensors and Fiber Optics Communication
Unit IV  Wave Mechanics  

Unit V  Nuclear Energy Source  

Text Books
1. V Rajendran, Engineering Physics, 2nd Edition TMH, New Delhi 2011 (For Units I to IV only)

References
<table>
<thead>
<tr>
<th>T103</th>
<th>CHEMISTRY</th>
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**Objectives:**
- To know about the importance of Chemistry in Engineering domain
- To understand the chemistry background of industrial process
- To apply chemistry knowledge for Engineering disciplines

**Outcomes:**
- The knowledge gained on engineering materials, fuels, energy sources and water treatment techniques will facilitate better understanding of engineering processes and applications for further learning.

**Unit I  Water** (12 Hours)

**Unit II  Polymers** (12 Hours)

**Unit III  Electrochemical Cells** (12 Hours)

**Unit IV  Corrosion and its Control** (12 Hours)

**Unit V  Phase Rule** (12 Hours)
Definition and derivation of phase rule. Application to one component system - water and Sulphur systems. Thermal analysis, condensed phase rule. Two component systems – Pb - Ag, Cu-Ni and Mg-Zn systems.
| Text Books                                                                                                                                 |
|---|---|

<p>| References                                                                 |
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<tr>
<th>T104</th>
<th>BASIC ELECTRICAL AND ELECTRONICS ENGINEERING</th>
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**Objectives:**
- To understand and gain basic knowledge about magnetic and electrical circuits, single phase and three phase power measurement and the operating principles of stationary and rotating machines.
- To understand the basic operation, functions and applications of PN junction diode, transistor, logic gates and flip flops.
- To gain knowledge on various communication systems and network models and the use of ISDN.

**Outcomes:**
- Understand electric circuits and working principles of electrical machines.
- Understand the concepts of various electronic devices.
- Choose appropriate instruments for electrical measurement for a specific application.

**PART A – ELECTRICAL**

**Unit I  DC Circuits**  
(10 Hours)

**Unit II  AC Circuits**  
(10 Hours)
Concepts of AC circuits – Rms value, average value, form and peak factors – simple RLC series circuits – concept of real and reactive power – power factor – introduction to three phase system – power measurement by two wattmeter method.

**Unit III  Electrical Machines and Power Plants**  
(10 Hours)

**PART B – ELECTRONICS**

**Unit IV  Electronic Circuits**  
(10 Hours)
V-I characteristics of diode – Half-wave rectifier and full-wave rectifier – with and without capacitor filter – Transistor – Construction & working – input and output characteristics of CB and CE configuration – Transistor as an Amplifier – Principle and working of Hartley oscillator and RC phase shift oscillator – Construction and working of JFET & MOSFET.

**Unit V  Digital Electronics**  
(10 Hours)
**UNIT VI Communication and Computer Systems**

(10 Hours)

Model of communication system – Analog and digital – Wired and wireless channel. Block diagram of various communication systems – Microwave, satellite, optical fiber and cellular mobile system.

Network model – PAN, LAN, MAN and WAN – Circuit and packet switching – Overview of ISDN.

<table>
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<th>Text Books</th>
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</table>
Objectives:
- To understand the basics of the thermodynamic principles
- To establish the relationship of these principles to thermal system behaviors
- To develop methodologies for predicting the system behavior
- To establish the importance of laws of thermodynamics applied to energy systems
- To explain the role of refrigeration and heat pump as energy systems
- To develop an intuitive understanding of underlying physical mechanism and a mastery of solving practical problems in real world

Outcomes:
- Express the laws and basic concept of thermodynamics
- Draw PV diagram and obtain the performance of air standard cycles
- Carry one dimensional heat transfer through conduction for a given system
- Explain the types of convection and determine heat transfer coefficient
- Compute the radiation effect among different surfaces

Unit I Basic Concepts And Definitions (12 Hours)

Unit II First Law of Thermodynamics (12 Hours)
The concept of work and adiabatic process – First law of thermodynamics – conservation of Energy Principle for closed and open systems – Calculation of work for different processes of expansion of gases

Unit III Second Law of Thermodynamics (12 Hours)

Unit IV Gas Power Cycles (12 Hours)
Air standard cycles: The air standard carnot cycle – Air standard Otto cycle, Diesel cycle, Dual cycle and Brayton cycles and their efficiencies

Unit V Refrigeration Cycles and Systems (12 Hours)
Reverse Carnot cycle – COP – Vapor compression refrigeration cycle and systems (only theory) – Gas refrigeration cycle – Absorption refrigeration system – Liquefaction – Solidification (only theory).

Text Books
References

<table>
<thead>
<tr>
<th>T106</th>
<th>COMPUTER PROGRAMMING</th>
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**Objectives:**
- To introduce the basics of computers and information technology. To educate problem solving techniques.
- To impart programming skills in C language.
- To practice structured programming to solve real life problems.

**Outcomes:**
- Recognize the basic concepts of computers.
- Implement programs using operators and expressions.
- Demonstrate the usage of control structures.
- Execute programs using Arrays and strings.
- Summarize the concepts of structures and functions.

**Unit I**
(12 Hours)

**Unit II**
(12 Hours)
Problem solving techniques – Program – Program development cycle – Algorithm design – Flowchart – Pseudo code.

**Unit III**
(12 Hours)

**Unit IV**
(12 Hours)
Structures – Arrays and structures – nested structures – passing structures to functions – user defined date types – Union.
Pointers – pointers and arrays – pointers and functions – pointer and strings – pointer and structures.

**Unit V**
(12 Hours)

**Text Books**

**References**
### Objectives:
- To study and understand the use of OS commands
- To gain a hands on experience of compilation and execution of ‘C’ programs

### List of Experiments

1. **Study of OS Commands**
2. Write a C program to find the area of Triangle.
3. Write a C program to find the total and average percentage obtained by a student of 6 subjects.
4. Write a C program to read a three digit number and produce output like
   - 1 hundreds
   - 7 tens
   - 2 units for an input of 172.
5. Write a C program to check whether a given character is vowel or not using switch – Case statement.
6. Write a C program to print the number from 1 to 10 along with their squares.
7. Write a C program to find the sum of ‘n’ numbers using for, do – while statements.
8. Write a C program to find the factorial of a given number using Functions.
9. Write a C program to swap two numbers using call by value and call by reference.
10. Write a C program to find the smallest and largest element in an array.
11. Write a C program to perform matrix multiplication.
12. Write a C program to demonstrate the usage of local and Global variables.
13. Write a C program to perform various string handling functions: strlen, strcpy, strcat, strcmp.
14. Write a C program to remove all characters in a string except alphabets.
15. Write a C program to find the sum of an integer array using pointers.
16. Write a C program to find the Maximum element in an integer array using pointers.
17. Write a C program to create student details using Structures.
18. Write a C program to display the contents of the file on the monitor screen.
19. Create a file by getting the input from the keyboard and retrieve the contents of the file using file operation commands.
20. Write a C program to pass the parameter using command line arguments.
Objectives:

- To convey the basics of engineering drawing
- To explain the importance of an engineering drawing
- To teach different methods of making the drawing
- To establish the importance of projects and developments mode in drawing that are used in real systems
- To explain the role of computer aided design _ Auto Cad
- To develop an intuitive understanding of underlying significance of using these drawings

Introduction to Standards for Engineering Drawing practice, Lettering, Line work and Dimensioning

UNIT I
Conic sections, Involutes, Spirals, Helix. Projection of Points, Lines and planes

UNIT II
Projection of Solids and Sections of solids

UNIT III
Development of surfaces – Intersection of surfaces (Cylinder-Cylinder, cylinder-cone)

UNIT IV
Isometric projections and Orthographic projections

UNIT V
Computer Aided Drafting: Introduction to computer Aided Drafting hardware overview of application software – 2D drafting commands (Auto CAD) for simple shapes – Dimensioning.

Text Books:

Reference Books:
# BASIC ELECTRICAL AND ELECTRONIC LAB

## Objectives:
- To get an exposure on the basic electrical tools, applications and precautions
- To gain training on different types of wiring used in domestic and industrial applications
- To detect and find faults in electrical lamp and ceiling fan
- To get an exposure on the measurements of voltage and phase using CRO, basic operation and applications of devices such as PN junctions diode and transistor
- To gain a practical knowledge on the functions and applications of basic logic gates and flip flops

## ELECTRICAL LAB

### List of Experiments
1. Electrical Safety, precautions, study of tools and accessories.
2. Practices of different joints.
3. Wiring and testing of series and parallel lamp circuits.
4. Staircase wiring.
5. Doctor’s room wiring.
6. Bed room wiring
7. Godown wiring.
8. Wiring and testing a ceiling fan and fluorescent lamp circuit.
9. Study of different types of fuses, circuit’s breakers and A.C and D.C meters

## ELECTRONICS LAB

### List of Experiments
1. **Study of CRO.**
   - (a) Measurement of AC and DC voltages
   - (b) Frequency and phase measurements (using Lissajou’s figures)
2. **Verification of Kirchhoff’s Voltage and Current Laws**
   Determine the voltage and current in given circuits using Kirchhoff’s laws theoretically and verify the laws experimentally.
3. **Characteristics and applications of PN junction diode.**
   - Forward and Reverse characteristics of PN junction diode.
   - Application of diode as Half wave Rectifier – Measurement of ripple factor with and without capacitor filter.
4. **Frequency response of RC Coupled Amplifiers.**
   - Determination of frequency response of given RC coupled amplifier- Calculation of bandwidth.
5. **Study of logic gates.**
   - a) Verification of Demorgan’s theorems.
   - b) Verification of truth tables of OR, AND, NOT, NAND, NOR, EX-OR, EXNOR gates and flip-flops – JK, RS, T and D
   - c) Implementation of digital functions using logic gates and universal gates.
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<tr>
<th>T107</th>
<th>MATHEMATICS – II</th>
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<td><strong>Objectives:</strong></td>
<td>To develop the use of matrix algebra techniques for practical applications.</td>
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<td>To introduce the concepts of Curl, Divergence and integration of vectors in vector calculus which is needed for many application problems.</td>
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<td></td>
<td>To introduce Laplace transform which is a useful technique in solving many application problems and to solve differential and integral equations.</td>
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<td>To acquaint the students with Fourier transform techniques used in wide variety of situations in which the functions used are not periodic.</td>
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<td><strong>Outcomes:</strong></td>
<td>Eigen values and eigenvectors, diagonalization of a matrix, Symmetric matrices, Positive definite matrices and similar matrices.</td>
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<td>Gradient, divergence and curl of a vector point function and related identities.</td>
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<td>Evaluation of line, surface and volume integrals using Gauss, Stokes and Green’s theorems and their verification.</td>
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<td>Analytic functions, conformal mapping and complex integration.</td>
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<td>Laplace transform and inverse transform of simple functions, properties, various related theorems and application to differential equations with constant coefficients.</td>
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<tr>
<td><strong>Unit I Matrices</strong></td>
<td>Eigenvalues and Eigen vectors of a real matrix, characteristic equation, Properties of Eigenvalues and Eigenvectors. Cayley-Hamilton Theorem, Diagonalization of matrices. Reduction of a quadratic form to canonical form by orthogonal transformation. Nature of quadratic forms.</td>
<td>(12 Hours)</td>
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<td><strong>Unit II Vector Calculus</strong></td>
<td>Gradient, divergence and curl, their properties and relations. Gauss divergence theorem and Stoke’s theorem (without proof). Simple application problems</td>
<td>(12 Hours)</td>
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<td><strong>Unit III Laplace Transform</strong></td>
<td>Definition, Transforms of elementary functions, properties. Transform of derivatives and integrals. Multiplication by t and division by t. Transform of unit step function, transform of periodic functions. Initial and final value theorems</td>
<td>(12 Hours)</td>
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<td><strong>Unit IV Applications of Laplace Transform</strong></td>
<td>Methods for determining inverse Laplace transforms, convolution theorem, Application to differential equations and integral equations. Evaluation of integral by Laplace transforms.</td>
<td>(12 Hours)</td>
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<td><strong>Unit V Fourier Transform</strong></td>
<td>Fourier integral theorem (statement only), Fourier transform and its inverse, properties. Fourier sine and cosine transforms, their properties, convolution and Parseval’s identity.</td>
<td>(12 Hours)</td>
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Objectives:
- To understand the importance of material science as a subject that revolutionized modern day technologies.
- To understand the significance of material science in the development of new materials and devices for all branches of engineering.
- To impart knowledge to the engineering students about some of the important areas of materials science so as to enable them perceive the significant contributions of the subject in Engineering and Technology.

Outcomes:
- Gained knowledge about crystal structures and lattice defects.
- Gained knowledge about polarization.
- Know about magnetic moment of dia, para, ferro materials.
- Gained knowledge about semi and super conductors.
- Know about advanced materials like liquid crystals, Nano materials.

Unit I  Crystal Structure And Lattice Defects  (12 Hours)
Lattice defects – Qualitative ideas of point, line, surface and volume defects

Unit II  Dielectric Properties  (12 Hours)

Unit III  Magnetic Properties  (12 Hours)

Unit IV  Semiconductors And Superconductors  (12 Hours)
Semiconductors- Derivation of Carrier concentration in intrinsic Semiconductors –Basic ideas of electrical conductivity in intrinsic and extrinsic semiconductors (without derivation) - temperature dependence of carrier concentration and electrical conductivity in semiconductors (qualitative ideas), Hall effect in semiconductors - Application of Hall Effect, Basic Ideas of Compound Semiconductors (II-VI & III-V)
Superconductivity - Basic concepts – transition temperature – Meissener effect –Type I and II superconductors – high temperature superconductors – 123 superconductor- applications of superconductors.
### Unit V  Advanced Materials  (12 Hours)

**Liquid Crystals** – Types – Application as Display Devices
Metallic Glasses – preparation by melt spinning. Twin roller system, properties and applications

**Shape Memory Alloys (SMA)**, shape memory effect, properties and applications of SMA.

**Nanomaterials** - Nano materials (one, two & three dimensional) – Methods of synthesis (PVD,CVD,laser Ablation, Solgel, Ball-milling Techniques), properties and applications of non-material’s. Carbon nanotubes- synthesis, Properties and applications.

### Text Books

### References
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<tr>
<th>T109</th>
<th>ENVIRONMENTAL SCIENCE</th>
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**Objectives:**
- To know about the environment.
- To understand about environmental pollution.
- To apply the knowledge in understanding various environmental issues and problems.

**Outcomes:**
- Demonstrate the importance of interdisciplinary nature of environment, its purpose, design and exploitation of natural resources.
- Analyze the fundamental physical and biological principles that govern natural processes and role of professionals in protecting the environment from degradation.
- Apprehend the existing environmental challenges related to pollution and its management.
- Evaluate strategies, technologies and methods for sustainable management of environmental systems.
- Characterize and analyze human impacts on the environment.

**Unit I  Environment and Energy Resources**  (12 Hours)
Environmental segments – atmosphere, hydrosphere, lithosphere and biosphere. Atmospheric layers. Pollution definition and classification. Pollutants classification. Forest resources - use and over exploitation, deforestation, forest management. Water resources - use and conflicts over water, dams-benefits and problems. Mineral resources - mineral wealth of India, environmental effects of extracting and using mineral resources. Food resources - world food problems, environmental impact of modern Agriculture - fertilizer and pesticides. Energy resources-growing needs, renewable and non-renewable energy resources and use of alternate energy sources. From unsustainable to sustainable development.

**Unit II  Ecosystem and Biodiversity**  (12 Hours)

**Unit III  Air Pollution**  (12 Hours)

**Unit IV  Water and Land Pollution**  (12 Hours)
Water pollution – causes and effects of organic water pollutants – pesticides, insecticides, detergents and surfactants, causes and effects of inorganic water pollutants – heavy metal pollution due to Hg, Pb,

### Unit V  Pollution Control and Monitoring  
(12 Hours)


### Text Books

1. K. Raghavan Nambiar, “Text Book of Environmental studies” 2nd Ed, Scitech Publications (India) Pvt Ltd, India, 2010 (For Units I & II)
2. A. K. De, “Environmental Chemistry” 7th Ed; New age International (p) Ltd, New Delhi, 2010.(For Units III,IV&V)

### References

Objectives:

- To be able to differentiate the type of buildings according to national building code.
- To understand building components and their functions as well as different types of roads, bridges and dams.
- To explain the concepts of thermal systems used in power plants and narrate the methods of harnessing renewable energies.
- To explain the role of basic manufacturing processes.
- To develop an intuitive understanding of underlying working principles of mechanical machines and systems.

Outcomes:

- Understand the fundamental philosophy of Civil Engineering.
- Identify the nature of building components, functions, construction practices and material qualities.
- Understand the fundamental concepts of water supply and transportation systems.
- Recognize the various engineering materials and understand the working principles and operations of manufacturing processes.
- Understand the working principles and operations of Internal Combustion Engines, Refrigeration, Boiler and power plants.

PART –A CIVIL ENGINEERING

Unit I Buildings, Building Materials
Buildings-Definition-Classification according to NBC-plinth area, Floor area, carpet area, floor space index-construction materials-stone, brick, cement, cement-mortar, concrete, steel-their properties and uses.

Unit II Buildings and their components
Various Components and their functions. Soils and their classification.
Roofs: definition and types.

Unit III Basic Infrastructure

PART- B MECHANICAL ENGINEERING

Unit IV Internal And External Combustion Systems
IC engines – Classification – Working principles – Diesel and petrol engines: two stroke and four stroke engines – Merits and demerits.
Steam generators (Boilers) – Classification – Constructional features (of only low pressure boilers) – Boiler mountings and accessories – Merits and demerits – Applications.
<table>
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<tr>
<th>Unit V</th>
<th>Power Generation Systems</th>
<th>(10 Hours)</th>
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<tr>
<th>UNIT VI</th>
<th>Manufacturing Process</th>
<th>(10 Hours)</th>
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**Text Books**

1. Natarajan, K V, Basic Civil Engineering, 11th edition, Dhanalakshmi publications Chennai, 2011. (For Units I to III)
2. Venugopal, K and Prabhu Raja, Basic Mechanical Engineering, Anuradha Publisher, 2012 (For Units IV to VI)

**References**

<table>
<thead>
<tr>
<th>Units of Study</th>
<th>Objectives:</th>
</tr>
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</table>
|               | • To understand the vector and scalar representation of forces and moments, static equilibrium of particles and rigid bodies in two dimensions.  
|               | • To comprehend the effect of friction on equilibrium  
|               | • To understand the laws of motion, the kinematics of motion and the interrelationship and to learn to write the dynamic equilibrium equation  
|               | • To emphasis the concepts through solved examples  
|               | Outcomes:  
|               | • Illustrate the vectorial and scalar representation of forces and moments.  
|               | • Analyse the rigid body in equilibrium.  
|               | • Evaluate the properties of surfaces and solids.  
|               | • Calculate dynamic forces exerted in rigid body.  
|               | • Determine the friction and the effects by the laws of friction.  

**Unit I  Fundamental of Mechanics**  
(12 Hours)  
Basic Concepts Force System and Equilibrium, Definition of force, Moment and Couple, Principle of Transmissibility, Varignon’s theorem, Resultant of force system – Concurrent and non-concurrent coplanar forces, Condition of static equilibrium for coplanar force system, stability of equilibrium, applications in solving the problems on static equilibrium of bodies.

**Unit II  Practical Application of Force System**  
(12 Hours)  
Structural member: Definition, degree of freedom, concept of free body diagrams, types of supports and reactions, types of loads, Analysis of trusses-method of joints, method of sections.  
Friction: Introduction, Static dry friction, simple contact friction problems, ladders, wedges.

**Unit III  Properties of Surfaces**  
(12 Hours)  
Properties of sections – area, centroids of lines, areas and volumes, moment of inertia first moment of inertia, second moment of inertia and product of moment of inertia, polar moment of inertia, radius of gyration, mass moment of inertia.

**Unit IV  Kinematics and Kinetics of Particles**  
(12 Hours)  

**Unit V  Kinematics and Kinetics of Rigid Bodies**  
(12 Hours)  
Plane motion, absolute motion, Relative motion, translating axes and rotating axes, work and energy, impulse and momentum

**Text Books**
References

## Objectives:
- To improve the LSWR skills of I B. Tech students
- To instill confidence and enable the students to communicate with ease
- To equip the students with the necessary skills and develop their language prowess

## Outcomes:
- Develop their fluency and language competency in English.

### Unit I  Basic Communication Theory  (12 Hours)
Importance of Communication – stages of communication, modes of communication – barriers to communication – strategies for effective communication – Listening: Importance, types, barriers – Developing effective listening skills.

### Unit II  Comprehension And Analysis  (12 Hours)
Comprehension of technical and non-technical material – skimming, scanning, inferring - Note making and extension of vocabulary, predicting and responding to context - Intensive Reading and Reviewing.

### Unit III  Writing  (12 Hours)
Effective sentences, cohesive writing, clarity and conciseness in writing – Introduction to Technical Writing – Better paragraphs, definitions, practice in summary Writing – Four modes of writing – Use of dictionaries, indices, library references – making bibliographical entries with regard to sources from books, journals, internet etc.

### Unit IV  Business Writing/Correspondence  (12 Hours)

### Unit V  Oral Communication  (12 Hours)

### Text Books

### References
Objectives:
- To provide a practical understanding of some of the concepts learnt in the theory course on physics

<table>
<thead>
<tr>
<th>List of Experiments (Any 10 Experiments)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Thermal conductivity – Lee’s DISC</td>
</tr>
<tr>
<td>2. Thermal conductivity – radial flow</td>
</tr>
<tr>
<td>3. Spectrometer – Prism or Hollow prism</td>
</tr>
<tr>
<td>4. Spectrometer – Transmission grating</td>
</tr>
<tr>
<td>5. Spectrometer – Ordinary &amp; Extraordinary rays</td>
</tr>
<tr>
<td>6. Newton’s rings</td>
</tr>
<tr>
<td>7. Air – wedge</td>
</tr>
<tr>
<td>8. Half shade polarimeter – determination of specific rotatory power</td>
</tr>
<tr>
<td>9. Jolly’s experiment – determination of α</td>
</tr>
<tr>
<td>10. Magnetism: i-h curve</td>
</tr>
<tr>
<td>11. Field along the axis of coil carrying current</td>
</tr>
<tr>
<td>12. Vibration magnetometer – calculation of magnetic moment &amp; pole strength</td>
</tr>
<tr>
<td>13. Laser experiment: wavelength determination using transmission grating,</td>
</tr>
<tr>
<td>1. reflection grating (vernier calipers) &amp; particle size determination</td>
</tr>
<tr>
<td>14. Determination of optical absorption coefficient of materials using laser</td>
</tr>
<tr>
<td>15. Determination of numerical aperture of an optical fiber</td>
</tr>
<tr>
<td>16. Electrical conductivity of semiconductor – two probe / four probe method</td>
</tr>
<tr>
<td>17. Hall effect in semiconductor</td>
</tr>
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</table>

**Objectives:**
- To gain a practical knowledge of Engineering chemistry in relevance to Industrial applications

**List of Experiments (Any 10 Experiments)**

1. Determination of dissolved oxygen in water.
2. Determination of total hardness of water by EDTA method.
3. Determination of carbonate and bicarbonate in water.
4. Estimation of chloride content in water.
5. Estimation of magnesium by EDTA.
6. Estimation of acetic acid in vinegar.
7. Estimation of ferrous by permanganometry.
8. Estimation of ferrous and ferric iron in a solution mixture by dichrometry.
10. Estimation of copper in copper sulphate solution.
11. Estimation of calcium by permanganometry.
12. Estimation of iron by colorimetry.

**Demonstration Experiments (Any two of the following)**

1. Determination of COD of water sample.
2. Determination of lead by conductometry.
3. Percentage composition of sugar solution by viscometry.
Objectives:
- To convey the basics of mechanical tools used in engineering
- To establish hands on experience on the working tools
- To develop basic joints and fittings using the hand tools
- To establish the importance of joints and fitting in engineering applications
- To explain the role of basic workshop in engineering
- To develop an intuitive understanding of underlying physical mechanism used in mechanical machines

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Trade</th>
<th>List of Exercises</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Fitting</td>
<td>Study of tools and Machineries. Exercises on symmetric joints and joints with acute angle.</td>
</tr>
<tr>
<td>2</td>
<td>Welding</td>
<td>Study of arc and gas welding equipment and tools – Edge preparation – Exercise on lap joint and V Butt joints – Demonstration of gas welding</td>
</tr>
<tr>
<td>3</td>
<td>Sheet metal work</td>
<td>Study of tools and Machineries – Exercise on simple products like Office tray and waste collection tray.</td>
</tr>
<tr>
<td>4</td>
<td>Carpentry</td>
<td>Study of tools and Machineries – Exercises on Lap joints and Mortise joints</td>
</tr>
</tbody>
</table>

List of Exercises

I - FITTING
1. Study of tools and Machineries
2. Symmetric fitting
3. Acute angle fitting

II - WELDING
1. Study of arc and gas welding equipment and tools
2. Simple lap welding (Arc)
3. Single V butt welding (Arc)

III - SHEET METAL WORK
1. Study of tools and machineries
2. Frustum
3. Waste collection tray

IV - CARPENTRY
1. Study of tools and machineries
2. Half lap joint
3. Corner mortise joint.
NCC / NSS training is compulsory for all Undergraduate students

1. The above activities will include practical/field activities/Extension lectures.
2. The above activities shall be carried out outside class hours.
3. In the above activities, the student participation shall be for a minimum period of 45 hours.
4. The above activities will be monitored by the respective faculty in-charge and the first Year coordinator.
5. Pass / Fail will be determined on the basis of participation, attendance, performance and behavior. If a candidate fails, he / she has to repeat the course in the subsequent years.
6. Pass in this course is mandatory for the award of degree.
<table>
<thead>
<tr>
<th>MAT31</th>
<th>ANALYTIC FUNCTIONS AND PARTIAL DIFFERENTIAL EQUATIONS</th>
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**Objectives:**
- To provide the concepts of functions of a complex variable, conformal mapping, complex integration, series expansion of complex functions, Harmonic analysis and Fourier series.
- To introduce Fourier series analysis which is the central to many applications in engineering apart from its use in solving boundary value problems.
- To acquaint the student with Fourier series techniques in solving heat flow problems used in various situations.
- To introduce the basic concepts of PDE for solving standard partial differential equations.
- To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems.

**Outcomes:**
- Understand the concepts of function of a complex variable and complex integration and apply these ideas to solve problems occurring in the area of engineering and technology.
- Solve differential equations using Fourier series analysis which plays an important role in engineering applications.
- Understand the physical significance of Fourier series techniques in solving one and two dimensional heat flow problems and one dimensional wave equations.
- Understand how to solve and use in engineering applications for the given standard partial differential equations.
- Use the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems.

**Unit I  Function of complex variables**
Analytic functions – Necessary and sufficient conditions for analyticity in Cartesian and polar coordinates - Properties – Harmonic conjugates – Construction of analytic function - Conformal mapping – Mapping by functions - Bilinear transformation. standard transformations like $w = z+c, cz, z^2, ez, \sin z, \cos h z$ and $z+1/z$

**Unit II  Complex integration**

**Unit III  Solution of Equations and Eigen value Problems**
### Unit IV  Partial Differential Equations  (12 Hours)

Classification of PDE – Method of separation of variables - Fourier Series Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction.

### Unit V  Interpolation, Numerical Differentiation and Numerical Integration  (12 Hours)


### Text Books


### References

Objectives:

- To understand the concepts of stress, strain, principal stresses and principal planes.
- To study the concept of shearing force and bending moment effect due to the external loads on beams.
- To determine stresses and deformation in circular shafts and helical spring due to torsion.
- To compute slopes and deflections in determinate beams by various methods.
- To study the stresses and deformations induced in thin and thick shells.

Outcomes:

- Understand the concepts of stress and strain in simple and compound bars, the importance of principal stresses and principal planes.
- Understand the load transferring mechanism in beams and stress distribution due to shearing force and bending moment.
- Apply the basic equation of simple torsion in designing of shafts and helical spring.
- Enable the students to calculate the slope and deflection in beams by using various methods.
- Analyze and design of thin and thick shells for the given applied internal and external pressures.

Unit I Stress, Strain and Deformation of Solids (12 Hours)

Unit II Transverse Loading on Beams and Stresses in Beam (12 Hours)

Unit III Torsion (12 Hours)
Torsion formulation stresses and deformation in circular and hollows shafts – Stepped shafts– Deflection in shafts fixed at the both ends – Stresses in helical springs – Deflection of helical springs, carriage springs.

Unit IV Deflection of Beams (12 Hours)

Unit V Thin Cylinders, Spheres and Thick Cylinders (12 Hours)
Stresses in thin cylindrical shell due to internal pressure circumferential and longitudinal stresses and deformation in thin and thick cylinders – spherical shells subjected to internal pressure – Deformation in spherical shells – Lame’s theorem.
**Text Books**


**References**

<table>
<thead>
<tr>
<th>MTT32</th>
<th>FLUID MECHANICS AND MACHINERY</th>
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**Objectives:**
- To introduce the properties of the fluid and flow characteristics.
- To introduce the concept of boundary layer phenomenon and flow through circular conduits.
- To understand the concept of impact of jets.
- To introduce the concepts of turbines and complexities involved in solving the fluid flow problems.
- To understand the importance of pumps and its energy exchange process

**Outcomes:**
- Understand the basic fluid property and its application.
- Understanding the concepts of boundary layer phenomenon and its importance
- Enable the students to understand the impacts of jet on turbo machinery
- Understand the working of turbine and its energy calculation
- Acquire knowledge about the pumps and performance

**Unit I Fluid Properties and Flow Characteristics** (12 Hours)
Units and dimensions- Properties of fluids- mass density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapor pressure, surface tension and capillarity. Flow characteristics – concept of control volume - application of continuity equation, energy equation and momentum equation.

**Unit II Flow Through Circular Conduits** (12 Hours)

**Unit III Impact of Jets** (12 Hours)

**Unit IV Hydraulic Turbines** (12 Hours)

**Unit V Hydraulic pumps** (12 Hours)
### Text Books


### References

Objectives:

- To understand in detail the operation, characteristics and various parameters of diodes.
- To learn and gain insight into the operation, characteristics and functional aspects of BJT in different configurations.
- To study the construction, operation and characteristics of several special semiconductor devices.
- To design the different types of feedback amplifier and oscillator.
- To acquaint the various rectifier circuits with filters and IC regulator circuits.

Outcomes:

- Could understand in detail the operation, characteristics and various parameters of Semiconductor diodes.
- Understand the operation, characteristics and functional aspects of BJT and FET in different configurations.
- Gain knowledge about the working principle of special semiconductor devices and can elucidate the circuit designs.
- Gain the knowledge in design of feedback amplifier and oscillator and can design real-time oscillation.
- Could design and analyze the rectifier and regulated circuits.

Unit I Semiconductor diode (12 Hours)
Theory of PN junction diode, Band structure of open circuited PN junction, Volt Ampere Characteristics, Temperature Dependence of PN diode, LED, LCD and Photo-diodes, Tunnel diode, Zener diode as Voltage Regulator.

Unit II Transistors, Characteristics and Biasing (12 Hours)
Transistor, Types of Transistor, Transistor current components, Transistor as an Amplifier, Transistor characteristics in CB, CE and CC modes. Operating point, bias stability, various biasing circuits, stabilization against Ic, VBE and beta, Construction, Characteristics & applications of Junction Field Effect Transistor (JFET), UJT and MOSFET.

Unit III Special Semiconductor Devices (12 Hours)
Construction, principle of operation and characteristics of Schottky barrier diode, Varactor diode, Tunnel diode, PIN diode, LED, LCD, UJT, SCR, DIAC and TRIAC. Photoconductivity – photodiode, APD, phototransistor, LDR, optocoupler, solar cell, LASER diode and MESFET.

Unit IV Feedback Amplifiers and Oscillator (12 Hours)
Feedback Concept, Effect of negative feedback on gain, bandwidth, stability, distortion and frequency Response, Sinusoidal Oscillators, Sinusoidal oscillators; criterion for oscillation, Different types of oscillators: RC Phase Shift, Wein Bridge, Hartley, Colpitts and Crystal Oscillators. Derivation of expression for frequency and amplitude of these oscillators.
Unit V Power Supplies (12 Hours)

**Text Books**
2. Electronic Devices & Circuits Theory by Boylested, Pearson Education. 2015
3. Electronic Fundamentals & Application, by J.D. Ryder, PHI. 2009

**References**
1. Electronic Devices, 10th Edition by Thomas L. Floyd, Pearson Education, 2018
2. Electronics Devices & Circuits by J.B.Gupta, Katson.2013
### Objectives:
- To identify the ways and means to solve magnetically coupled circuits
- To understand the different operations of DC and AC machines.
- To analyze the utilization of different home appliances.
- To analyze the synchronous motors

### Outcomes:
At the end of the course the students
- Will be able to describe the fundamental parts of various transformers.
- Explain the operating principles of induction machines, synchronous machines and dc machines
- Use equivalent circuits to analyze electrical machines in steady state
- Describe the principle of synchronous machines

### Unit I Transformers (12 Hours)

### Unit II D.C. Machines (12 Hours)

### Unit III A.C. Machines (12 Hours)

### Unit IV Special Machines (12 Hours)

### Unit V Synchronous Machines (12 Hours)

### Text Books


References

### MTT35 DIGITAL CIRCUITS DESIGN

<table>
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#### Objectives:
- To present the Digital fundamentals, Boolean algebra and its applications in digital systems
- To familiarize with the design of various combinational digital circuits using logic gates
- To introduce the analysis and design procedures for synchronous and asynchronous sequential circuits
- To explain the various semiconductor memories and related technology
- To introduce the electronic circuits involved in the making of logic gates

#### Outcomes:
- Use digital electronics in the present contemporary world
- Design various combinational digital circuits using logic gates
- Do the analysis and design procedures for synchronous and asynchronous sequential circuits
- Acquire knowledge can be used to expand semiconductor memories and related technology.

### Unit I Digital Fundamentals (12 Hours)
Number Systems – Decimal, Binary, Octal, Hexadecimal, 1’s and 2’s complements, Codes – Binary, BCD, Excess 3, Gray, Alphanumeric codes, Boolean theorems, Logic gates, Universal gates, Sum of products and product of sums, Minterms and Maxterms, Karnaugh map Minimization and Quine-McCluskey method of minimization.

### Unit II Combinational Circuit Design (12 Hours)

### Unit III Synchronous Sequential Circuits (12 Hours)

### Unit IV Asynchronous Sequential Circuits (12 Hours)
Stable and Unstable states, output specifications, cycles and races, state reduction, race free assignments, Hazards, Essential Hazards, Pulse mode sequential circuits, Design of Hazard free circuits.

### Unit V Memory Devices And Digital Integrated Circuits (12 Hours)
Basic memory structure – ROM -PROM – EPROM – EEPROM –EAPROM, RAM – Static and dynamic RAM - Programmable Logic Devices – Programmable Logic Array (PLA) - Programmable Array Logic (PAL) – Field Programmable Gate Arrays (FPGA) - Implementation of combinational logic circuits using PLA, PAL.
<table>
<thead>
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<th>Text Books</th>
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<th>References</th>
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<td>MTP31</td>
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**Objectives:**
- To study the mechanical properties of materials when subjected to the different types of loading.
- To enable the students to impart knowledge on flow measurement equipments and performance test on different fluid machinery

**Outcomes:**
- Ability to perform tension, torsion, hardness, compression, and other tests on various materials as per standards.
- Acquiring basic knowledge in flow measurement equipments and Understanding the performance test on fluid machinery

## STRENGTH OF MATERIALS

**List of Experiments**

1. Tension test on a mild steel rod.
2. Double shear test on Mild steel and Aluminium rods.
3. Impact test on metal specimen
4. Hardness test on metals - Brinnell and Rockwell Hardness Number.
5. Deflection test on beams.
6. Compression test on helical springs.

## FLUID MECHANICS AND MACHINERY LABORATORY

**List of Experiments**

1. Determination of the Coefficient of discharge of given Orificemeter.
2. Determination of the Coefficient of discharge of given Venturimeter.
3. Conducting experiments and drawing the characteristic curves of Centrifugal pump.
4. Conducting experiments and drawing the characteristic curves of reciprocating pump.
5. Conducting experiments and drawing the characteristic curves of Gear pump.
6. Conducting experiments and drawing the characteristic curves of Pelton wheel.
### Objectives:
- To familiarize the basic concepts of electrical circuits and associated theorems.
- To understand the load test and performance characteristics of DC shunt motor, stepper motor and induction motors.

### Outcomes:
- Test and assess the performances of the DC motors and single phase AC motor for varying load.
- Knowledge in Control the speed of AC and DC motor is used to choose for appropriate applications

### List of Experiments
1. Load test on D.C. shunt motor.
2. Speed control of D.C. shunt motor.
3. Swinburne’s test.
4. Load test on three phase induction motor.
5. No load and blocked rotor tests on three – phase induction motor.
7. No load and blocked rotor tests on single phase induction motor.
8. Load test on Synchronous motors.
**Objectives:**
- To study about the VI characteristics of PN junction diode, Zener Diode, UJT, SCR.
- To design and implement the digital circuits.

**Outcomes:**
- Acquire a basic knowledge in solid state electronics including diode, FET, BJT.
- An ability to design various synchronous sequential circuits design such as Counters and Shift Registers

### List of Experiments

1. V-I characteristics of semiconductor diodes
   a) PN Junction diode  
   b) Point contact diode  
   c) Zener diode
2. Characteristics of BJT in CE configuration
   a) Determination of input and output characteristics
   b) Determination of voltage gain, current gain, input and output resistances from the characteristics
3. Characteristics of JFET
   a) Determination of output and transfer characteristics
   b) Determination of pinch off voltage, rd, gm and η from the characteristics
4. Characteristics of MOSFET
   a) Determination of output and transfer characteristics
   b) Determination of pinch off voltage, rd, gm and η from the characteristics
5. Rectifier and Voltage Regulators
   a) Determination of ripple factor for different types of rectifiers with and without filters.
   b) Voltage regulation characteristics of shunt, series and IC regulators
6. i) Clipper circuits using diodes  
   Positive, negative, biased and combinational clippers  
   ii) Switching circuit  
   a) AND and OR logic gates using diodes  
   b) NOT gate using transistor
7. Study of Logic gates
8. Design and implementation of the following Code converters
   i. BCD to excess-3 code and vice versa  
   ii. Binary to gray code and vice-versa
9. Design and implementation of 4 bit binary adder/subtractor and BCD adder.
10. Design and implement a multiplexer and de-multiplexer
11. Design and implement an encoder and decoder
12. Construction and verification of 4 bit ripple counter and Mod 10 Ripple counter.
13. Implementation of SISO, SIPO, PISO and PIPO shift registers using Flip-flops
<table>
<thead>
<tr>
<th>Objectives:</th>
<th>Outcomes:</th>
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</thead>
<tbody>
<tr>
<td>• This course aims at providing the necessary basic concepts of a few statistical and numerical methods and give procedures for solving numerically different kinds of problems occurring in engineering and technology.</td>
<td>• Interpret the concept of testing of hypothesis for small and large samples in real life problems</td>
</tr>
<tr>
<td>• To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems</td>
<td>• Interpret the basic concepts of classifications of design of experiments in the various fields.</td>
</tr>
<tr>
<td>• To introduce the basic concepts of solving algebraic and transcendental equations</td>
<td>• Analyse the numerical techniques of interpolation in various intervals and apply the numerical techniques of differentiation and integration for engineering problems.</td>
</tr>
<tr>
<td>• To introduce the numerical techniques of interpolation in various intervals and numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines.</td>
<td>• Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.</td>
</tr>
<tr>
<td>• To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.</td>
<td>• Ability to solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.</td>
</tr>
</tbody>
</table>

**Unit I  Testing of Hypothesis**  
Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample tests based on Normal distribution for single mean and difference of means - Tests based on t, Chi-square and F distributions for mean, variance and proportion - Contingency table (test for independent) - Goodness of fit.  

**Unit II  Design of Experiments**  
ANOVA - one way and two way classifications - Completely randomized design – Randomized block design – Latin square design - complete factorial design.  

**Unit III  Solution of Equations and Eigen value Problems**  
<table>
<thead>
<tr>
<th>Unit IV</th>
<th>Interpolation, Numerical Differentiation and Numerical Integration</th>
<th>(12 Hours)</th>
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<tbody>
<tr>
<td></td>
<td>Lagrange’s and Newton’s divided difference interpolations – Newton’s forward and backward difference interpolation – Approximation of derivatives using interpolation polynomials – Numerical single and double integrations using Trapezoidal and Simpson’s 1/3 rules.</td>
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<tr>
<th>Unit V</th>
<th>Numerical Solution of Ordinary Differential Equations</th>
<th>(12 Hours)</th>
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**Text Books**


**References**

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<thead>
<tr>
<th>MTT41</th>
<th>MECHANICS OF MACHINES - I</th>
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**Objectives:**
- To learn the basics of various mechanisms involved in machines
- To introduce the methods to solve velocity and acceleration
- To acquaint knowledge in the construction of cam profile
- To understand the effects of friction in transmission and machine components
- To introduce the concept of gear ratio for simple, compound, reverted and epicycle gear train

**Outcomes:**
- Acquire knowledge on basics and working of commonly used mechanisms
- Know the construction of velocity and acceleration diagrams
- Understand and interpret the cam profile
- Acquire the knowledge about the effects of friction in machine components
- Understand the concepts of gears and gear trains

**Unit I Basics of Mechanisms**
(12 Hours)
Basic concepts of link, pair, chain, mechanism, machine and structure - degree of freedom – mobility of mechanism - Kutzbach criterion - Grashoff's law - Inversions of mechanisms: Four bar and slider crank - Mechanical advantage - Transmission angle - Description of some common mechanisms: Straight line generators, dwell mechanisms, ratchets and escapements, universal joint – Basic structures of Robot manipulators (serial and parallel).

**Unit II Kinematics**
(12 Hours)
Displacement, velocity and acceleration - Graphical method of velocity (relative velocity method) and acceleration diagrams for simple mechanisms - Kliens construction for single slider crank mechanism - Coriolis component of acceleration.

**Unit III Kinematics of CAM**
(12 Hours)
Classifications of Cam and follower - Radial cam nomenclature - Analysis of follower motion: uniform velocity motion, Simple harmonic motion, uniform acceleration and retardation motion and cycloidal motion - Construction of cam profile for a radial cam - Pressure angle – undercutting.

**Unit IV Friction**
(12 Hours)

**Unit V Gears and Gear Trains**
(12 Hours)
Law of toothed gearing - Involute and cycloidal tooth profiles - Spur gear terminology and definitions - Gear tooth action - Interference and undercutting Problems Helical, bevel, worm, rack and pinion gears [basics only] - Introduction to gear correction - gear trains: Speed ratio - train value -Parallel axis gear trains - Epicyclic gear trains - Determination of gear speeds using tabular method.
<table>
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**Objectives:**
- To introduce the basics of IC engine and its performance.
- To understand the concepts involved and various types of jet and rocket propulsion engine.
- To understand the application of various experimental heat transfer correlations in engineering calculations.
- To learn about fundamental of heat conduction process.
- To impart knowledge about convection mode of heat transfer.
- To impart knowledge about radiation.

**Outcomes:**
- Enable the students to understand the fundamentals of IC engines.
- Enable the students to understand the fundamentals of Jet and rocket propulsion.
- Acquire knowledge in heat conduction mechanism.
- Understand the convective heat process.
- Understand the knowledge about radiation concepts.

**Unit I  IC Engines** (12 Hours)

**Unit II  Jet Propulsion** (12 Hours)

**Unit III Heat Transfer: Conduction** (12 Hours)

**Unit IV Convection** (12 Hours)

**Unit V Radiation** (12 Hours)
Basic Concepts, Laws of Radiation - Stefan Boltzmann Law, Kirchhoff's Law - Black Body Radiation and radiation between different surfaces
### Text Books

### References
### Objectives:
- To impart knowledge on casting technology and foundry shop
- To study about bulk deformation processes of metals
- To learn about the various machines tools and its metal removal processes
- To impart knowledge on various metal joining processes
- To study about the various surface finishing processes

### Outcomes:
- Acquire complete knowledge about casting
- Recognize the various metal forming processes
- Learn the various metal removal processes
- Familiarize the principles of metal joining processes
- Acquaint knowledge on various surface finishing processes

### Unit I Foundry Technology (12 Hours)

### Unit II Metal Forming Processes (12 Hours)

### Unit III Metal Removal Processes (12 Hours)

### Unit IV Metal Joining Processes (12 Hours)

### Unit V Metal Finishing Processes (12 Hours)
**Text Books**


**References**

Objectives:

- To learn basic concepts of measurement system
- To select suitable non-electrical, electrical transducers and sensors for various measurements
- To identify suitable electrical transducers and sensors for various measurements
- To explore advanced sensors for measurements

Outcomes:

- Identity the measurement system and error.
- Ability to choose non-electrical, electrical transducers and sensors for various measurements
- Able to identify suitable electrical transducers and analysis for various measurement.
- Explore advanced sensors for measurements
- Acquire Knowledge to design signal conditioning circuit to interface with processor.

Unit I Introduction to Measurement Systems (12 Hours)


Unit II Non-Electrical Transducers (12 Hours)


Unit III Electrical Transducers (12 Hours)


Unit IV Miscellaneous Transducer And Sensors (12 Hours)


Unit V Signal Conditioning And Digital Instruments (12 Hours)

## Text Books


## References

<table>
<thead>
<tr>
<th>MTT45</th>
<th>POWER ELECTRONICS AND DRIVES</th>
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**Objectives:**
- To obtain the switching characteristics of different types of power semiconductor devices
- To determine the operation, characteristics and performance parameters of converters
- To understand the concept of DC and AC drives

**Outcomes:**
- Know the construction, operation and characteristics of different types of power semiconductor devices.
- Understand the operation, characteristics and performance parameters of converters and choppers.
- Acquire the knowledge in the operation and characteristics of invertors and its related techniques.
- Acquire the knowledge on solid-state DC drives and its control.

**Unit I Power Semiconductor Devices** (12 Hours)

**Unit II Converters And Choppers** (12 Hours)
Phase Control - Single Phase and Three phase uncontrolled and controlled rectifiers with R and RL load, Choppers, Time ratio control, Types, Buck-boost chopper-four quadrant operation, Cyclo converters

**Unit III Inverter** (12 Hours)
Single phase and three phase (both 120° and 180° modes.) voltage source inverters – PWM techniques: Sinusoidal PWM modified sinusoidal PWM and multiple PWM - Current source inverters- Harmonics elimination technique

**Unit IV Solid State DC Drives** (12 Hours)
Types of electrical drives - selection of drives - heating and cooling curves - Four quadrant operation of hoist - Ward Leonard control system - Control of DC drives using rectifiers and choppers.

**Unit V Solid State AC Drives** (12 Hours)
Control of three phase induction motors using stator voltage and frequency control – variable frequency drive - static rotor resistance control - Slip power recovery schemes - Static Kramer control method - Static Scherbius control method - Power factor correction.

**Text Books**
References

### Objectives:
- To provide the basic understanding about operational characteristics and applications of various sensors and transducers.
- To provide the basic understanding about operational characteristics and applications of various measurement devices.

### Outcomes:
- Perform the signal conditioning circuits for sensor applications
- Demonstrate the characteristics of sensor measurement system

### List of Experiments
1. Measurement of temperature using: Thermistor
2. Measurement of temperature using Thermocouple & RTD.
5. Flow measurement using Orifice meter and Rotameter.
6. Diaphragm based Pressure measurement.
7. Capacitive based Level Measurement.
8. Speed Measurement using Encoder and Opt coupler
10. Measurement of unknown Resistance using Wheatstone Bridge
11. Measurement of unknown Inductance using Maxwell Bridge
12. Measurement of unknown Capacitance using Schering Bridge
<table>
<thead>
<tr>
<th>Objectives:</th>
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<tbody>
<tr>
<td>- To study and practice the various operations that can be performed in lathe, drilling, milling, planning and shaping machines.</td>
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<td>- To equip with their practical knowledge required in the core industries.</td>
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<table>
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<th>Outcomes:</th>
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<tbody>
<tr>
<td>- Ability to use different machine tools for finishing operations</td>
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<tr>
<td>- Ability to use different machine tools for industrial applications.</td>
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</table>

### List of Experiments

#### LATHE PRACTICE
- 1. Plain Turning
- 2. Taper Turning
- 3. Thread Cutting

#### DRILLING PRACTICE
- 1. Drilling
- 2. Tapping
- 3. Reaming.

#### MILLING
- 1. Surface Milling.
- 2. Gear Cutting.

#### PLANNING AND SHAPING
- 1. Cutting Key Ways.
- 2. Dovetail machining
Objectives:
- To make the students understand and interpret drawings of machine components and draft them using Autocad.
- To draft various Circuits and Panel Layouts using Autocad.

Outcomes:
- Understand detailed Parts and assembly drawings of Mechanical Components and create part drawings, sectional views and assembly drawings as per standards.
- Students will develop and design circuits.

List of Experiments

2D Drafting of Mechanical Components
Preparation of Drawings for Parts and Assembly of the following by using Drafting software
- Bearings - Bush bearing
- Plummer block
- Valves – Safety and non-return valves
- Knuckle Joint and Flange Coupling

2D Drafting of Electronic Circuits
- Introduction of Symbols and Circuits
- Diode, BJT, FET, Relay, Switch using symbols
- PLC Circuits and Panel Layouts
- PCB Layout for Electronic Circuits
Objectives:
- To perform force analysis and balancing of reciprocating engines and to determine basic parameters of flywheel and its functions
- To perform balancing of rotating and reciprocating masses
- To understand the effects of free vibration in single and multi-degree of freedom systems
- To understand the dynamic effect of undesirable forced vibrations.
- To understand the principles and mechanisms used for speed control and stability control.

Outcomes:
- Carry out static and dynamic force analysis on various parts of reciprocating engine and to determine flywheel parameters by constructing turning moment diagram
- Calculate the balancing masses and their locations of reciprocating and rotating masses.
- Compute the frequency of free vibration in single and multi-degree of freedom systems
- Compute the frequency of forced vibration in damped and undamped systems
- Calculate the speed, lift of the governor, and estimate the gyroscopic effect on automobiles, ships and airplanes.

Unit I  Force Analysis  (12 Hours)

Unit II  Balancing  (12 Hours)

Unit III  Free Vibration  (12 Hours)

Unit IV  Forced Vibration  (12 Hours)
### Unit V  Mechanism for Control

(12 Hours)


**Text Books:**

2. Sadhu Singh, Theory of Machines: Kinematics and Dynamics, 3 edition, Publisher: Pearson Education India, 2011

**Reference Books:**

<table>
<thead>
<tr>
<th>MTT52</th>
<th>PROGRAMMING FOR AUTOMATION USING PYTHON</th>
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**Objectives:**
- To know the basics of algorithmic problem solving, to read and write simple Python programs.
- To develop Python programs with conditionals and loops.
- To define Python functions and call them.
- To use Python data structures — lists, tuples, dictionaries.
- To do input/output with files in Python.

**Outcomes:**
- Develop algorithmic solutions to simple computational problems. Read, write, execute by hand simple Python programs.
- Structure simple Python programs for solving problems.
- Decompose a Python program into functions.
- Represent compound data using Python lists, tuples, and dictionaries.
- Read and write data from/to files in Python Programs.

**Unit I  Algorithmic Problem Solving** *(12 Hours)*

Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range.

**Unit II  Data, Expressions, Statements** *(12 Hours)*

Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

**Unit III Control Flow, Functions** *(12 Hours)*

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

**Unit IV Lists, Tuples, Dictionaries** *(12 Hours)*

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: selection sort, insertion sort, mergesort, histogram.
<table>
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<tr>
<th>Unit V  Files, Modules, Packages</th>
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<tr>
<td>Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file.</td>
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**Text Books**


**References**

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<th>MTT53</th>
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### Objectives:
- To know about basic concepts of metal cutting and CNC machines
- To know about various tooling systems and fixtures
- To gain knowledge in part programming
- To gain knowledge on linear and angular measurement systems
- To gain knowledge on laser interferometer, CMM and machine vision in measurement

### Outcomes:
- Estimate the parameters of metal cutting and comprehend the basic components, drives and controls involved in a CNC system
- Select various tooling systems and fixtures for CNC and identify maintenance features of CNC machines
- Develop Part Programming for various machining process
- Infer linear and angular measurements using various instruments and determine the surface roughness
- Interpret the operations of laser interferometer, CMM and machine vision in measurement

### Unit I  Basic concepts of Metal Cutting and CNC Machines  (12 Hours)

**Basic Concepts of Metal Cutting and CNC Machines:** Introduction – Mechanics of chip formation- Mechanics of oblique cutting- Cutting forces and power- Tool life –Surface finish-Machinability.


### Unit II  Tooling for CNC Machines  (12 Hours)


**Economics of CNC Machines and Retrofitting:** Factors influencing selection of CNC Machines – Cost of operation of CNC Machines – Practical aspects of introducing CNC machines in industries – Maintenance features of CNC Machines – Preventive Maintenance, Other maintenance requirements. Retrofitting.

### Unit III  Part Programming of CNC Machines  (12 Hours)

**Part Programming of CNC Machines:** Part Program Terminology - G and M Codes – Types of interpolation. CNC part programming – Manual part programming (Turning and Milling)
## Unit IV  Linear and Angular Measurements

**Linear and Angular Measurements:** Basic concepts: Legal metrology- Precision- Accuracy- Types of errors – Standards of measurement- Traceability – Interchangeability and selective assembly. Introduction to limits, fits and tolerances, Gauge design- Comparators-Angular measurement: bevel protractor - Angle gauges - Sine bar.


## Unit V  Interferometry and Laser Metrology

**Interferometry and laser Metrology:** Principle of light wave interference – Optical flats -Michelson and NPL flatness interferometer, Laser interferometer. **Advances in Metrology:** Coordinate Measuring Machine (CMM): Types - Constructional features-Possible causes of errors in CMM - Probing system – Performance and applications of CMM. **Machine Vision System:** Applications of machine vision in measurement- In process and On line measurement.

### Text books:


### Reference books:

### Objectives:

- To gain knowledge about 8085 and 8051 microcontrollers
- To know about C programming using 8051 microcontroller
- To gain knowledge of internal and external peripherals
- To apply microcontroller for mechatronics applications

### Outcomes:

- Infer the basic concepts of 8085 microprocessor and 8051 microcontroller
- Acquire knowledge in Embedded C programming concepts with 8051 microcontroller is used to interface the real-time hardware.
- Able to develop programming using internal and external peripherals with microcontroller
- Design a microcontroller based system for Mechatronics applications

### Unit I 8085 Microprocessor (12 Hours)

8085 Architecture – Pin configuration – Register organization – Memory organization – memory and I/O decoding – Interrupts

### Unit II 8051 Microprocessor (12 Hours)


### Unit III 8051 Assembly Language/Embedded C Programming (12 Hours)

Compiler C - programming structure, Data types, memory models, infinite loops and handling interrupts in C. Intel Hex file format. Instruction set – Addressing modes – I/O port programming – Timer programming – Counter programming – Serial communication programming – Interrupt programming.

### Unit IV Peripheral Interfacing (12 Hours)


### Unit V Microcontroller for Mechatronics Applications (12 Hours)

Application case studies related to Interfacing of sensors analog and discrete type (Temperature, Pressure, Level, Proximity sensors). Interfacing of actuators (Servo motor, pneumatic cylinders, PWM control of a DC motor). RF module Interfacing – IR module interfacing. Traffic light control application
<table>
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<th>References</th>
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<tr>
<td>1. A. Nagoorkani, “8085 Microprocessor and its Applications”, 2017</td>
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<td>MTT55</td>
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**Objectives:**
- To know about mathematical models of electrical, mechanical and electromechanical systems
- To gain knowledge about time domain responses of first and second order systems
- To know about frequency response of systems
- To design the compensator for uncompensated open loop systems

**Outcomes:**
- Develop mathematical model of electrical, mechanical and electromechanical systems
- Acquire knowledge in the time domain response of first and second order systems
- Acquire knowledge in frequency response of systems which is used to analyze the stability of the system
- Design the compensator for uncompensated open loop system

**Unit I System Modeling**  
(12 Hours)

**Unit II Time Response Analysis**  
(12 Hours)
Concepts of Poles, Zeros and System response - Type and Order of System - Significance of test signals - First order system - Second order system: Classification and nature of response - Step response of second order underdamped System - Time domain specifications - Steady state error and error constant - Generalized error series.

**Unit III Stability Analysis**  
(12 Hours)
Concepts of stability – Location of Poles and Zeros for stability - Routh Hurwitz Criterion - Root Locus Technique - Effect of addition of poles and zeros on stability.

**Unit IV Frequency Response Analysis**  
(12 Hours)
Concepts of frequency Response - Frequency domain specifications - Bode plot - Polar plot - Nyquist stability criterion.

**Unit V Compensator Design**  
(12 Hours)

**Text Books**

<table>
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<th>References</th>
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## Objectives:
- To write, test, and debug simple Python programs.
- To implement Python programs with conditionals and loops.
- Use functions for structuring Python programs.

## Outcomes:
- Represent compound data using Python lists, tuples and dictionaries.
- Read and write data from/to files in Python.

### List of Experiments
1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton’s method)
3. Exponentiation (power of a number)
4. Find the maximum of a list of numbers
5. Linear search and Binary search
6. Selection sort, Insertion sort
7. Merge sort
8. First n prime numbers
9. Multiply matrices
10. Programs that take command line arguments (word count)
11. Find the most frequent words in a text read from a file
12. Simulate elliptical orbits in Pygame
13. Simulate bouncing ball using Pygame
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**Objectives:**
- To develop, simulate and execute part program using CNC production machines
- To interpret the fundamentals of calibration and measurements processes and perform the characteristics on instruments

**Outcomes:**
- Develop, simulate and execute part program using CNC production machines
- Interpret the fundamentals of calibration and measurements processes and perform the characteristics on instruments

### List of Experiments
1. Study of G codes and M codes for machining centre and turning centre
2. Programming and machining of given component using MTAB trainer machine
3. Programming and machining of given component using CNC turning centre
4. CNC code generation of given component using MASTER CAM (Lathe) and interfacing it to CNC turning centre
5. Programming and machining of given component using CNC machining centre
6. CNC code generation of given component using MASTER CAM (Mill) and interfacing it to CNC machining centre
7. Calibration of Vernier / Micrometer; static characteristic study- Measurement of Components like V block etc.
8. Calibration of Dial Gauge; static characteristic study; Use of dial gauge as measuring device and Comparators.
9. Calibration of profile projector and measurement of micro components.
10. Study of Autocollimator, Surface roughness tester and coordinate measuring machine (CMM).
### Objectives:
- To know about programming for 8085 microprocessor and 8051 microcontrollers
- To Verify programming logic and interfacing circuits using simulation software
- To Develop a microcontroller based system for Mechatronics applications

### Outcomes:
- Build programming for 8085 microprocessor and 8051 microcontroller
- Knowledge in programming logic and interfacing the hardware with microcontroller
- Develop a microcontroller based system for Mechatronics applications

### List of Experiments

#### Assembly Language Programming
1. Arithmetic functions using 8085 Microprocessor

#### Embedded C Programming and hardware interfacing using 8051 Microcontroller
3. Interfacing of switch, LED and seven segment LED
4. Interfacing of LCD
5. DC motor programming for the given case study
6. Stepper motor programming for the given case study
7. Servo motor programming for the given case study
8. Actuation of pneumatic cylinders for the given case study
9. Interfacing of high power devices for the given case study
10. Study on Interfacing sensors, microcontroller with IoT module
### Objectives:
- To help the students to get rid of the inhibitions and communicate with ease by improving their Listening, Speaking, Reading and Writing skills of students
- To ensure the personality development of the students by sharpening their soft skills

### Outcomes:
- Students will have enhanced Listening, Speaking, Reading and Writing skills
- Students will have well-regulated soft skills and personality development

### Unit I  Art of Communication
Verbal and Non-verbal Communication – Barriers to Communication – Importance of Body Language – Effective Listening – Feedback

### Unit II  Introduction to Soft Skills

### Unit III Writing
Importance of Writing – Written Vs Spoken Language – Formal and Informal Styles of writing – Resources for improving writing – Grammar and Usage – Vocabulary Building – SWOT analysis

### Unit IV  Speaking Practice

### Unit V  Aptitude
Verbal and Numerical aptitude

### References:
Objectives:
- To familiarize the various steps involved in the design process and to understand the concepts of principle stresses and strains subject to steady and variable stresses in machine components
- To design shafts, keys and couplings
- To design gears and analyzing the influence of stresses on it
- To design brakes and clutches for automobiles with appropriate assumptions
- To design bearings and springs with appropriate assumptions

Outcomes:
- Interpret the influence of steady and variable stresses in machine component design.
- Acquire knowledge on design concepts of shafts, keys and couplings with proper assumptions
- Acquire knowledge on design and analyse of spur, helical, bevel, worm gear drives and multi speed gear box
- Able to design and analyse clutches and braking systems
- Able to design and analyse bearings and springs

Unit I Design Fundamentals (12 Hours)

Unit II Shafts and Couplings (12 Hours)

Unit III Design of Spur, Helical, Bevel and Worm Gears (12 Hours)

Unit IV Design of Brakes and Clutches: (12 Hours)

Unit V Design of Bearings and Springs (12 Hours)
### Text book:

### Reference books:
<table>
<thead>
<tr>
<th>Objectives:</th>
<th>Outcomes:</th>
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| • To understand the concepts, construction and working principles of fluid power system  
  • To understand the construction and working of pumps and actuators for hydraulic system  
  • To understand and identify the usage of various directional control valves in hydraulic systems  
  • To understand the performance of pneumatic systems  
  • To apply various methods to design and execute hydraulic and pneumatic circuits for simple applications using software and hardware tools | • Acquaint knowledge on the fundamentals of hydraulic systems and determine losses incurred in hydraulic circuit  
  • Recognize the suitable pump and actuators for particular application  
  • Interpret and use of various hydraulic valves  
  • Understand the fundamentals of pneumatic systems  
  • Design hydraulic and pneumatic circuits for simple application |

### Unit I Fluid power systems

(12 Hours)


### Unit II Hydraulic Pumps and Actuators

(12 Hours)


### Unit III Hydraulic Valves

(12 Hours)


### Unit IV Pneumatic Systems

(12 Hours)

Unit V Design of Hydraulic and Pneumatic Circuits (12 Hours)
Sequential circuit design for simple applications: Step counter method, Cascade methods & Karnaugh Veitch map method – PLC circuit design using ladder logic.

Text Books:

References Books:
<table>
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<th>Objectives:</th>
<th>Outcomes:</th>
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| • To impart knowledge on direct and inverse kinematics of manipulator  
• To understand the basic elements of serial and parallel robots  
• To learn trajectory and motion analysis of robotic movements  
• To learn about robot dynamics and trajectory planning  
• To know about various robotic sensors and application of robots in various fields | • Understand the components and parameters of industrial robots.  
• Understand the classification of end effectors.  
• Evaluate the kinematic calculations to the industrial robots.  
• Apply trajectory planning to the robots.  
• Identify sensors for robotic applications |

**Unit I Introduction**  

**Unit II End Effectors**  
Unilateral Vs Multilateral end effectors - mechanical grippers: gripping force estimation with payload under acceleration – vacuum - magnetic - air operated grippers Remote centre compliance - Robot cell layouts.

**Unit III Kinematics of Robot Manipulator**  
Representing position and rotation - rotation in plane - rotation in three dimension - Rotational transformation - Rotation with respect to the current frame and fixed frame - Rule for composition of rotational transformation - Parameterization of rotation - Euler angle, Roll, Pitch, Yaw angles Axis/angle representation - rigid motion - Homogeneous transformation - DenavitHartenberg convention

**Unit IV Robot Dynamics and Trajectory Planning**  
Velocity kinematics - Jacobian - Derivative of rotation matrix - addition of angular velocity - Derivation of Jacobian combining the linear and angular velocity Jacobian - Euler Lagrange equation, kinetic and potential energy, Equation of motion, Newton Euler formulation - Trajectory planning for point to motion - Cubic polynomial - Quintic polynomial trajectory - Linear segment with parabolic bend (LSPB) minimum time trajectory - trajectory for path specified by via point.

**Unit V Robot Sensor**  
Ultrasonic sensors -Range finding- time of flight LIDAR- triangulation techniques -Vision for 3D measurement - structured lighting stereo vision and camera calibration. For Further Reading - Industrial robots for welding, painting and assembly, remote Controlled robots, Robots for nuclear thermal and chemical plants, Industrial automation, typical example of automated industries, application of visual inspection
### Text books:

### Reference books:
Objectives:
• To understand the construction, operation and installation of PLCs
• To provide the knowledge on interfacing the PLCs and field devices with communication protocols.
• To understand the concepts of SCADA System & Architecture
• To understand the concepts of DCS and SCADA systems.
• To understand the concepts of industrial process control

Outcomes:
• Select appropriate PLC for architecture, installation procedures and trouble shooting.
• Develop PLC programs using various functions of PLCs for a given application.
• Explain the application development procedures in SCADA and manage data, alarm and storage.
• Distinguish DCS, SCADA and PLC and explain the architecture of DCS
• Describe the controller elements and program methods

Unit I  Programmable Logic Controller (12 Hours)

Unit II  Applications of PLC (12 Hours)
Timer instructions - On delay, Off delay, Cyclic and Retentive timers, Up/Down Counters, control instructions – Data manipulating instructions, math instructions; Applications of PLC – Motor start and stop, Simple materials handling applications, Automatic water level controller, Automatic lubrication of supplier Conveyor belt, Automatic car washing machine, Bottle label detection and process control application.

Unit III  SCADA System and Architecture (12 Hours)
Data acquisition systems, Evolution of SCADA, Communication technologies, Monitoring and supervisory functions, SCADA applications in Utility Automation, Industries - SCADA System Components: Schemes- Remote Terminal Unit (RTU), Intelligent Electronic Devices (IED), Communication Network, SCADA Server, SCADA/HMI Systems Various SCADA architectures, advantages and disadvantages of each system
# Unit IV  Distributed Control System

(12 Hours)

Introduction to DCS – Various Architectures – Comparison – Local control unit – Process interfacing issues – Communication facilities Operator interfaces - Low level and high level operator interfaces – Displays - Engineering interfaces – Low level and high level engineering interfaces – Factors to be considered in selecting DCS – Case studies – Sugar industry and Power plant

# Unit V  Industrial Process Control

(12 Hours)

Study of Advanced Process control blocks: Statistical Process Control, Model Predictive Control, Fuzzy Logic Based Control, Neural-Network Based Control, PID Control

## Text Books:


## References books:

## Objectives:
- To develop knowledge on Mechatronics system design and simulation, ergonomics and safety
- To gain knowledge on the theoretical and practical aspects of computer interfacing, real time data acquisition and control
- To gain knowledge on Mechatronic system modelling
- To gain knowledge on real time interfacing
- To undergo case studies on Mechatronic system

## Outcomes:
- Understand the basics and key elements of Mechatronics design process
- Familiarize with basic system modeling
- Familiarize with Mechatronic system modelling
- Realize the concepts of real time interfacing and data acquisition
- Understand the concepts of design of Mechatronic system through case studies

### Unit I Introduction to Design of Mechatronics System (12 Hours)
Key elements – Mechatronics design process – design parameters – mechatronics and traditional design – Advanced approaches in mechatronics design – Introduction to industrial design, modelling, simulation and analysis – Ergonomics and safety.

### Unit II Basic System Modelling (12 Hours)

### Unit III Mechatronic System Modelling (12 Hours)

### Unit IV Real Time Interfacing (12 Hours)
Introduction – Selection of interfacing standards- elements of data acquisition and control systems – Overview of I/O process – general purpose I/O cards and its installation – Data conversion process – Application software’s – Man machine interface

### Unit V Case Studies on Design of Mechatronics System (12 Hours)
Motion control using DC Motor, AC Motor and Servomotor - Temperature control of hot/cold reservoir – Pick and place robot – Car parking barriers – Motion and temperature control of washing machine – Auto focus camera, exposure control
### Text Books:


### References books:

1. Yigang He, Xue Qing, Automatic Control, Mechatronics and Industrial Engineering, CRC Press, 2019
### Objectives:
- The intention and purpose of this course is to acquire knowledge about Lab VIEW Programming.
- The intention and purpose of this course is to study the interfacing of different sensors with Lab VIEW.

### Outcomes:
- Interpret the software tools in virtual instrumentation
- Develop programming through Lab VIEW graphical programming environment
- Perform interface of data acquisition hardware with Lab VIEW software
- Select the hardware and software concept of data acquisition system for advanced applications

### List of Experiments

#### Repetition and Loops:
1. GSD using For loops, while loops with shift registers / feedback nodes
2. GSD using Local variables and Global variables

#### Structures
3. GSD using Case structures and Sequence structures
4. GSD using Timed structures, Formula nodes and Event structures

#### Plotting data:
5. GSD using Waveform graph, Waveform chart, XY graph

#### Strings:
6. GSD using string functions, editing, formatting and parsing string

#### Arrays and clusters:
7. GSD using arrays functions and multi-dimensional arrays
8. GSD using clusters operations: assembling clusters and disassembling clusters

#### Modular Programming:
9. Creating sub VIs from section of a VI
10. File Input / File Output function Read / Write a file.

#### Data Acquisition system (DAQ or MyRio):
11. GSD for real time measurement using Thermistor / Piezo-electric sensor
12. GSD for real time monitoring using Seven-Segment LED Display/ Motor/ Buzzer/ Speaker
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<th>MTP62</th>
<th>INDUSTRIAL AUTOMATION LAB</th>
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**Objectives:**
- To identify the differences between various PLCs
- To control some process parameters and test PID algorithm.
- To use the VFD to control the speed of AC motor.

**Outcomes:**
- Carry out wiring connections and troubleshoot in different PLCs.
- Develop simple applications using LD, ST and FBD mode of programming.
- Develop SCADA application using open source software and perform speed control on AC motor using VFD and PLC.

**List of Experiments**

1. Study of different PLCs and their specification
2. Study of installations and troubleshooting of PLC.
3. Development of Ladder Diagram (LD) and Structured Text (ST) programming in PLC for simple applications.
4. Development of an application by using timer and counter of PLC.
5. Solving simple problems using Functional Block Diagram (FBD) programming in PLC
6. Interfacing between PLC and Process loop (temperature)
7. Interfacing between PLC and Process loop (level)
8. Interfacing between PLC and Process loop (flow)
9. Verification and testing of PID controller in a process loop.
10. Develop one application using SCADA system.
11. AC motor speed control using PLC and VFD
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<th>FLUID POWER SYSTEMS LAB</th>
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**Objectives:**
- To understand the concepts, construction and working principles of fluid power system Components
- To design circuits using ladder logic, step counter method, cascade method and KV map method

**Outcomes:**
- Understanding the concepts, construction and working principles of fluid power system Components
- Design circuits using ladder logic, step counter method, cascade method and KV map method

**List of Experiments**

1. Identification of fluid power system components
2. Drawing standard symbols of FPS
3. Actuating Single Acting Cylinder
4. Actuating Double Acting Cylinder
5. Simple sequencing
6. Circuit design using ladder logic
7. Circuit design using step counter method
8. Circuit design using cascade method
9. Circuit design using KV map method
10. Circuit design using three methods and making comparison
### Objectives:
- To develop the student’s critical thinking and problem solving skills
- To prepare the students industry-ready and employable by enabling the students to prepare for interviews and face them with confidence.

### Outcomes:
- Students will attain and enhance competence in critical thinking and problem solving skills
- Students will be industry-ready with enhanced communication skill

### UNIT I Composition Analysis
Technical and Non-Technical Passages (GRE Based)- Differences in American and British English- Analyzing Contemporary issues- Expanding Terminology

### UNIT II Writing
Job Application Letter- Resume Writing

### UNIT III Oral Skills
Group Discussion- Introduction and Practice- Team work- Negotiation skills- Organizing and attending meetings- Facing Interviews

### UNIT IV Aptitude
Verbal and Numerical aptitude

### Unit V Adapting to Corporate Life
Corporate Etiquette- Grooming and Dressing

### References:
<table>
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<tr>
<th>MTT71</th>
<th>ENGINEERING ECONOMICS AND MANAGEMENT</th>
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**Objectives:**
- To provide basic concepts and principles of economics
- To study about national income estimation
- To impart knowledge about marketing strategies and techniques
- To enumerate the appropriate operation management concept in business situations
- To learn about the accounting principles and financial statements

**Outcomes:**
- Estimate market equilibrium and interpret national income calculation and inflation issues
- Interpret national income calculation
- Acquire knowledge about marketing concepts
- Apply appropriate operation management concept in business situations
- Acquire knowledge on accounting principles and financial statements

**Unit I Introduction to Economics**
(12 Hours)

**Unit II National Income and its measurement techniques**
(12 Hours)

**Unit III Marketing Concepts**
(12 Hours)

**Unit IV Operations Management**
(12 Hours)
Operations Management - Resources - Types of Production system - Site selection, Plant Layout, Steps in Production Planning and Control - Inventory - EOQ Determination.

**Unit V Accounting Principles and Financial Statements**
(12 Hours)

**Text Books**
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<th>References</th>
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<td>MTT72</td>
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**Objectives:**
- To provide the overview of embedded system design principles
- To understand the concepts of real time operating systems
- To provide exposure to embedded system development tools with hands on experience in using basic programming techniques

**Outcomes:**
- Learn the need of embedded systems and their development procedures
- Understand the construction, addressing modes and instructions sets of PIC micro controller
- Could understand various tools for developing embedded applications
- Summaries the concepts involved in Real time operating systems and memory with respect Architecture to I/P devices
- Can conduct experiments with I/O systems used in embedded systems

**Unit I Introduction to Embedded System**  
(12 Hours)
System Design: Definitions - Classifications and brief overview of microcontrollers – Microprocessors and DSP’s - Embedded processor architectural definitions - Typical Application scenarios of embedded systems.

**Unit II Processor and Memory Organization**  
(12 Hours)

**Unit III I/O Devices and Networks**  
(12 Hours)

**Unit IV Operating Systems**  
(12 Hours)

**Unit V Embedded System Development**  
(12 Hours)
### Text Books


### References

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<tr>
<th>MTP71</th>
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**Objectives:**
- To draw the models and assembly in 3D using 3D Modeling Software
- To analyze the models using ANSYS

**Outcomes:**
- Explore the various CAD packages and CAE tools
- Enable the student to simulate real-time condition on a product using CAE Package and validate them

**List of Experiments**

1. Part and Assembly drawing of Couplings using CATIA/Creo/ SOLIDWORKS.
2. Part and Assembly drawing of Bearings using CATIA/Creo/ SOLIDWORKS.
3. Part and Assembly drawing of Valves using CATIA/Creo/ SOLIDWORKS.
4. Modeling and Drafting of Machine Elements i.e. Tail Stock/ Screw Jack / Connecting Rod using CATIA/Creo/ SOLIDWORKS
5. Structural analysis of a given component using ANSYS.
6. Thermal analysis of a given application using ANSYS.
7. Modal analysis of a given model using ANSYS.
8. Contact analysis of a model using ANSYS.
9. Shear Force and bending moment diagram using ANSYS.
10. Vibration analysis of an object using ANSYS.
11. Modeling and analyzing of any part models using CAD and CAE packages

**Reference**

5. University of Alberta - ANSYS Tutorials - [https://sites.ualberta.ca/~w moussa/AnsysTutorial/](https://sites.ualberta.ca/~w moussa/AnsysTutorial/)
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**Objectives:**
- To introduce system design concepts to students using microcontrollers with foundational concepts of microcontroller architecture and programming.
- To introduce hardware and software integration for real time systems using microcontrollers and thereby imparting real time system design knowledge to students.

**Outcomes:**
- Understand about Analog to digital converting technique, Pulse with modulation methods, various bus communication techniques, Real time clock and various sensor handling methods.
- Have an ability to work in different Operating systems (Copy righted and open source) such as Ubuntu, Rasbian OS, Integrated Development environments, Compilers, Assemblers and programmers.
- Develop programs in various platforms such as Embedded C, C++, HTML, DBMS etc.,
- Develop project with different types of analog and digital sensors.

**List of Experiments**

1. Voltage Measurement with display
2. Designing a voltmeter to measure voltage from 0 to 5 volts and displaying the measured value using 7 segment displays
3. Design of Real Time Clock using MCS 51 using segment Displays.
4. Design of Water Pump Controller to sense the water level in a tank
5. Digital Clock with LCD display
   a. Temperature Measurement with 7 segment display
6. Implementation of UART, ADC and DAC features
7. Design of Single Channel Data Acquisition System
8. PC Communication
9. Interfacing the microcontroller to a PC through RS232 interface and displaying the messages sent by the microcontroller on the PC using Visual Basic program running in PC
10. Remote Control through FM Link
11. Establishing an FM link between two microcontrollers for data transfers.
12. Hot Chamber Controller to maintain the temperature at the set point.
13. Obstacle Detector using ultrasonic transmitter-receiver
14. Moisture sensor and sprinkler controller design
<table>
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<tr>
<th>MTP73</th>
<th>PROJECT PHASE I</th>
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| **Objectives:** | To develop knowledge to formulate a real world problem and project's goals  
| | To identify the various tasks of the project to determine standard procedures  
| | To identify and learn new tools, algorithms and techniques  
| | To understand the various procedures for validation of the product and analysis the cost-effectiveness |
| **Outcomes:** | Formulate a real world problem, identify the requirement and develop the design solutions  
| | Express the technical ideas, strategies and methodologies  
| | Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project |

**Details**

Project phase I is to enable the students to work in groups of not more than four members in each group on a project involving analytical, experimental, design or combination of these in the area of Mechatronics Engineering. Each project shall have a guide. The student is required to do literature survey, formulate the problem and form a methodology of arriving at the solution of the problem. The evaluation is based on continuous internal assessment by an internal assessment committee scenarios of embedded systems.

On completion of the Phase I work, a project report should be prepared and submitted to the department. The project work and the report will be evaluated by an internal assessment committee for 50 marks. The external university examination, which carries a total of 50 marks, will have report evaluation and viva voce examination conducted by a committee of one external examiner and one internal examiner appointed by the University.
### MTP74  
**INDUSTRIAL VISITS / TRAINING REPORT**

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**Objectives:**
- To provide an exposure to students about practical working environment.
- To experience the importance of working safely.

**Outcomes:**
- Understand how does the product of the plant is interfaced to the world.
- Experience the importance of working safety

**Details**

During the course of study from 3rd to 7th semester each student is expected to undertake a minimum of four industrial visits or undertake a minimum of two weeks of industry/field training. The students are expected to submit a report, which shall be evaluated by an internal assessment committee at the end of seventh semester for 100 marks.

### MTP75  
**COMPREHENSIVE VIVA VOCE**

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**Objectives:**
- The objective of comprehensive viva-voce is to assess the overall knowledge of the student in the relevant field of Mechatronics Engineering acquired over 4 years of study in the undergraduate program.
- To prepare the students to face interview both at the academic and the industrial sector

**Outcomes:**
- Enable the student’s learning and understanding during the course of their undergraduate program.
- Enriched with academic and industrial skills

**Details**

The student will be tested for his understanding of basic principles of the core Mechatronics Engineering subjects. The internal assessment for a total of 50 marks will be made by an internal assessment committee. The committee will conduct two written examinations of objective or short questions type from all the core subjects. The external university examination, which carries a total of 50 marks, will be a Viva Voce examination conducted by a committee of one external examiner and one internal examiner appointed by the University.
MTT81 | AUTOMOTIVE ELECTRONICS | L | T | P | C | Hours
|---|---|---|---|---|---
| 4 | 0 | 0 | 4 | 60 |

**Objectives:**
- To impart knowledge on the basics of electronics, emission controls and standards in automobiles.
- To study the various ignition and injection system
- To study the various sensors and actuators used in automobiles for improving fuel economy and emission control.
- To study the various blocks of control units used for control of fuel, ignition and exhaust systems
- To learn about chassis and vehicle safety systems

**Outcomes:**
- Acquire knowledge in emission standards in automobiles.
- Understand the electronic fuel injection/ignition components and their function.
- Knowledge to choose and use sensors and equipment for measuring mechanical quantities, temperature and appropriate actuators.
- Diagnose electronic engine control systems problems with appropriate diagnostic tools.
- Analyses the chassis and vehicle safety system.

**Unit I Introduction** (12 Hours)

**Unit II Ignition and Injection Systems.** (12 Hours)

**Unit III Sensor and Actuators in Automotives** (12 Hours)

**Unit IV Engine Control Systems** (12 Hours)
### Unit V Chassis And Safety Systems  
(12 Hours)


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<th>Text Books</th>
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| Objectives: | • To enable the students to create an awareness on Engineering Ethics and Human Values  
• To impart Moral and Social Values and Loyalty and to appreciate the rights of others. |
|-------------|------------------------------------------------------------------------------------------------|

| Outcomes    | • Students will have awareness on Engineering Ethics and Human Values  
• Students will have better understanding on Indian constitution and its values |
|-------------|--------------------------------------------------------------------------------------------------------------------------------|

The course should cover the following topics by way of Seminars, Expert Lectures and assignments:

1. Engineering Ethics – Moral issues, Ethical theories and their uses
2. Engineering as Experimentation – Code of Ethics
3. Engineer’s responsibility for safety
4. Responsibilities and rights
5. Global issues of engineering ethics
6. Fundamental Rights and Constitution of India

References

4. World Community Service Centre, "Value Education", Vethathiri publications, Erode, 2011
### MTP81
#### PROJECT PHASE II

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**Objectives:**
- To develop knowledge to formulate a real world problem and project's goals.
- To identify the various tasks of the project and to identify and learn new tools, algorithms and techniques with standard procedures.

**Outcomes:**
- Design, analyze, realize / simulate a physical system by using the technology they learnt during the program.
- Disseminate his/her work both in oral and written format in a team.

Project work phase II will be an extension of the project work started in the seventh semester. On completion of the work, a project report should be prepared and submitted to the department. The project work and the report will be evaluated by an internal assessment committee for 50 marks. The external university examination, which carries a total of 50 marks, will have report evaluation and viva voce examination conducted by a committee of one external examiner and one internal examiner appointed by the University.

### MTP82
#### SEMINAR

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**Objectives:**
- To develop the self-learning skills and to utilize various technical resources available from multiple field
- To promote the technical presentation and communication skills

**Outcomes:**
- Refer and utilize various technical resources available from multiple field
- Improve the technical presentation and communication skills

Each one of the students will be assigned a Seminar Topic in the current and frontier areas. The student has to conduct a detailed study/survey on the assigned topic and prepare a report. The student will make an oral presentation followed by a brief question and answer session. The Seminar (presentation and report) will be evaluated by an internal assessment committee for a total of 100 marks.
# ELECTIVE -I

## Objectives
- To enable students identify the different parts of the automobile.
- To learn working of various parts like engine, transmission, clutch, brakes.
- To study how the steering and the suspension systems operate and Students will know the working of various parts like brakes and chassis.
- To enable the students know about battery and lighting system
- To learn about alternate energy sources in automobiles

## Outcomes
- Identify the IC engine components and its function
- Categorize the types of transmission system
- Choose appropriate suspension, brake and steering systems for automobile applications
- Design the circuit for automotive electrical systems for automobiles
- Analyze the use of alternate fuel sources recommended for automobiles

## Unit I: Engine Components (9 Hours)

## Unit II: Transmission Systems (9 Hours)

## Unit III: Steering, Brakes and Suspension (9 Hours)

## Unit IV: Battery and Lighting System (9 Hours)

## Unit V: Alternate Energy Sources (9 Hours)
### Text Books


### References

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<th>MTE52</th>
<th>TOTAL QUALITY MANAGEMENT</th>
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**Objectives**
- To understand the need for total quality management
- To enumerate the total quality principles in industries
- To learn about the various tools and techniques used in TQM
- To know about the quality concepts followed in industries
- To understand the benefits of quality and environmental management systems

**Outcomes**
- Interpret the need for total quality management
- Familiarize on the total quality principles in industries
- Familiarize on bench marking and failure mode effect analysis techniques
- Understand the performance measure tools and techniques
- Understand the quality management tools and environmental management tools

**Unit I Introduction** *(9 Hours)*

**Unit II TQM Principles** *(9 Hours)*
Leadership - Quality Statements, Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating

**Unit III TQM Tools And Techniques I** *(9 Hours)*
The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types

**Unit IV TQM Tools And Techniques II** *(9 Hours)*
Quality Circles - Cost of Quality - Quality Function Deployment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.

**Unit V Quality Management System** *(9 Hours)*
Introduction—Benefits of ISO Registration—ISO 9000 Series of Standards—Sector-Specific Standards—AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements—Implementation—Documentation—Internal Audits—Registration-

**Environmental Management System:** Introduction—ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO 14001—Benefits of EMS.

**Text Books**

<table>
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<th>References</th>
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### Objectives
- To differentiation between convention and unconventional machining process and need of unconventional machining in the current scenario.
- To know about the metal removal rate and surface finish of different materials using mechanical energy based processes.
- To know about the metal removal rate and surface finish of different materials using electrical energy based processes.
- To know about the metal removal rate and surface finish of different materials using chemical energy based processes.
- To know about the metal removal rate and surface finish of different materials using thermal energy based processes.

### Outcomes
- Understand the basic principle of conventional machining process.
- Interpret the mechanical energy based processes.
- Familiarize on the various electrical energy based processes.
- Interpret the chemical energy based processes.
- Familiarize on the various thermal energy based processes.

### Unit I Introduction  (9 Hours)
Introduction to Non-traditional machining, Need for Non-traditional machining process, Comparison between traditional and non-traditional machining, general classification Nontraditional machining processes, classification based on nature of energy employed in machining, selection of non-traditional machining processes, Specific advantages, limitations and applications of non-traditional machining processes.

### Unit II Mechanical Energy Based Processes  (9 Hours)

### Unit III Electrical Energy Based Processes  (9 Hours)

### Unit IV Chemical And Electro-Chemical Energy Based Processes  (9 Hours)

### Unit V Thermal Energy Based Processes  (9 Hours)
Laser Beam machining and drilling (LBM), plasma Arc machining (PAM) and Electron Beam Machining (EBM). Principles – Equipment –Types - Beam control techniques – Applications.
<table>
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<th>Text Books</th>
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<td>Objectives</td>
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</table>
| • To introduce the concepts of mathematical modeling of engineering problems.  
• To provide knowledge on one dimensional elasticity problems  
• To provide knowledge on two dimensional elasticity problems  
• To learn about axisymmetric and isoparametric elements  
• To appreciate the use of FEM to a range of engineering problems | • Comprehend the finite element concepts used for designing engineering components.  
• Derive the element matrix equation for solving one dimensional structural problems for different applications  
• Compute the results for a 3D domain using simple two dimensional assumptions for different applications  
• Solve and analyze the engineering problems using axisymmetric assumptions  
• Solve and analyze the engineering problems using isoparametric elements for two dimensional continuum |

Unit I Introduction  

Unit II One Dimensional Elasticity Problems  

Unit III Two Dimensional Elasticity Problems  

Unit IV Axisymmetric Elements  
Axisymmetric formulation – Element stiffness matrix and force vector – Galerkin approach – Body forces and temperature effects – Stress calculations – Boundary conditions – Applications to cylinders under internal or external pressures – Rotating discs.

Unit V Isoparametric Elements for Two Dimensional Continuum  
Four node quadrilateral elements – Shape functions – Element stiffness matrix and force vector – Numerical integration - Stiffness integration – Stress calculations

Text Books  
### References

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<th>MTE55</th>
<th>SMART MATERIAL FOR MECHATRONICS</th>
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<td>Outline the properties and applications of smart materials and Nano materials</td>
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<td>Select the Smart Materials for Magneto-Thermo-Mechanical applications</td>
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<td>Interpret the usage of shape memory alloys</td>
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<td>Interpret the applications of EAP</td>
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<td>Familiarize on the applications of magnetostrictive materials</td>
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**Unit I Introduction & Nano Materials** *(9 Hours)*
Smart materials and their application for sensing and actuation, Mechatronics aspects, properties and applications Nano Materials: Low dimensional structures (quantum dot, wire and well) – Features of nano materials – Synthesis: top down and bottom up approaches – Ball milling and lithographic methods – Physical and chemical vapor phase depositions – Sol gel method.

**Unit II Piezoelectric Materials** *(9 Hours)*
Piezoelectricity and piezoelectric materials, Constitutive equations of piezoelectric materials, Piezoelectric actuator types, Control of piezoelectric actuators, Applications of piezoelectric actuators for precise positioning and scanning

**Unit III Shape Memory Alloys (SMA)** *(9 Hours)*
Properties of shape memory alloys, Shape memory effects, Pseudo-elasticity in SMA, Design of shape memory actuator, selection of materials, Smart actuation and control, Applications of SMA in precision equipment for automobiles, trains and medical devices.

**Unit IV Electro-Active Polymers (EAPS)** *(9 Hours)*
Ionic polymer metal composites (IPMC), Conductive polymers, Carbon nanotubes, Dielectric elastomers, Design & control issues for EAP actuators, Applications of EAP for biomemetic, tactile display and medical devices.

**Unit V Magnetostrictive Materials** *(9 Hours)*
Basics of magnetic properties of materials, magnetostriction: constitutive equations, types of magnetostrictive materials, Design & control of magnetostrictive actuators, Applications of magnetostrictive materials for active vibration control

**Text Books**
1. Jose L. Pons, Emerging Actuator Technologies, a Micro mechatronics Approach, John Wiley & Sons Ltd, 2005
References

Objectives
- To know the principle methods, areas of usage, possibilities and limitations as well as environmental effects of the Additive Manufacturing technologies
- Usage of CAD & Reverse Engineering concept in Additive Manufacturing
- To be familiar with the characteristics of the different materials those are used in Additive Manufacturing.
- To be familiar with various rapid prototyping Additive Manufacturing Techniques
- Usage of Additive Manufacturing in Bio Products

Outcomes
- Upon completion of this course, the students can able to compare different method and discuss the effects of the Additive Manufacturing technologies.
- Use Latest technologies like CAD Model and Simulation tools and do computer assisted Additive Manufacturing
- Analyze the characteristics of the different materials in Additive Manufacturing.
- Will learn the latest trends and opportunities in 3D printing, localized services, production parts
- Understand the latest trends and business opportunities in Additive Manufacturing, distributed manufacturing and mass customization.

Unit I Introduction (9 Hours)

Unit II CAD & Reverse Engineering (9 Hours)

Unit III Liquid and Solid Based Additive Manufacturing (9 Hours)
Classification – Liquid based system – Stereo lithography Apparatus (SLA)- Principle, process, advantages and applications – Solid based system –Fused Deposition Modeling – Principle, process, advantages and applications, Laminated Object Manufacturing

Unit IV Powder Based Additive Manufacturing Systems (9 Hours)
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<th>Unit V  Bio-Additive Manufacturing &amp; Software’s</th>
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<tr>
<td>Customized implants and prosthesis: Design and production. Bio-Additive Manufacturing- Computer Aided Tissue Engineering (CATE) – Case studies Preparation of Drawings for Parts and Assembly of the following by using Drafting software. Designing for Additive Manufacturing (DfAM), Software Tools vs. Requirements</td>
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**Text Books**


**References**

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<tr>
<th>MTE62</th>
<th>MEMS AND NANO TECHNOLOGY</th>
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**Objectives**

- To impart knowledge about the latest trends in manufacturing micro components and measuring systems to Nano scale.
- To provide knowledge on processing techniques of micro-electro mechanical systems
- To enumerate the concepts on applications of micro devices
- To gain knowledge on the properties of nano materials
- To perform characterization study on nano materials

**Outcomes**

- Familiarize on MEMS and Microsystems
- Understand the processing techniques of MEMS
- Understand the need for smart materials
- Understand the science of nano materials
- Familiarize on various characterization tests for nano materials

**Unit I  Overview of Mems and Microsystems** (9 Hours)
Definition – historical development – fundamentals – properties, micro fluidics, design and fabrication of micro-system, microelectronics, working principle and applications of micro system

**Unit II  Materials, Fabrication Processes and Micro System Packaging** (9 Hours)
Substrates and wafers, silicon as substrate material, mechanical properties of Si, Silicon Compounds silicon pies resistors, Gallium arsenide, quartz, polymers for MEMS, conductive polymers. Photolithography, photo resist applications, light sources, in implantation, diffusion process exudation – thermal oxidation, silicon diode, chemical vapor deposition, sputtering - deposition by epitaxy – etching – bulk and surface machining – LIGA process Micro system packaging – considerations packaging – levels of micro system packaging die level, device level and system level.

**Unit III  Micro Devices and Materials** (9 Hours)

**Unit IV  Science of Nano Materials** (9 Hours)
Classification of Nano structures – effect of the nanometer length scale effects of Nanoscale dimensions on various properties – structural, thermal, chemical, mechanical, magnetic, optical and electronic properties – effect of Nanoscale dimensions on biological systems. Fabrication methods – Top down processes – bottom up process.

**Unit V  Characterization of Nano Materials** (9 Hours)

**Text Books**
2. Charles P Poole, Frank J Owens, Introduction to Nano technology, John Wiley and Sons, 2003
References

<table>
<thead>
<tr>
<th>MTE63</th>
<th>BIOMEDICAL INSTRUMENTATION</th>
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**Objectives**
- To Introduce Fundamentals of Biomedical Engineering
- To study the communication mechanics in a biomedical system with few examples
- To study measurement of certain important electrical and non-electrical parameters
- To understand the basic principles in imaging techniques
- Students will have basic knowledge in life assisting and therapeutic devices

**Outcomes**
- Differentiate different bio potentials and its propagations
- Illustrate different electrode placement for various physiological recordings
- Design bio amplifier for various physiological recordings
- Explain various technique for non-electrical physiological measurements
- Demonstrate different biochemical measurement techniques

**Unit I Introduction to Bio-Medical Instrumentation** *(9 Hours)*

**Unit II Electrical Parameters Acquisition and Analysis** *(9 Hours)*

**Unit III Non Electrical Parameters Measurement and Diagnostic Procedures** *(9 Hours)*

**Unit IV Imaging Modalities and Analysis** *(9 Hours)*

**Unit V Life Assisting, Therapeutic and Robotic Devices** *(9 Hours)*
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**Objectives**
- To provide knowledge about various techniques used for the measurement of industrial parameters
- To provide knowledge on measurement of velocity, displacement, viscosity, temperature using various types of sensors and related circuits
- To introduce Force & Torque Measuring Instruments
- To introduce Pressure & flow Measuring Instruments
- To impart knowledge on measuring of process variables, analytical instrumentation, automatic process controls.

**Outcomes**
- Capable to select and use strain measuring instruments
- Check various available techniques available and select appropriate to obtain satisfactory task for the parameter to be measured like displacement, Force & Torque
- Be acquainted with measurement of Pressure & flows.
- Be acquainted with measurement of Level & Temperature of a system
- Acquire and Interpret the measurement results and cause of any possible error

**Unit I Introduction and Strain Measurement** *(9 Hours)*
Introduction to instrumentation system, static and dynamic characteristics of an instrumentation system.
Strain Gauge and Strain Measurement: Factors affecting strain measurements, Types of strain gauges, theory of operation of resistive strain gauge, gauge factor, types of electrical strain gauges, strain gauge materials, gauging techniques and other factors, strain gauge circuits and temperature compensation, applications of strain gauges.

**Unit II Displacement, Forces and Torque Measurement** *(9 Hours)*
Resistive potentiometer (Linear, circular and helical), L.V.D.T., R.V.D.T. and their characteristics, variable inductance and capacitance transducers, Piezo electrical transducers-output equations and equivalent circuit, Hall effect devices and Proximity sensors, Large displacement measurement using synchros and resolvers, Shaft encoders. Load cells and their applications, various methods for torque measurement. Use of torque wrenches.

**Unit III Pressure and Flow Measurement** *(9 Hours)*
Mechanical devices like Diaphragm, Bellows, and Bourdon tube for pressure measurement, Variable inductance and capacitance transducers, Piezo electric transducers, L.V.D.T. for measurement of pressure, Low pressure and vacuum pressure measurement using Pirani gauge, McLeod gauge, Ionization gauge, Pressure gauge calibration. Differential pressure meter like Orifice plate, Venturi tube, flow nozzle, Pitot tube, Rotameter, Turbine flow meter, Electromagnetic flow meter, hot wire anemometer, Ultrasonic flow meter.

**Unit IV Level & Temperature Measurement** *(9 Hours)*
**Unit V  Digital Data Acquisition systems & control**  
(9 Hours)

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<th>Text Books</th>
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<tbody>
<tr>
<td>1. Industrial Instrumentation &amp; Control by S. K. Singh. TMH Publication</td>
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<tr>
<td>2. Electrical and Electronics Measurement and Instrumentation, By A. K. Shawney, Dhanpatrai &amp; sons publications</td>
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<tr>
<td>1. Measurement Systems – Application and Design By E.O. Doebelin, TMH Publication</td>
</tr>
<tr>
<td>3. Mechanical &amp; Industrial Measurements by R. K. Jain, Khanna pub</td>
</tr>
</tbody>
</table>

132
INTERNET OF THINGS

Objectives

- To understand the fundamentals of Internet of Things
- To understand the concept of IoT Architecture & models
- To learn about the basics of IoT protocols
- To build a small low cost embedded system using Raspberry Pi
- To apply the concept of Internet of Things in the real world scenario

Outcomes

- Analyze various protocols for IoT
- Develop web services to access/control IoT devices
- Design a portable IoT using Raspberry Pi
- Deploy an IoT application and connect to the cloud & Analyze applications of IoT in real time scenario
- Design and develop various IoT enabled products

Unit I  Introduction to IoT

Internet of Things - Physical Design- Logical Design- IoT Enabling Technologies – IoT Levels & Deployment Templates - Domain Specific IoTs - IoT and M2M - IoT System Management with NETCONF-YANG- IoT Platforms Design Methodology

Unit II  IoT Architecture

M2M high-level ETSI architecture - IETF architecture for IoT - OGC architecture – IoT reference model - Domain model - information model - functional model – communication model - IoT reference architecture

Unit III  IoT Protocols


Unit IV  Building IoT with Raspberry pi & Arduino


Unit V  Case studies and Real-world applications

Real world design constraints - Applications - Asset management, Industrial automation, smart grid, Commercial building automation, Smart cities - participatory sensing – Data Analytics for IoT – Software & Management Tools for IoT Cloud Storage Models & Communication APIs - Cloud for IoT - Amazon Web Services for IoT.

Text Books


References

2. Qusay F. Hassan ,”Internet of Things A to Z: Technologies and Applications” IEEE Press, 2018
MTE71 | PROCESS PLANNING AND COST ESTIMATION | L | T | P | C | Hours
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**Objectives**
- To provide knowledge about the basics of process planning concepts
- To study about process planning activities
- To impart knowledge on costing and estimation
- To study about the cost estimation for various products after process planning
- To learn about the machining time for various machining operations

**Outcomes**
- Acquire knowledge on the basics of process planning
- Interpret and prepare process planning activities chart
- Analyse and interpret the concept of costing and estimation
- Understand and compute the job order cost for different type of shop floor
- Analyze and computation of the machining time for various machining operations

**Unit I Introduction to Process Planning** *(9 hours)*
Introduction- methods of process planning- Drawing interpretation- Material evaluation – steps in process selection- Production equipment and tooling selection

**Unit II Process Planning Activities** *(9 hours)*
Process parameters calculation for various production processes- Selection jigs and fixtures election of quality assurance methods - Set of documents for process planning- Economics of process planning- case studies

**Unit III Introduction to Cost Estimation** *(9 hours)*

**Unit IV Production Cost Estimation** *(9 hours)*
Estimation of Different Types of Jobs - Estimation of Forging Shop, Estimation of Welding Shop, Estimation of Foundry Shop

**Unit V Machining Time Calculation** *(9 hours)*
Estimation of Machining Time - Importance of Machine Time Calculation- Calculation of Machining Time for Different Lathe Operations, Drilling and Boring - Machining Time Calculation for Milling, Shaping and Planning - Machining Time Calculation for Grinding.

**Text Books**

**References**
<table>
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<tr>
<th>MTE72</th>
<th>ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING</th>
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**Objectives:**
- To understand the various characteristics of Intelligent agents
- To learn the different search strategies in AI
- To gain knowledge in solving AI problems
- To introduce students to the basic concepts and techniques of Machine Learning.
- To have a thorough understanding of the Supervised and Unsupervised learning techniques

**Outcomes:**
- Familiarize on characteristics Intelligent agents
- Interpret on various problem solving methods
- Understand AI techniques
- Understand Machine learning
- Interpret the supervised and unsupervised learning techniques

**UNIT I Introduction**

**UNIT II Problem Solving Methods**

**UNIT III Knowledge Representation**

**UNIT IV Introduction**

**UNIT V Linear Models**
Text Books

References
Objectives:

- Introduce the principle, programming technique with instrument interfaces and applications of virtual instruments and to understand the basics of data acquisition are introduced in mechatronics systems.

Outcomes:

- Study about the basics of data acquisition
- Acquiring Knowledge on VI programming techniques
- Study about the use of analysis tools with various applications
- Understand the evolution, advantages, techniques, architecture and applications of visual instrumentation

Unit I Review of Virtual Instrumentation  (9 hours)
Historical perspectives, advantages, block diagram and architecture of a virtual instrument, data-flow techniques, graphical programming in data flow, comparison with conventional programming

Unit II Programming Techniques  (9 hours)
VIS and sub-VIS loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, string and file I/O.

Unit III Data Acquisition Basics  (9 hours)
AOC. OAC. 010. Counters & timers. PC Hardware structure, timing. Interrupts OMA, software and hardware installation

Unit IV Common Instrument Interfaces  (9 hours)
Current loop, RS.232C/RS.485, GPIB, System buses, interface buses: USB, PCMCIA, VXI, SCXI, PXI, etc., networking basics for office & industrial applications, Visa and IVI, image acquisition and processing. Motion control.

Unit V Use of Analysis Tools  (9 hours)
Fourier transforms, power spectrum correlation methods, windowing & filtering, VI application in various fields.

Text Books


References

<table>
<thead>
<tr>
<th>Objectives</th>
<th>Outcomes</th>
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<tbody>
<tr>
<td>To study about the fundamentals of automation in material handling</td>
<td>Acquire knowledge on automation in material handling systems</td>
</tr>
<tr>
<td>To provide knowledge on common material handling systems</td>
<td>Acquire knowledge on RGVS, AGVS, AS/RS</td>
</tr>
<tr>
<td>To impart knowledge on automated material handling systems like RGVS, AGVS, AS/RS, etc.</td>
<td>Familiarize on robots in material handling</td>
</tr>
<tr>
<td>To provide knowledge on transfer mechanisms, conveyors, part feeding devices, robots in material handling</td>
<td>Recognize the automated systems with real time applications</td>
</tr>
<tr>
<td>To discuss various case studies related to automated material handling</td>
<td>Understand the Principles of work holding devices and apply in real time applications</td>
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</table>

**Unit I Introduction** *(9 hours)*

Introduction to work handling concepts in manufacturing – configuration, symbolic representation, work piece characteristics and their significance, Facilities planning process, Facilities design and diagrams, Storage facilities planning, Materials flow, Activity relationship, Space requirements, Facility lay out – computerized lay outs, Evaluation and selection of alternatives, Defined materials handling, Storage – open and closed storage systems, Bulk loading, Unloading, Shipping and Receiving systems and operations.

**Unit II Common Material Handling Equipment’s** *(9 hours)*

Concepts of Unit Loads, Material handling and Storage equipments operation and selection, Containers, Pallets, Conveyor systems, Industrial trucks, Wagon tipplers, Transporters, Stackers, Reclaimers, Silos & hoppers and their accessories, Ropeways, Ship loaders, Cable cranes, Container handling systems, Electric lifts & Hoists, EOT cranes, Elevators, Material handling equipments in Steel mills, Power plants, Mines, Automobile and Transport 27 CIM-2013 SRM(E&T) Industries, Large scale Constructions etc.,

**Unit III Automation of Material Handling** *(9 hours)*

Automated feeding arrangements for discrete parts, their design based in work piece requirements, orienting methods, one by one feeding, agonizing, stapling etc., - Feeding continuous material liquids, granules etc., - Automated assembly system, elements, configuration design, details and control – Special feeding mechanisms – Automated inspection and their design

**Unit IV Classification of Automated Systems** *(9 hours)*

Concepts of Unit Built Machines (UBM) – classification and elements, Power Units, self-contained and separate feed type, Change over UBMs, Transfer lines – classification and their components, Automated systems for handling and transfer of prismatic, axis symmetric parts and asymmetric parts in transfer lines, Case studies on transfer lines – interlocked, palleleted and flexible inter linkage transfer lines, control systems – SWARP handling and disposal systems.
**Unit V  Automated Material Handling Equipment’s**  
(9 hours)

Automated handling and storage systems in manufacturing environment, Rail Guided Vehicles (RGVs), Automated Guided Vehicles (AGVs), Applications of RGVs and AGVs, Automated Storage and Retrieval Systems (AS / RS), AS / RS in the Automated factory, Considerations for planning an AS /RS system, Applications of AS / RS, Principles of work holding devices – Modular fixturing, Flexible fixturing systems – Fixturing for FMS, Robots and their applications in handling and storage.

<table>
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Objectives:

- Intelligent control is a class of control techniques that use various artificial intelligence computing approaches like neural networks, Bayesian probability, fuzzy logic, machine learning, reinforcement learning, evolutionary computation and genetic algorithms.

Outcomes:

- Learn basics of fuzzy set theory and neural networks, Implement fuzzy based decision making systems, Implement Neural Network based approximator, Design Fuzzy and Neural Network based control system.

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<tr>
<th>Unit I Introduction</th>
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<tr>
<th>Unit II Artificial Neural Networks</th>
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<th>Unit III Genetic Algorithm</th>
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<td>Basic concept of Genetic algorithm and detail algorithmic steps, adjustment of free parameters. Solution of typical control problems using genetic algorithm. Concept on some other search techniques like tabu search and ant-colony search techniques for solving optimization problems.</td>
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<th>Unit IV Fuzzy Logic System</th>
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<tr>
<td>Introduction to crisp sets and fuzzy sets, basic fuzzy set operation and approximate reasoning. Introduction to fuzzy logic modeling and control. Fuzzification, inferencing and defuzzification. Fuzzy knowledge and rule bases. Fuzzy modeling and control schemes for nonlinear systems. Self-organizing fuzzy logic control. Fuzzy logic control for nonlinear time-delay system.</td>
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<th>Unit V Applications</th>
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Text Books

References

### ELECTIVE - IV

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<th>MTE76</th>
<th>AVIONICS</th>
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#### Objectives
- To introduce the basic of avionics and its need
- To study about digital avionics architecture and various avionics data buses
- To impart knowledge about the control and display technology
- To gain more knowledge on navigation system
- To study about the concepts of air data systems and auto pilot

#### Outcomes
- Acquaint knowledge on basics of avionics
- Ability to build digital avionics architecture
- Ability to design Navigation system
- Analyze the performance of various cockpit display technologies
- Ability to design and perform analysis on air system.

#### Unit I Introduction to Avionics (9 Hours)
Need for avionics in civil and military aircraft and space systems – integrated avionics and weapon systems – typical avionics subsystems, design, technologies – Introduction to digital computer and memories

#### Unit II Digital Avionics Architecture (9 Hours)

#### Unit III Flight Decks and Cockpits (9 Hours)
Contro and display technologies: CRT, LED, LCD, EL and plasma panel – Touch screen – Direct voice input (DVI) – Civil and Military Cockpits: MFDS, HUD, MFK, HOTAS.

#### Unit IV Introduction to Navigation Systems (9 Hours)

#### Unit V Air Data Systems and Auto Pilot (9 Hours)
Air data quantities – Altitude, Air speed, Vertical speed, Mach Number, Total air temperature, Mach warning, Altitude warning – Auto pilot – Basic principles, Longitudinal and lateral auto pilot.

#### Text Books

#### References
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<th>Unit</th>
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<tr>
<td>I</td>
<td>Introduction and Process Control for Variables</td>
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<td>II</td>
<td>Process Control for Attributes</td>
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<td>III</td>
<td>Acceptance Sampling</td>
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<td>IV</td>
<td>Life Testing – Reliability</td>
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<td>V</td>
<td>Quality and Reliability</td>
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**Objectives:**
- To introduce the concept of statistical quality control
- To understand process control and acceptance sampling procedure and their application
- To learn the concept of sampling
- To study about the life testing
- To impart knowledge about quality and reliability

**Outcomes:**
- Summarize the concept of quality and process control for variables
- Apply the process control for attributes
- Interpret the concept of sampling and to solve problems
- Understand the concept of life testing
- Acquaint knowledge on reliability and quality techniques involved

**Text Books**
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**Objectives:**
- To become familiar with digital image fundamentals
- To get exposed to simple image enhancement techniques in Spatial and Frequency domain.
- To learn concepts of degradation function and restoration techniques
- To study the image segmentation and representation techniques
- To become familiar with image compression and recognition methods

**Outcomes:**
- Know and understand the basics and fundamentals of digital image processing, such as digitization, sampling, quantization, and 2D-transforms
- Operate on images using the techniques of smoothing, sharpening and enhancement.
- Understand the restoration concepts and filtering techniques.
- Learn the basics of segmentation, features extraction, compression and recognition methods for color models.

**Unit I Digital Image Fundamentals** *(9 Hours)*

**Unit II Image Enhancement** *(9 Hours)*

**Unit III Image Restoration** *(9 Hours)*

**Unit IV Image Segmentation** *(9 Hours)*

**Unit V Machine Vision Fundamentals** *(9 Hours)*
Machine vision: image acquisition, digital images-sampling and quantization-levels of computation Feature extraction-windowing technique- segmentation- Thresholding- edge detection- binary morphology - grey morphology.
Text Books

References
<table>
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<tr>
<th>MTE79</th>
<th>AUTONOMOUS MOBILE ROBOTS</th>
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<td>Objectives</td>
<td>Students will learn about basics of robots, programming and machine vision applications in robots</td>
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<td>Outcomes</td>
<td>Express the basic concepts, laws, components and parameters of robots</td>
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<td>Explain the types of grippers and its functions.</td>
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<td>Evaluate the kinematic calculations and apply Lagrangian and Newton-Euler methods to analyze dynamic characteristics of robots</td>
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<td>Describing the various programming techniques used in industrial robots</td>
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<td>Basis of machine vision and apply the concept of image processing</td>
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**Unit I Basics of Robotics**

(9 Hours)

**Unit II Robot End Effectors**

(9 Hours)
Robot End effectors: Introduction- types of End effectors- Mechanical gripper- types of gripper mechanism- gripper force analysis- other types of gripper- special purpose grippers.

**Unit III Robot Mechanics**

(9 Hours)

**Unit IV Robot Programming**

(9 Hours)
Robot programming: Robot Languages- Classification of robot language-Computer control and robot software-Val system and Languages- application of robots.

**Unit V Machine Vision Fundamentals**

(9 Hours)
Machine vision: image acquisition, digital images-sampling and quantization-levels of computation Feature extraction-windowing technique-segmentation- Thresholding-edge detection-binary morphology - grey morphology.

**Text Books**

**References**
<table>
<thead>
<tr>
<th>MTE 710</th>
<th>PRODUCT DESIGN AND DEVELOPMENT</th>
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**Objectives:**
- To study about the importance of product design and customer understanding
- To gain knowledge on concept generation and selection criteria in product design and development
- To learn about the product architecture
- To conduct investigation on industrial design
- To study about the principles for design for manufacturing and product development

**Outcomes:**
- Familiarizing the product design principles
- Understand the principles of concept generation and selection
- Understand product architecture
- Assess the quality of industrial design
- Understand the principles for design for manufacturing and product development

**Unit I Introduction**  
(9 Hours)

**Unit II Concept Generation and Selection**  
(9 Hours)

**Unit III Product Architecture**  
(9 Hours)

**Unit IV Industrial Design**  
(9 Hours)

**Unit V Design for Manufacturing and Product Development**  
(9 Hours)
Text Books

References
# ELECTIVE – V

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<tr>
<th>MTE81</th>
<th>NON-DESTRUCTIVE TESTING METHODS</th>
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**Objectives:**
- To study about basics of NDT
- To provide basic understanding on surface NDE methods
- To impart knowledge on thermography testing
- To introduce students to a variety of practical applications associated with ultrasonic testing
- To get familiarized with radiography (RT)

**Outcomes:**
- Acquire knowledge about non destruction testing methods.
- Students will have a basic knowledge of surface NDE techniques which enables them to carry out various inspections with standard procedures.
- Students will be able to have a basic knowledge of ultrasonic testing which enables them to perform inspection of samples.
- Students will have a complete theoretical and practical understanding of the radiographic testing, interpretation and evaluation.

## Unit I Overview of NDT
NDT Versus Mechanical testing, Overview of the Non Destructive Testing Methods for the detection of manufacturing defects as well as material characterization. Relative merits and limitations, Various physical characteristics of materials and their applications in NDT., Visual inspection – Unaided and aided.

## Unit II Surface NDE Methods

## Unit III Thermography and Eddy Current Testing (ET)

## Unit IV Ultrasonic Testing (UT) and Acoustic Emission (AE)

## Unit V Radiography (RT)
Principle, interaction of X-Ray with matter, imaging, film and film less techniques, types and use of filters and screens, geometric factors, Inverse square, law, characteristics of films – graininess, density, speed, contrast, characteristic curves, Penetrameters, Exposure charts, Radiographic equivalence. Fluoroscopy- Xero-Radiography, Computed Radiography
Text Books


References

## Objectives:
- To enable the student to understand the principles and functions of maintenance planning.
- To impart the policies and practices adapted in industry for the successful management of maintenance activities.
- To illustrate some of the simple instruments used for condition monitoring in industry.
- To study about the different maintenance categories like Preventive maintenance, condition monitoring and repair of machine elements.
- To study about the repair of material handling equipment.

## Outcomes:
- Acquaint knowledge on basics principle of maintenance planning.
- To implement the maintenance function and different practices in industries for the successful management of maintenance activities.
- To identify the different maintenance categories like Preventive maintenance, condition monitoring.
- Understand the repair concepts of simple machine elements.
- Select appropriate repair tool to characterize the material handling equipment.

## Unit I Principles and Practices of Maintenance Planning (9 Hours)

## Unit II Maintenance policies - Preventive Maintenance (9 Hours)
Maintenance categories – Comparative merits of each category – Preventive maintenance, maintenance schedules, repair cycle – Principles and methods of lubrication – TPM.

## Unit III Condition Monitoring (9 Hours)
Condition Monitoring – Cost comparison with and without CM – On-load testing and offload testing – Methods and instruments for CM – Temperature sensitive tapes – Pistol thermometers – wear-debris analysis.

## Unit IV Repair Methods for basic Machine Elements (9 Hours)
Repair methods for beds, slideways, spindles, gears, lead screws and bearings – Failure analysis – Failures and their development – Logical fault location methods – Sequential fault location.

## Unit V Repair Methods for Material Handling Equipment (9 Hours)
### Text Books

### References
Objectives:
- To study and understand the various sensor and its application.

Outcomes:
- Interpret the basic concepts of sensors and its characteristics demonstrate the Advanced concepts of chemical sensors
- Analyze the characteristics of optic sensor measurement system
- Explain the concepts, network architectures and applications of wireless sensor networks
- Analyze the protocol design issues of wireless sensor networks
- Students will have a complete theoretical and practical understanding of the radiographic testing, interpretation and evaluation.

Unit I Introduction to Sensors

Unit II Chemical Sensors

Unit III Optic Sensors

Unit IV Fundamentals of Wireless Communication

Unit V Wireless Sensor Networks (WSNs)

Text Books
2. Francis To So Yu and Shizhuo Yin, —Fiber Optic Sensorsl, CRC Press, 2008.
References

### Objectives:
- To learn industrial electronics in applied manner with perspective of mechanical engineering.
- To introduce the design philosophy for mechanical processes control based on analog and digital electronics and electrical machines.

### Outcomes:
- To learn industrial electronics in applied manner with perspective of mechanical engineering.
- To introduce the design philosophy for mechanical processes control based on analog and digital electronics and electrical machines.

#### Unit I Amplifiers (9 Hours)

#### Unit II Regulators (9 Hours)

#### Unit III SCR and Thyristor (9 Hours)
SCR and Thyristor: Principles of operation and characteristics of SCR, Triggering of Thyristors, Commutation Techniques of Thyristors – Classes A, B, C, D, E and F, Ratings of SCR

#### Unit IV SCR in Power Control (9 Hours)

#### Unit V Industrial Applications (9 Hours)
**Industrial Applications – I:** Industrial timers -Classification, types, Electronic Timers – Classification, RC and Digital timers, Time base Generators. Electric Welding Classification, types and methods of Resistance and ARC wielding, Electronic DC Motor Control.

Text Books

References
3. Integrated Circuits and Semiconductor Devices – Deboo and Burroughs, ISE
### Objectives:
- To introduce the basic concepts of cyber physical system
- To study about the various automated control design
- To impart knowledge on modeling and analysis of advanced automata
- To provide knowledge on hybrid automata modeling
- To perform various case studies on CPS

### Outcomes:
- Understand the basic concepts of cyber physical system
- Acquire knowledge on automated control design
- Acquire knowledge on modelling and analysis on advanced automata
- Understand on hybrid automata modelling
- Interpret the various case studies on cyber physical system

### Unit I  Introduction  
(9 Hours)

### Unit II  Stability Analysis:  
(9 Hours)
Principles of Automated Control Design: Dynamical Systems and Stability, Controller Design Techniques CLFs, MLFs, stability under slow switching, Performance under Packet drop and Noise. CPS : From features to software components, Mapping software components to ECUs

### Unit III  Advanced Automata based modelling and analysis  
(9 Hours)
Basic introduction and examples ,Timed and Hybrid Automata, Definition of trajectories, zenoness, Formal Analysis: Flow pipe construction, reachability analysis, Analysis of CPS Software, Weakest Pre-conditions, Bounded Model checking

### Unit IV  Hybrid Automata Modelling  
(9 Hours)

### Unit V  Automotive Case study , CPS Performance Analysis  
(9 Hours)

### Text Books

### References
## MTE86

**DATA COMMUNICATION AND NETWORKING**

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### Objectives
- To introduce the fundamental various types of computer networks.
- To demonstrate the TCP/IP and OSI models with merits and demerits.
- To explore the various layers of OSI Model.
- To introduce UDP and TCP Models.

### Outcomes
- Students should be understand and explore the basics of Computer Networks and Various Protocols.
- Acquaint knowledge to understand the World Wide Web concepts.
- Students should be understand to administrate a network and flow of information further he/she can understand easily the concepts of network security, Mobile and networks.

### Unit I Data Communications (9 Hours)

### Unit II Data Link Layer (9 Hours)

### Unit III Network Layer (9 Hours)
Logical Addressing, Internetworking, Tunneling, Address mapping, ICMP, IGMP, Forwarding, Unicast Routing Protocols, Multicast Routing Protocols.

### Unit IV Transport Layer (9 Hours)
Process to Process Delivery, UDP and TCP protocols, Data Traffic, Congestion, Congestion Control, QoS, Integrated Services, Differentiated Services, QoS in Switched Networks.

### Unit V Application Layer (9 Hours)
Domain name space, DNS in internet, electronic mail, SMTP, FTP, WWW, HTTP, SNMP

### Text Books

### References
1. Data communications and Computer Networks, P.C. Gupta, PHI.
Objectives:

- To introduce the basics of NCES and statistical data on conventional energy resources.
- To study about the concept of solar energy and its types
- To learn the wind energy conversion systems
- To provide knowledge on geothermal energy resources and biomass energy conversion systems
- To impart knowledge about tidal, wave and OTEC energy power generation system

Outcomes:

- Acquaint knowledge on basics of NCES
- Acquire knowledge on the solar energy and its conversion systems.
- Understand the concepts of Wind energy conversion systems
- Analyze harnessing of Geothermal, Ocean energies.
- Recognize the need and ability to engage in lifelong learning for further developments in this field.

Unit I Statistics on Conventional Energy Sources (9 Hours)
Statistics on conventional energy sources and supply in developing countries, Definition Concepts of NCES, Limitations of RES, Criteria for assessing the potential of NCES. Classification of NCES – Solar, Wind, Geothermal, Bio-mass, Ocean Energy Sources, comparison of these energy sources.

Unit II Solar Energy (9 Hours)
Solar Energy-Energy available form Sun, Solar radiation data, Solar energy conversion into heat, Flat plate and Concentrating collectors, Mathematical analysis of Flat plate collectors and collector efficiency, Principle of Natural and Forced convection, Solar engines-Stirling, Brayton engines, Photovoltaic, p-n junction, solar cells, PV systems, Stand-alone, Grid connected solar power satellite.

Unit III Wind Energy (9 Hours)
Wind energy conversion, General formula -Lift and Drag- Basis of wind energy conversion – Effect of density, frequency variances, angle of attack, and wind speed. Windmill rotors Horizontal axis and vertical axis rotors. Determination of torque coefficient, Induction type generators- working principle

Unit IV Geothermal Sources (9 Hours)
Nature of Geothermal sources, Definition and classification of resources, Utilization for electric generation and direct heating, Well Head power generating units, Basic features Atmospheric exhaust and condensing, exhaust types of conventional steam turbines. Pyrolysis of Biomass to produce solid, liquid and gaseous fuels, Biomass gasification, Constructional details of gasifier, usage of biogas for chulhas, various types of chulhas for rural energy needs.

Unit V Wave, Tidal and OTEC Energy (9 Hours)
Wave, Tidal and OTEC energy- Difference between tidal and wave power generation, Principles of tidal and wave power generation, OTEC power plants, Operational of small cycle experimental facility, Design of 5 Mw OTEC pro-commercial plant, Economics of OTEC, Environmental impacts of OTEC, Status of multiple product OTEC systems.
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<td>1. Ramesh R &amp; Kumar K U, Renewable Energy Technologies, Narosa Publishing House, New Delhi, 2004</td>
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**Objectives:**
- To study about the basic concepts of composite materials
- To impart knowledge about macro mechanics
- To make the student understand the analysis of composite laminates under different loading conditions and different environmental conditions.
- To study about the fabrication process and repair methods
- To learn about the design concepts of sandwich construction

**Outcomes:**
- Understand the basics of composite materials
- Understanding the mechanics of composite materials
- Ability to analyse the laminated composites for various loading cases
- Acquaint knowledge in manufacture of composites
- Interpret design concepts of sandwich construction

**Unit I Micromechanics** (9 Hours)

**Unit II Macro mechanics** (9 Hours)

**Unit III Laminated Plate Theory** (9 Hours)
Governing differential equation for a laminate. Stress – strain relations for a laminate. Different types of laminates. in plane and flexural constants of a laminate. hygrothermal stresses and strains in a laminate. failure analysis of a laminate. Impact resistance and inter-laminar stresses. netting analysis

**Unit IV Fabrication Process and Repair Methods** (9 Hours)
Various open and closed mould processes, manufacture of fibers, importance of repair and different types of repair techniques in composites – autoclave and non-autoclave methods.

**Unit V Sandwich Constructions** (9 Hours)
Basic design concepts of sandwich construction – materials used for sandwich construction – failure modes of sandwich panels – bending stress and shear flow in composite beams.

**Text Books**
1. Dam Ishai., “Mechanics of Composite Materials,”
References

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**Objectives**
- To introduce about the basics of entrepreneurship
- To study about various generation of ideas
- To impart awareness on various legal aspects of business
- To provide knowledge on business finance
- To learn about operation management and decisions

**Outcomes**
- Understand the basics of entrepreneurship
- Acquire knowledge on various generation of ideas
- Understand the legal aspects of business
- Students will be able to understand the finance criteria.
- Interpret the strategies for successful implementation of ideas

**Unit I  Basics of Entrepreneurship**  
(9 Hours)
Nature, scope and types of Entrepreneurship, Entrepreneur Personality Characteristics, Entrepreneurship process. Role of entrepreneurship in economic development

**Unit II  Generation of Ideas**  
(9 Hours)
Creativity and Innovation, Lateral Thinking, Generation of Alternatives, Fractionation, Reversal Method, Brain Storming, Analogies

**Unit III  Legal Aspects of Business**  
(9 Hours)

**Unit IV  Business Finance**  
(9 Hours)
Project evaluation and investment criteria (cases), sources of finance, financial statements, break even analysis, and cash flow analysis.

**Unit V  Operations Management**  
(9 Hours)
Importance- functions-deciding on the production system- facility decisions: plant location, plant layout (cases), capacity requirement planning- inventory management (cases)-lean manufacturing, Six sigma.

**Text Books**

**References**
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<th>AUTOMATED INSTRUMENTATION AND EMBEDDED SYSTEMS</th>
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| **Objectives:** | To make the students review the instruments used for measurement of basic process parameters like level, flow, pressure and temperature.  
To explore the various types of analyzers used in industrial applications.  
To introduce the Building Blocks of Embedded System  
To Educate in Various Embedded Development Strategies  
To Introduce Bus Communication in processors, Input/output interfacing |    |    |    |    |       |
| **Outcomes:** | Understand the instrumentation behind flow, level, temperature and pressure measurement  
Acquire basic knowledge on the various types of analyzers used in typical industries.  
Acquire a basic knowledge about fundamentals of microcontrollers, programming and system control to perform a specific task.  
Acquire knowledge about devices and buses used in embedded networking.  
Develop programming skills in embedded systems for various applications |    |    |    |    |       |

**Unit I Measurement of Process Parameters**  
(9 Hours)  
Review the various Measurement techniques of temperature, pressure, flow and level – application - selection of sensors– calibration methods.

**Unit II Instruments for Analysis**  
(9 Hours)  

**Unit III Introduction to Embedded Systems**  
(9 Hours)  
Brief overview of real time systems and embedded systems - Classification of embedded systems - Embedded system definitions - Functional and non-functional requirements - Architectures and standards - Typical applications.

**Unit IV Embedded System Components and Interface**  
(9 Hours)  
Device choices - Selection criteria and characteristics of Processors and memory systems for embedded applications - Interface and Peripherals - Power sources and management.

**Unit V Embedded System Design and Development**  
(9 Hours)  
Design methods and techniques - Classification of need - Need analysis -Requirement and specification - Conceptual design - Models and languages – State machine model - State machine tables - Verification – Validation - Simulation and emulation.
### Text Books


### References