

# **St. PETER'S UNIVERSITY**

St. Peter's Institute of Higher Education and Research  
(Declared under section 3 of UGC Act 1956)  
Avadi, Chennai – 600 054.



## **B.E. (MECHANICAL ENGINEERING) PROGRAMME**

(I TO VIII SEMESTERS)

### **REGULATIONS AND SYLLABI**

(REGULATIONS – 2012)

**(Effective from the Academic Year 2012-'13)**

# B.E. (MECHANICAL ENGINEERING) PROGRAMME

## Regulations and Syllabi

(Effective from the Academic Year 2012-'13)

### 1. Eligibility:

(1) Candidates who passed the following Examination or any other equivalent Examination thereto and who appeared for the entrance test conducted by the University or approved institutions wherever prescribed are eligible for admission to Four Year B.E. (Mechanical Engineering) Programme.

Higher Secondary Examination with Mathematics, Physics and Chemistry conducted by the Government of Tamil Nadu or its equivalent in the relevant subjects.

(2) Candidates who passed Three Year Diploma in Technical Education in the concerned subject conducted by the Government of Tamil Nadu are eligible for admission to Second Year of Four Year B.E. (Mechanical Engineering) Programme.

**2. Duration:** Four Years comprising 8 Semesters. Each semester has a minimum 90 working days with a minimum of 5 hours a day.

**3. Medium:** English is the medium of instruction and examination.

**4. Weightage for Continuous and End Assessment:** The weightage for Continuous Assessment (CA) and End Assessment (EA) be 25:75 unless the ratio is specifically mentioned in the scheme of Examinations.

**5. Credit System:** Credit system be followed with 18 credits for each semester and each credit is equivalent to 25 hours of effective study provided in the Time Table.

### 6. Scheme of Examinations

#### I Semester

Code No.	Course Title	Credit	Marks		
			CA	EA	Total
<b>Theory</b>					
112EHT01	Technical English - I	1	25	75	100
112MAT02	Mathematics - I	3	25	75	100
112PHT03	Engineering Physics - I	3	25	75	100
112CYT04	Engineering Chemistry - I	3	25	75	100
112EGT05	Engineering Graphics - I	3	25	75	100
112FCT06	Fundamentals of Computing - I	3	25	75	100
<b>Practical</b>					
112CLP01	Computer Practices Laboratory - I	1	25	75	100
112ELP02	Engineering Practices Laboratory -I	1	25	75	100
<b>Total</b>		<b>18</b>	<b>200</b>	<b>600</b>	<b>800</b>

## II Semester

Code No.	Course Title	Credit	Marks		
			CA	EA	Total
<b>Theory</b>					
212EHT01	Technical English – II	2	25	75	100
212MAT02	Mathematics – II	3	25	75	100
212PHT03	Engineering Physics – II	2	25	75	100
212CYT04	Engineering Chemistry – II	2	25	75	100
212EMT05	Engineering Mechanics	3	25	75	100
212EET06	Basic Electrical & Electronics Engineering	3	25	75	100
<b>Practical</b>					
212CLP01	Computer Practices Laboratory – II	1	25	75	100
212ELP02	Physics & Chemistry Laboratory – II	1	25	75	100
212DMP03	Computer Aided Drafting and Modelling Laboratory	1	25	75	100
	<b>Total</b>	<b>18</b>	<b>225</b>	<b>675</b>	<b>900</b>

## III Semester

Code No.	Course Title	Credit	Marks		
			CA	EA	Total
<b>Theory</b>					
312MAT01	Transforms And Partial Differential Equation	3	25	75	100
312MET02	Manufacturing Technology – I	2	25	75	100
312MET03	Engineering Thermodynamics	3	25	75	100
312MET04	Kinematics of Machinery	3	25	75	100
312MET05	Fluid Mechanics and Machinery	2	25	75	100
312MET06	Electrical Drives and Control	2	25	75	100
<b>Practical</b>					
312MEP01	Manufacturing Technology Lab – I	1	25	75	100
312MEP02	Fluid Mechanics and Machinery Laboratory	1	25	75	100
312MEP03	Electrical Engineering Laboratory	1	25	75	100
	<b>Total</b>	<b>18</b>	<b>225</b>	<b>675</b>	<b>900</b>

## IV Semester

Code No.	Course Title	Credit	Marks		
			CA	EA	Total
<b>Theory</b>					
412MET01	Statistics and Numerical Methods	3	25	75	100
412MET02	Heat and Mass Transfer	3	25	75	100
412MET03	Manufacturing Technology – II	2	25	75	100
412MET04	Engineering Materials & Metallurgy	2	25	75	100
412MET05	Strength of Materials	3	25	75	100
412MET06	Electronics and Microprocessor	2	25	75	100
<b>Practical</b>					
412MEP01	Manufacturing Technology Lab – II	1	25	75	100
412MEP02	Strength of Materials Lab	1	25	75	100
412MEP03	Computer Aided Machine Drawing Laboratory	1	25	75	100
	<b>Total</b>	<b>18</b>	<b>225</b>	<b>675</b>	<b>900</b>

### V Semester

Code No.	Course Title	Credit	Marks		
			CA	EA	Total
<b>Theory</b>					
512MET01	Environmental Science & Engineering	2	25	75	100
512MET02	Thermal Engineering	2	25	75	100
512MET03	Dynamics of Machinery	3	25	75	100
512MET04	Design of Machine Elements	3	25	75	100
512MET05	Engineering Metrology & Measurements	2	25	75	100
512MET06	Applied Hydraulics & Pneumatics	2	25	75	100
<b>Practical</b>					
512MEP01	Thermal Engineering Laboratory - I	1	25	75	100
512MEP02	Dynamics Laboratory	1	25	75	100
512MEP03	Metrology & Measurements Laboratory	1	25	75	100
512MEP04	CAD / CAM Laboratory	1	25	75	100
<b>Total</b>		<b>18</b>	<b>250</b>	<b>750</b>	<b>1000</b>

### VI Semester

Code No.	Course Title	Credit	Marks		
			CA	EA	Total
<b>Theory</b>					
612MET01	Principles of Management	2	25	75	100
612MET02	Gas Dynamics & Jet Propulsion	3	25	75	100
612MET03	Design of Transmission Systems	3	25	75	100
612MET04	Automobile Engineering	3	25	75	100
612MET05	Finite Element Analysis	3	25	75	100
<b>612MET07</b>	<b>Elective - I : Quality control reliability engg (OR)</b>	4	25	75	100
<b>612MET09</b>	<b>Renewable sources of energy (Arrear)</b>				
<b>612MET12</b>	<b>Elective - II :Unconventional Manufacturing Processes</b>				
<b>Practical</b>					
612MEP01	Thermal Engineering Laboratory - II	1	25	75	100
612MEP02	Design & Fabrication Project	1	25	75	100
<b>Total</b>		<b>18</b>	<b>200</b>	<b>600</b>	<b>800</b>

### VII Semester

Code No.	Course Title	Credit	Marks		
			CA	EA	Total
<b>Theory</b>					
712MET01	Total Quality Management	2	25	75	100
712MET02	Mechatronics	3	25	75	100
712MET03	Computer Integrated Manufacturing	3	25	75	100
712MET04	Power Plant Engineering	2	25	75	100
<b>712MET05</b>	<b>Elective - III : Process Planning &amp; Cost Estimation</b>	3	25	75	100
<b>712MET07</b>	<b>Elective - IV : Design of Jigs, Fixtures &amp; Press Tools</b>	3	25	75	100
<b>Practical</b>					
712MEP01	Computer Aided Simulation & Analysis Laboratory	1	25	75	100
712MEP02	Mechatronics Laboratory	1	25	75	100
<b>Total</b>		<b>18</b>	<b>200</b>	<b>600</b>	<b>800</b>

### VIII Semester

Code No.	Course Title	Credit	Marks		
			CA	EA	Total
<b>Theory</b>					
812MET01	Engineering Economics & Cost Analysis	2	25	75	100
<b>812MET04</b>	<b>Elective – V : Entrepreneurship Development</b>	3	25	75	100
<b>812MET05</b>	<b>Elective – VI : Production Planning &amp; Control</b>	3	25	75	100
<b>Practical</b>					
812MEP01	Project Work	10	25	75	100
<b>Total</b>		<b>18</b>	<b>100</b>	<b>300</b>	<b>400</b>

### LIST OF ELECTIVE COURSES

Code No.	Course Title
<b>Elective – I &amp; II</b>	
612MET06	Marketing Management
<b>612MET07</b>	<b>Quality Control &amp; Reliability Engineering</b>
612MET08	Refrigeration & Air conditioning
<b>612MET09</b>	<b>Renewable Sources of Energy</b>
612MET10	Industrial Tribology
612MET11	Vibration & Noise Control
<b>612MET12</b>	<b>Unconventional Manufacturing Processes</b>
<b>Elective – III &amp; IV</b>	
<b>712MET05</b>	<b>Process Planning &amp; Cost Estimation</b>
712MET06	Robotics
<b>712MET07</b>	<b>Design of Jigs, Fixtures &amp; Press Tools</b>
712MET08	Composite Materials
712MET09	Thermal Turbomachines
712MET10	Computational Fluid Dynamics
712MET11	Nuclear Engineering
<b>Elective – V &amp; VI</b>	
812MET02	Professional Ethics In Engineering
812MET03	Fundamentals of Nanoscience
<b>812MET04</b>	<b>Entrepreneurship Development</b>
<b>812MET05</b>	<b>Production Planning &amp; Control</b>
812MET06	Maintenance Engineering
812MET07	Operations Research
812MET08	Design of Pressure vessel and piping
812MET09	Advanced I.C. Engines
812MET10	Design of Heat Exchangers

**7. Passing Requirements:** The minimum pass mark (raw score) be 50% in End Assessment (EA) and 50% in Continuous Assessment (CA) and End Assessment (EA) put together. No minimum mark (raw score) in Continuous Assessment (CA) be prescribed unless it is specifically mentioned in the scheme of Examination.

**8. Grading System:** Grading System on a 10 Point Scale be followed with 1 mark = 0.1 Grade point to successful candidates as given below.

## CONVERSION TABLE

(1 mark = 0.1 Grade Point on a 10 Point Scale)

Range of Marks	Grade Point	Letter Grade	Classification
90 to 100	9.0 to 10.0	O	First Class
80 to 89	8.0 to 8.9	A	First Class
70 to 79	7.0 to 7.9	B	First Class
60 to 69	6.0 to 6.9	C	First Class
50 to 59	5.0 to 5.9	D	Second Class
0 to 49	0 to 4.9	<b>F</b>	<b>Reappearance</b>

### Procedure for Calculation

Cumulative Grade Point Average (CGPA) =  $\frac{\text{Sum of Weighted Grade Points}}{\text{Total Credits}}$

$$= \frac{\sum (CA+EA) C}{\sum C}$$

Where Weighted Grade Points in each Course = Grade Points (CA+EA) multiplied by Credits

$$= (CA+EA)C$$

Weighted Cumulative Percentage of Marks(WCPM) = CGPAx10

C- Credit,

CA-Continuous Assessment,

EA- End Assessment

**9. Pattern of the Question Paper:** The question paper for End Assessment will be set for three hours and for the maximum of 100 marks with following divisions and details.

**Part A:** 10 question (with equal distribution to all units in the syllabus).  
Each question carries 2 marks.

**Part B:** 5 question with either or type (with equal distribution to all units in the syllabus). Each question carries 16 marks.

The total marks scored by the candidates will be reduced to the maximum prescribed in the Regulations.

**10. Effective Period of Operation for the Arrear Candidates :** Two Year grace period is provided for the candidates to complete the arrear examination, if any.

**Registrar**

## 11.Syllabus

### 112EHT01 - TECHNICAL ENGLISH – I

#### AIM:

To encourage students to actively involved in participative learning of English and to help them acquire Communication Skills.

#### OBJECTIVES:

- To help students develop listening skills for academic and professional purposes.
- To help students acquire the ability to speak effectively in English in real-life situations.
- To inculcate reading habit and to develop effective reading skills.
- To help students improve their active and passive vocabulary.
- To familiarize students with different rhetorical functions of scientific English.
- To enable students write letters and reports effectively in formal and business situations.

#### UNIT I

General Vocabulary - changing words from one form to another - Adjectives, comparative adjectives – Adverbs - Active and passive voice – Tenses - simple present, present continuous - Adverb forms – Nouns – compound nouns - Skimming and scanning - Listening and transfer of information – bar chart, flowchart - Paragraph writing, description – Discussing as a group and making an oral report on the points discussed, conversation techniques - convincing others.

#### Suggested activities:

1. Matching words & meanings - Using words in context – Making sentences.
2. Changing sentences from active to passive voice & vice versa.
3. Skimming, cloze exercises, exercises transferring information from text to graphic form – bar charts, flow charts.
4. Writing descriptions using descriptive words & phrases, and technical vocabulary.
5. Role play, conversation exercises, discussions, oral reporting exercises  
Any other related relevant classroom activity

#### UNIT II

Vocabulary – prefixes & suffixes – simple past tense - Spelling and punctuation – 'wh' Question forms - Scanning, inference - Listening & note-taking - Paragraph writing - comparison and contrast - Creative thinking and speaking.

#### Suggested Activities:

1. a. Vocabulary activities using prefixes and suffixes.  
b. Exercises using questions – asking & answering questions.
2. Scanning the text for specific information
3. Listening guided note-taking - Writing paragraphs using notes, giving suitable headings and subheadings for paragraphs. Using expressions of comparison and contrast.
4. Discussion activities and exploring creative ideas.  
Any other related relevant classroom activity

#### UNIT III

Tenses - simple past, simple future and past perfect - Reading in Context -Listening & note-taking – single line – Definitions – sequencing of sentences – instruction - Persuasive speaking.

#### Suggested activities:

1. a. Providing appropriate context for the use of tenses

2. Listening and note-taking
3. (a) Writing sentence definitions, instructions  
(b) Identifying the discourse links and sequencing jumbled sentences / writing instructions.
4. Speaking exercises, discussions, role play exercises using explaining, convincing and persuasive strategies  
Any other related relevant classroom activity

#### **UNIT IV**

Modal verbs and Probability – Concord subject verb agreement – Correction of errors - Cause and effect expressions – Extended Definition - Speaking about the future plans.

#### **Suggested activities:**

1. a. Making sentences using modal verbs to express probability  
b. Gap filling using relevant grammatical form of words.
2. Writing extended definitions
3. Speaking - role play activities, discussions, extempore speaking exercises speculating about the future.  
Any other related relevant classroom activity

#### **UNIT V**

'If' conditionals – Gerunds - Intensive reading - Speaking – Presentation of problems & solutions - Itinerary – planning for an industrial visit - Formal Letter writing – Letter to the editor, invitation letter, accepting, declining letter and permission letter.

#### **Suggested activities:**

1. a) Sentence completion exercises using 'If' conditionals.  
b) Gap filling exercises using gerunds and present participle forms
2. Reading comprehension exercises.
3. Role play, discussion, debating and speaking activities for stating, discussing  
a. problems and suggesting solutions.
4. Planning a tour, Writing a travel itinerary. Writing letters to officials and to the  
a. editor in formal/official contexts.  
Any other related relevant classroom activity

#### **TEXT BOOK:**

1. Department of Humanities & Social Sciences, Anna University, 'English for Engineers and Technologists' Combined Edition (Volumes 1 & 2), Chennai: Orient Longman Pvt. Ltd., 2006. Themes 1 – 4 (Resources, Energy, Computer, Transport)

#### **REFERENCES:**

1. Meenakshi Raman and Sangeeta Sharma, 'Technical Communication English skills for Engineers', Oxford University Press, 2008.
2. Andrea, J. Rutherford, 'Basic Communication Skills for Technology', Second Edition, Pearson Education, 2007.

#### **Extensive Reading:**

1. A.P.J. Abdul Kalam with Arun Tiwari, 'Wings of Fire' An Autobiography, University Press (India) Pvt. Ltd., 1999, 30<sup>th</sup> Impression 2007.

#### **NOTE:**



The book given under Extensive Reading is meant for inculcating the reading habit of the students. They need not be used for testing purposes.

### **UNIT I MATRICES**

Characteristic equation – Eigen values and eigen vectors of a real matrix – Properties – Cayley-Hamilton theorem (excluding proof) – Orthogonal transformation of a symmetric matrix to diagonal form – Quadratic form – Reduction of quadratic form to canonical form by orthogonal transformation.

### **UNIT II THREE DIMENSIONAL ANALYTICAL GEOMETRY**

Equation of a sphere – Plane section of a sphere – Tangent Plane – Equation of a cone – Right circular cone – Equation of a cylinder – Right circular cylinder.

### **UNIT III DIFFERENTIAL CALCULUS**

Curvature in Cartesian co-ordinates – Centre and radius of curvature – Circle of curvature – Evolutes – Envelopes – Evolute as envelope of normals.

### **UNIT IV FUNCTIONS OF SEVERAL VARIABLES**

Partial derivatives – Euler's theorem for homogenous functions – Total derivatives – Differentiation of implicit functions – Jacobians – Taylor's expansion – Maxima and Minima – Method of Lagrangian multipliers.

### **UNIT V MULTIPLE INTEGRALS**

Double integration – Cartesian and polar coordinates – Change of order of integration – Change of variables between Cartesian and polar coordinates – Triple integration in Cartesian co-ordinates – Area as double integral – Volume as triple integral

### **TEXT BOOK:**

1. Bali N. P and Manish Goyal, "Text book of Engineering Mathematics", Third edition, Laxmi Publications(p) Ltd.,(2008).
2. Grewal. B.S, "Higher Engineering Mathematics", 40<sup>th</sup> Edition, Khanna Publications, Delhi, (2007).

### **REFERENCES:**

1. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, (2007).
2. Glyn James, "Advanced Engineering Mathematics", 7<sup>th</sup> Edition, Pearson Education, (2007).
3. Jain R.K and Iyengar S.R.K," Advanced Engineering Mathematics", 3<sup>rd</sup> Edition, Narosa Publishing House Pvt. Ltd., (2007).

## 112PHT03 – ENGINEERING PHYSICS I

### UNIT-I: ACOUSTICS & ULTRASONICS

Classifications of sound – Characteristics of musical sound – Intensity – Loudness – Weber Fechner law – Decibel – reverberation – reverberation time, derivation of Sabine's formula for reverberation – (Jager's Method) - absorption coefficient and its determination – factors affecting acoustics of building (optimum reverberation time, loudness, focusing, echo, echelon, effect, resonance, and noise) and their remedies – Ultrasonic production –Magnetostriction and piezoelectric methods – Properties – applications of ultrasonic with particular reference to detection of flaws in metal (Non – Destructive testing NDT) – SONAR.

### UNIT II LASER & ITS APPLICATIONS

Introduction – Principle of Spontaneous emission and stimulated emission. Population inversion, pumping. Einsteins A and B Coefficient – derivations. Types of lasers – He-Ne, CO<sub>2</sub>, Nd-YAG, Semiconductor lasers (homojunction & heterojunction) Qualitative Industrial Applications – Lasers in welding, heat treatment, cutting – Medical applications – Holography (construction & reconstruction).

### UNIT III CRYSTAL PHYSICS

Lattice –Unit cell –Bravais lattice –Lattice Planes – Miller indices – d spacing in cubic lattice – Calculation of number of atoms per unit cell – atomic radius – Coordination number –Packing factor for SC, BCC, FCC and HCP structure –Polymorphism and allotropy – Crystal defects – point, line and surface defects.

### UNIT IV PROPERTIES OF MATTER

Elasticity – types of moduli of elasticity – stress strain diagram –Young's modulus of elasticity – rigidity modulus – bulk modulus – Factors affecting elasticity – twisting couple on a wire – Torsional pendulum – determination of rigidity modulus of a wire – depression of a cantilever – Young's modulus by cantilever – uniform and non uniform bending – viscosity – Coefficient of viscosity – Determination of viscosity - Poiseuille's Method –Ostwalds viscometer – comparison of viscosities.

### Unit V OPTICS & FIBER OPTICS

Air Wedge theory and experiment – testing of flat surfaces –anti reflection coating – Michelson interferometer – types of fringes, determination of wave length of monochromatic source and thickness of a thin transparent sheet – Double refraction – Photoelasticity – Photoelastic effect – Photoelastic analysis –Photoelastic material – Block diagram of a photoelastic bench. Principle and propagation of light in optical fibres – Numerical aperture and Acceptance angle – Types – Types of optical fibres (material, refraction index, mode )- Double crucible technique of fibre drawing – Fibre drawing – Fibre optical communication system (Block diagram)

#### Text Book:

1. S.Stella Mary , m. Parasuraman and a. Mohammed Hidayathullah , 'Engineering Physics I R.K. Publishers, Coimbatore (2012)

**REFERENCES:**

1. R.K. Gaur and S.C.Gupta, "Engineering Physics" Dhanpat Rai Publications , New Delhi(2003)
2. M.N. Avadhanulu and PG Kshirsagar, 'A Text book of Engineering Physics' S.Chand and company, Ltd. New Delhi, 2005.
3. Serway and Jewett, 'Physics for Scientists and Engineering with Modern Physics', 6<sup>th</sup> Edition, Thomson Brooks/Cole, Indian reprint (2007).
4. Rajendran, Vand Marikani A, 'Engineering Physics' Tata McGraw Hill Publications Ltd,III edition New Delhi,(2004).
5. Palaniswamy, P.K. 'Engineering Physics' Scitech publications,Chennai,(2007)
6. Jayakumar.s 'Engineering Physics' , R.K.publishers, Coimbatore. (2007)
7. Jayakumar. S 'Engineering Physics', Pearson Education,New Delhi, (2007).
8. Dr. P. Santhana Raghavan, Dr.P. Ramasamy, Crystal Growth- Process and Methods – KRU Publications-Kumbakonam.

## 212CYT04 ENGINEERING CHEMISTRY –II

To impart a sound knowledge on principles of Chemistry involving industrial application oriented topics required for all engineering branches.

### Objectives

- \* The student should be conversant with the principles of Electrochemistry  
Electrochemical cells and their applications.
- Principles of corrosion and its inhibition.
- \* Chemistry of fuels and combustion.
- Importance of phase rule, alloys and their industrial application.
- Analytical techniques and their instrumentation.

### UNIT I ELECTROCHEMISTRY

Electrochemical cells-Reversible and irreversible cells-Concentration cells -EMF Measurement of emf- Single electrode potential -Nernst equation( problem)-Reference electrodes-Standard hydrogen electrode-Calomel electrode-Ion selective electrode-Glass electrode-Measurement of pH- Electrochemical series-significance- Potentiometric titration (redox  $\text{Fe}^{2+}$  Vs Dichromate,) - Conductometric titrations (acid-base and precipitation titrations)

### UNIT II CORROSION AND CORROSION CONTROL

Chemical corrosion -Pilling- Bedworth rule-electrochemical corrosion -mechanism Different types of corrosion-Galvanic corrosion-Differential aeration corrosion -pitting corrosion-waterline corrosion -stress corrosion -crevice corrosion-Factors influencing corrosion -corrosion control-sacrificial anode and impressed cathodic current methods-corrosion inhibitors -protective coatings-paints-constituents-functions- metallic coatings- anodic coating -cathodic coating-metal cladding -diffusion coating - electroplating of gold and electroless plating of nickel.

### UNIT III FUELS AND COMBUSTION

Calorific value -Classification-coal -Proximate analysis and Ultimate analysis-Metallurgical Coke-Manufacture by Bee-hive oven and Otto-Hoffmann method-Petroleum processing and fractions-Cracking -Catalytic cracking and methods-Knocking -octane number -cetane number-Synthetic petrol-Fischer -Tropsch and Bergius process-Gaseous fuels-,Water gas-Producer gas., CNG and LPG-Flue gas analysis-Orsat apparatus-Theoretical air for combustion-Problems

### UNIT IV PHASE RULE AND ALLOYS

Statement and Explanation of terms involved with examples- Phase diagram-One Component system-Water system- Condensed phase rule-Construction of phase diagram by Thermal analysis-Simple eutectic system(Lead-silver system only)- Limitations of phase rule-Alloys-importance of Ferrous alloys-Nichrome-Alnico -Stainless steel-Heat treatment of steel -Non-Ferrous alloys -Brass and Bronze

### UNIT V ANALYTICAL TECHNIQUES

Spectroscopy -Atomic and molecular spectroscopy-Absorption spectrum -Emission spectrum - Absorbance-Beer-Lamberts law-Problems-UV Visible spectroscopy -IR spectroscopy-(principle,instrumentation (block diagram only)and applications colorimetry(principle ,instrumentation and applications )-Estimation of iron by colorimetry.Flame photometry-( principle , instrumentation and applications)-Estimation of Sodium by Flame photometry-Atomic absorption spectroscopy(principle , instrumentation and applications)-Estimation of Nickel by Atomic absorption spectroscopy.

**Text Books**

1. P.C.Jain and Monica Jain , "Engineering Chemistry", Dhanpat Rai Pub Co Ltd ,New Delhi (2002)
2. S.S.Dara , " A Text Book of Engineering Chemistry", S.Chand & Co Ltd New Delhi (2006)
3. Dr.Sayeeda Sultana " Engineering chemistry " Vol -II, Professional and Technical publishers ,Coimbatore (2011)

**Reference Books**

1. B.K.Sharma "Engineering Chemistry",Krishna Prakasan Media (P) Ltd Meerut (2001)
2. B.Shiva Sankar "Engineering Chemistry",Tata McGraw-Hill Pub Co Ltd New Delhi (2008)

## 112EGT05 - ENGINEERING GRAPHICS

### AIM

To develop graphic skills in students.

### OBJECTIVES

To develop in students graphic skill for communication of concepts, ideas and design of engineering products and expose them to existing national standards related to technical drawings.

### Concepts and conventions (Not for Examination)

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

### UNIT I PLANE CURVES AND FREE HAND SKETCHING

#### Curves used in engineering practices:

Conics – Construction of ellipse, Parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves.

#### Free hand sketching:

Representation of Three Dimensional objects – General principles of orthographic projection – Need for importance of multiple views and their placement – First angle projection – layout views – Developing visualization skills through free hand sketching of multiple views from pictorial views of objects.

### UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACES

Projection of points and straight lines located in the first quadrant – Determination of true lengths and true inclinations – Projection of polygonal surface and circular lamina inclined to both reference planes.

### UNIT III PROJECTION OF SOLIDS

Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane by change of position method.

### UNIT IV SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES

Sectioning of above solids in simple vertical position by cutting planes inclined to one reference plane and perpendicular to the other – Obtaining true shape of section.

Development of lateral surfaces of simple and truncated solids – Prisms, pyramids, cylinders and cones – Development of lateral surfaces of solids with cylindrical cutouts, perpendicular to the axis.

### UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS

Principles of isometric projection – isometric scale – isometric projections of simple solids, truncated prisms, pyramids, cylinders and cones.

Perspective projection of prisms, pyramids and cylinders by visual ray method.

### TEXT BOOKS:

1. N.D. Bhatt, "Engineering Drawing" Charotar Publishing House, 46<sup>th</sup> Edition, (2003).

## **REFERENCES:**

1. K. V. Natrajan, "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai (2006).
2. M.S. Kumar, "Engineering Graphics", D.D. Publications, (2007).
3. K. Venugopal & V. Prabhu Raja, "Engineering Graphics", New Age International (P) Limited (2008).
4. M.B. Shah and B.C. Rana, "Engineering Drawing", Pearson Education (2005).
5. K. R. Gopalakrishnana, "Engineering Drawing" (Vol.I&II), Subhas Publications (1998).
6. Dhananjay A.Jolhe, "Engineering Drawing with an introduction to AutoCAD" Tata McGraw Hill Publishing Company Limited (2008).
7. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, (2008).

## **Publication of Bureau of Indian Standards:**

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
3. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4. IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods.

## **Special points applicable to University Examinations on Engineering Graphics:**

1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scale to fit solution within A3 size.
4. Whenever the total number of candidates in a college exceeds 150, the University Examination in that college will be conducted in two sessions (FN and AN on the same day) for 50 percent of student (approx) at a time.



## **112FCT06 - FUNDAMENTALS OF COMPUTING AND PROGRAMMING**

### **AIM :**

To provide an awareness to Computing and Programming

### **OBJECTIVES :**

- To enable the student to learn the major components of a computer system
- To know the correct and efficient ways of solving problems
- To learn to use office automation tools
- To learn to program in C

### **UNIT I INTRODUCTION TO COMPUTERS**

Introduction – Characteristics of Computers – Evolution of Computers - Computer Generations – Classification of Computers – Basic Computer organization – Number Systems

### **UNIT II COMPUTER SOFTWARE**

Computer Software –Types of Software – Software Development Steps – Internet Evolution - Basic Internet Terminology – Getting connected to Internet Applications.

### **UNIT III PROBLEM SOLVING AND OFFICE APPLICATION SOFTWARE**

Planning the Computer Program – Purpose – Algorithm – Flow Charts – Pseudocode - Application Software Packages- Introduction to Office Packages (not detailed commands for examination).

### **UNIT IV INTRODUCTION TO C**

Overview of C – Constants, Variables and Data Types – Operators and Expressions – Managing Input and Output operators – Decision Making - Branching and Looping.

### **UNIT V FUNCTIONS AND POINTERS**

Handling of Character Strings – User-defined Functions – Definitions – Declarations - Call by reference – Call by value – Structures and Unions – Pointers – Arrays – The Preprocessor – Developing a C Program : Some Guidelines

### **TEXT BOOKS:**

1. Ashok.N.Kamthane, " Computer Programming", Pearson Education (India) (2008).
2. Behrouz A.Forouzan and Richard.F.Gilberg, "A Structured Programming Approach Using C", II Edition, Brooks-Cole Thomson Learning Publications, (2007).

### **REFERENCES:**

1. Pradip Dey, Manas Ghoush, "Programming in C", Oxford University Press. (2007).
2. Byron Gottfried, "Programming with C", 2<sup>nd</sup> Edition, (Indian Adapted Edition), TMH publications, (2006).
3. Stephen G.Kochan, "Programming in C", Third Edition, Pearson Education India, (2005).
4. Brian W.Kernighan and Dennis M.Ritchie, "The C Programming Language", Pearson Education Inc., (2005).
5. E.Balagurusamy, "Computing fundamentals and C Programming", Tata McGraw-Hill Publishing Company Limited, (2008).
6. S.Thamarai Selvi and R.Murugan, "C for All", Anuradha Publishers, (2008).

**LIST OF EXERCISES**

**a) Word Processing**

1. Document creation, Text manipulation with Scientific notations.
2. Table creation, Table formatting and Conversion.
3. Mail merge and Letter preparation.
4. Drawing - flow Chart

**b) Spread Sheet**

5. Chart - Line, XY, Bar and Pie.
6. Formula - formula editor.
7. Spread sheet - inclusion of object, Picture and graphics, protecting the document and sheet.
8. Sorting and Import / Export features.

**Simple C Programming**

9. Data types, Expression Evaluation, Condition Statements.
10. Arrays
11. Structures and Unions
12. Functions

\* For programming exercises Flow chart and pseudocode are essential

**HARDWARE / SOFTWARE REQUIRED FOR A BATCH OF 30 STUDENTS**

**Hardware**

- LAN System with 33 nodes (OR) Standalone PCs – 33 Nos.
- Printers – 3 Nos.

**Software**

- OS – Windows / UNIX Clone
- Application Package – Office suite
- Compiler – C

## 108ELP02 - ENGINEERING PRACTICES LABORATORY

### OBJECTIVES

To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.

### GROUP A (CIVIL & MECHANICAL)

#### I CIVIL ENGINEERING PRACTICE

##### Buildings:

- (a) Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

##### Plumbing Works:

- (a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.
- (b) Study of pipe connections requirements for pumps and turbines.
- (c) Preparation of plumbing line sketches for water supply and sewage works.
- (d) Hands-on-exercise:
  - Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.
- (e) Demonstration of plumbing requirements of high-rise buildings.

##### Carpentry using Power Tools only:

- (a) Study of the joints in roofs, doors, windows and furniture.
- (b) Hands-on-exercise:
  - Wood work, joints by sawing, planing and cutting.

#### II MECHANICAL ENGINEERING PRACTICE

##### Welding:

- (a) Preparation of arc welding of butt joints, lap joints and tee joints.
- (b) Gas welding practice

##### Basic Machining:

- (a) Simple Turning and Taper turning
- (b) Drilling Practice

##### Sheet Metal Work:

- (a) Forming & Bending:
- (b) Model making – Trays, funnels, etc.
- (c) Different type of joints.

##### Machine assembly practice:

- (a) Study of centrifugal pump
- (b) Study of air conditioner

##### Demonstration on:

- (a) Smithy operations, upsetting, swaging, setting down and bending. Example –
  - Exercise – Production of hexagonal headed bolt.
- (b) Foundry operations like mould preparation for gear and step cone pulley.
- (c) Fitting – Exercises – Preparation of square fitting and vee – fitting models.

## **GROUP B (ELECTRICAL & ELECTRONICS)**

### **III ELECTRICAL ENGINEERING PRACTICE**

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair case wiring
4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
5. Measurement of energy using single phase energy meter.
6. Measurement of resistance to earth of an electrical equipment.

### **IV ELECTRONICS ENGINEERING PRACTICE**

1. Study of Electronic components and equipments – Resistor, colour coding measurement of AC signal parameter (peak-peak, rms period, frequency) using CR.
2. Study of logic gates AND, OR, EOR and NOT.
3. Generation of Clock Signal.
4. Soldering practice – Components Devices and Circuits – Using general purpose PCB.
5. Measurement of ripple factor of HWR and FWR.

### **REFERENCES:**

1. K.Jeyachandran, S.Natarajan & S, Balasubramanian, "A Primer on Engineering Practices Laboratory", Anuradha Publications, (2007).
2. T.Jeyapoovan, M.Saravanapandian & S.Pranitha, "Engineering Practices Lab Manual", Vikas Publishing House Pvt.Ltd, (2006)
3. H.S. Bawa, "Workshop Practice", Tata McGraw – Hill Publishing Company Limited, (2007).
4. A. Rajendra Prasad & P.M.M.S. Sarma, "Workshop Practice", Sree Sai Publication, (2002).
5. P.Kannaiah & K.L.Narayana, "Manual on Workshop Practice", Scitech Publications, (1999).

## SEMESTER EXAMINATION PATTERN

The Laboratory examination is to be conducted for Group A & Group B, allotting 90 minutes for each group, with a break of 15 minutes. Both the examinations are to be taken together in sequence, either in the FN session or in the AN session. The maximum marks for Group A and Group B lab examinations will be 50 each, totaling 100 for the Lab course. The candidates shall answer either I or II under Group A and either III or IV under Group B, based on lots.

### Engineering Practices Laboratory

#### List of equipment and components (For a Batch of 30 Students)

##### CIVIL

1. Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings. 15 Sets.
2. Carpentry vice (fitted to work bench) 15 Nos.
3. Standard woodworking tools 15 Sets.
4. Models of industrial trusses, door joints, furniture joints 5 each
5. Power Tools:
  - (a) Rotary Hammer 2 Nos
  - (b) Demolition Hammer 2 Nos
  - (c) Circular Saw 2 Nos
  - (d) Planer 2 Nos
  - (e) Hand Drilling Machine 2 Nos
  - (f) Jigsaw 2 Nos

##### MECHANICAL

1. Arc welding transformer with cables and holders 5 Nos.
2. Welding booth with exhaust facility 5 Nos.
3. Welding accessories like welding shield, chipping hammer, wire brush, etc. 5 Sets.
4. Oxygen and acetylene gas cylinders, blow pipe and other welding outfit. 2 Nos.
5. Centre lathe 2 Nos.
6. Hearth furnace, anvil and smithy tools 2 Sets.
7. Moulding table, foundry tools 2 Sets.
8. Power Tool: Angle Grinder 2 Nos
9. Study-purpose items: centrifugal pump, air-conditioner One each.

##### ELECTRICAL

1. Assorted electrical components for house wiring 15 Sets
2. Electrical measuring instruments 10 Sets
3. Study purpose items: Iron box, fan and regulator, emergency lamp 1 each
4. Megger (250V/500V) 1 No.
5. Power Tools: (a) Range Finder 2 Nos  
(b) Digital Live-wire detector 2 Nos

##### ELECTRONICS

1. Soldering guns 10 Nos.
2. Assorted electronic components for making circuits 50 Nos.
3. Small PCBs 10 Nos.
4. Multimeters 10 Nos.
5. Study purpose items: Telephone, FM radio, low-voltage power supply

#### COMMON TO ALL BRANCHES

## **PHYSICS LABORATORY (Any Ten Experiments)**

1. Determination of Young's modulus of the material – non uniform bending.
2. Determination of Young's modulus of the material – uniform bending .
3. Determination of viscosity of liquid – Poiseuille's method.
4. Torsional pendulum – Determination of rigidity modulus.
5. Determination of the thermal conductivity of a bad conductor – Lee's Disc method.
6. Determination of the thickness of a thin wire – Air Wedge method.
7. (a) Particle size determination using Diode Laser.  
(b) Determination of Laser Parameters – Wave length, and angle of divergence.  
(c) Determination of acceptance angle in an optical fiber.
8. Spectrometer dispersive power of a prism.
9. Determination of Wave length of mercury spectrum –Spectrometer grating.
10. Determination of Band Gap of a Semiconductor diode.
11. Determination of velocity of sound and compressibility of liquid- Ultrasonic Interferometer.
12. Determination of Hysteresis loss in a ferromagnetic material

- **A minimum of FIVE experiments shall be offered in Each Semester.**
- **Laboratory classes on alternate weeks for physics and chemistry.**
- **The lab examinations will be held only in the second Semester.**

## CHEMISTRY LABORATORY – I

### LIST OF EXPERIMENTS

1. Estimation of hardness of Water by EDTA method
  2. Estimation of Copper in brass by EDTA method
  3. Determination of DO in water ( Winkler's method)
  4. Estimation of Chloride in Water sample (Argentometric)
  5. Estimation of alkalinity of Water sample
  6. Determination of molecular weight and degree of polymerization of a polymer by viscometry.
  7. Determination of cloud and pour point of a Lubricating oil
- Any five experiments

## 212EHT01 - TECHNICAL ENGLISH II

### AIM:

To encourage students to actively involve in participative learning of English and to help them acquire Communication Skills.

### OBJECTIVES:

1. To help students develop listening skills for academic and professional purposes.
2. To help students acquire the ability to speak effectively in English in real-life situations.
3. To inculcate reading habit and to develop effective reading skills.
4. To help students improve their active and passive vocabulary.
5. To familiarize students with different rhetorical functions of scientific English.
6. To enable students write letters and reports effectively in formal and business situations.

### UNIT I

Technical Vocabulary - meanings in context, sequencing words, Articles- Prepositions, intensive reading& predicting content, Reading and interpretation, extended definitions, Process description

#### Suggested activities:

1. Exercises on word formation using the prefix 'self' - Gap filling with preposition.
2. Exercises - Using sequence words.
3. Reading comprehension exercise with questions based on inference – Reading headings and predicting the content – Reading advertisements and interpretation.
5. Writing extended definitions – Writing descriptions of processes – Writing paragraphs based on discussions – Writing paragraphs describing the future.

### UNIT II

Phrases / Structures indicating use / purpose – Adverbs-Skimming – Non-verbal communication - Listening – correlating verbal and non-verbal communication -Speaking in group discussions – Formal Letter writing – Writing analytical paragraphs.

#### Suggested activities:

1. Reading comprehension exercises with questions on overall content – Discussions analyzing stylistic features (creative and factual description) - Reading comprehension exercises with texts including graphic communication - Exercises in interpreting non-verbal communication.
2. Listening comprehension exercises to categorise data in tables.
3. Writing formal letters, quotations, clarification, complaint – Letter seeking permission for Industrial visits– Writing analytical paragraphs on different debatable issues.

### UNIT III

Cause and effect expressions – Different grammatical forms of the same word - Speaking – stress and intonation, Group Discussions - Reading – Critical reading - Listening, - Writing – using connectives, report writing – types, structure, data collection, content, form, recommendations .



**Suggested activities:**

1. Exercises combining sentences using cause and effect expressions – Gap filling exercises using the appropriate tense forms – Making sentences using different grammatical forms of the same word. ( Eg: object –verb / object – noun )
2. Speaking exercises involving the use of stress and intonation – Group discussions– analysis of problems and offering solutions.
3. Reading comprehension exercises with critical questions, Multiple choice question.
4. Sequencing of jumbled sentences using connectives – Writing different types of reports like industrial accident report and survey report – Writing recommendations.

**UNIT IV**

Numerical adjectives – Oral instructions – Descriptive writing – Argumentative paragraphs – Letter of application - content, format (CV / Bio-data) - Instructions, imperative forms - Checklists, Yes/No question form – E-mail communication.

**Suggested Activities:**

1. Rewriting exercises using numerical adjectives.
2. Reading comprehension exercises with analytical questions on content – Evaluation of content.
3. Listening comprehension – entering information in tabular form, intensive listening exercise and completing the steps of a process.
4. Speaking - Role play – group discussions – Activities giving oral instructions.
5. Writing descriptions, expanding hints – Writing argumentative paragraphs – Writing formal letters – Writing letter of application with CV/Bio-data – Writing general and safety instructions – Preparing checklists – Writing e-mail messages.

**UNIT V**

Speaking - Discussion of Problems and solutions - Creative and critical thinking – Writing an essay, Writing a proposal.

**Suggested Activities:**

1. Case Studies on problems and solutions
2. Brain storming and discussion
3. Writing Critical essays
4. Writing short proposals of 2 pages for starting a project, solving problems, etc.
5. Writing advertisements.

**TEXT BOOK:**

1. Chapters 5 – 8. Department of Humanities & Social Sciences, Anna University, 'English for Engineers and Technologists' Combined Edition (Volumes 1 & 2), Chennai: Orient Longman Pvt. Ltd., 2006. Themes 5 – 8 (Technology, Communication, Environment, Industry)

**REFERENCES:**

1. P. K. Dutt, G. Rajeevan and C.L.N Prakash, 'A Course in Communication Skills', Cambridge University Press, India 2007.
2. Krishna Mohan and Meera Banerjee, 'Developing Communication Skills', Macmillan India Ltd., (Reprinted 1994 – 2007).
3. Edgar Thorpe, Showick Thorpe, 'Objective English', Second Edition, Pearson Education, 2007.

**Extensive Reading:**

1. Robin Sharma, 'The Monk Who Sold His Ferrari', Jaico Publishing House, 2007

**Note:**

The book listed under Extensive Reading is meant for inculcating the reading habit of the students. They need not be used for testing purposes.

## 212MAT02 - MATHEMATICS – II

### UNIT I ORDINARY DIFFERENTIAL EQUATIONS

Higher order linear differential equations with constant coefficients – Method of variation of parameters – Cauchy's and Legendre's linear equations – Simultaneous first order linear equations with constant coefficients.

### UNIT II VECTOR CALCULUS

Gradient Divergence and Curl – Directional derivative – Irrotational and solenoidal vector fields – Vector integration – Green's theorem in a plane, Gauss divergence theorem and Stokes' theorem (excluding proofs) – Simple applications involving cubes and rectangular parallelepipeds.

### UNIT III ANALYTIC FUNCTIONS

Functions of a complex variable – Analytic functions – Necessary conditions, Cauchy – Riemann equation and Sufficient conditions (excluding proofs) – Harmonic and orthogonal properties of analytic function – Harmonic conjugate – Construction of analytic functions – Conformal mapping :  $w = z + c$ ,  $cz$ ,  $1/z$ , and bilinear transformation.

### UNIT IV COMPLEX INTEGRATION

Complex integration – Statement and applications of Cauchy's integral theorem and Cauchy's integral formula – Taylor and Laurent expansions – Singular points – Residues – Residue theorem – Application of residue theorem to evaluate real integrals – Unit circle and semi-circular contour(excluding poles on boundaries).

### UNIT V LAPLACE TRANSFORM

Laplace transform – Conditions for existence – Transform of elementary functions – Basic properties – Transform of derivatives and integrals – Transform of unit step function and impulse functions – Transform of periodic functions.

Definition of Inverse Laplace transform as contour integral – Convolution theorem (excluding proof) – Initial and Final value theorems – Solution of linear ODE of second order with constant coefficients using Laplace transformation techniques.

### TEXT BOOK:

1. Bali N. P and Manish Goyal, "Text book of Engineering Mathematics", 3<sup>rd</sup> Edition, Laxmi Publications (p) Ltd., (2008).
2. Grewal. B.S, "Higher Engineering Mathematics", 40<sup>th</sup> Edition, Khanna Publications, Delhi, (2007).

### REFERENCES:

1. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, (2007).
2. Glyn James, "Advanced Engineering Mathematics", 3<sup>rd</sup> Edition, Pearson Education, (2007).
3. Erwin Kreyszig, "Advanced Engineering Mathematics", 7<sup>th</sup> Edition, Wiley India, (2007).
4. Jain R.K and Iyengar S.R.K, "Advanced Engineering Mathematics", 3<sup>rd</sup> Edition, Narosa Publishing House Pvt. Ltd., (2007).

## 212PHT03 – ENGINEERING PHYSICS II

### UNIT I: CONDUCTING MATERIALS

Conductors – classical free electron theory of metals-Electrical and thermal conductivity – Derivation – Wiedemann – Franz law – Lorentz number – Draw backs of Classical free electron theory –Quantum theory – Fermi distribution function – Effect of temperature on Fermi function – Density of energy states – Carrier concentration in metals.

### UNIT II: SEMICONDUCTING MATERIALS

INTRINSIC SEMICONDUCTOR: Intrinsic semiconductor – Density of electrons in conduction band – Density of holes in valence band – Intrinsic carrier concentration – derivation – Fermi level – Variation – of Fermi with temperature – electrical conductivity – mobility – band gap determination.

EXTRINSIC SEMICONDUCTOR: Extrinsic semiconductors – carrier concentration derivation in n- type and p- type semiconductor variation of Fermi level with temperature and impurity concentration – compound semiconductors.

### UNIT III: DIELECTRIC MATERIALS

Electrical susceptibility – dielectric constant – electronic, ionic, orientational and space charge polarization – frequency and temperature dependence of polarization- internal field – Claussius – Mosotti relation (derivation ) – dielectric loss - dielectric breakdown – uses of dielectric materials (capacitor and transformer ) Ferro electricity and applications.

### UNIT IV: QUANTUM AND SUPER CONDUCTING MATERIALS

Black body radiation – Planck's theory (derivation) – Deduction of Wien' displacement law and Rayleigh – jeans' Law from Planck's theory - Compton Effect – Theory and experimental verification – Matter waves – Schrodinger's wave equation – Time independent and time dependent equations – Physical significance of wave function – Particle in a one dimensional box – Superconductivity: Properties – Types of super conductors – BCS theory of superconductivity(Qualitative) – High Tc superconductors – Applications of super conductors - SQUID, cryotron, magnetic levitation.

### UNIT V: NEW ENGINEERING & NANO MATERIALS

Metallic glasses: Preparation, properties and applications – Shape memory alloys (SMA): Characteristic, Properties of NiTi alloy, application, advantages and disadvantages of SMA-synthesis –Plasma arcing – Chemical vapour deposition – sol-gels – eletrodeposition – ball milling – properties of nanoparticles and applications Carbon nanotubes: fabrication – arc method –pulsed laser deposition – chemical vapour deposition –Structure – properties and applications.

#### Text Books:

1. S. Stella Mary, M. Parasuraman and A. Mohammed Hidayathullah, 'Engineering Physics II' R.K Publishers, Coimbatore(2012).

**REFERENCES:**

1. Charles Kittel 'Introduction to solid state physics', John Wiley & Sons, 7<sup>th</sup> edition, Singapore (2007).
2. Charles P.Poole and Frank J. Ownen, 'Introduction to nanotechnology' Wiley India (2007)(for unit V)
3. Rajendran. v and Marikani.A. 'Materials Science' Tata McGraw hill publications, (2004) New Delhi.
4. Jayakumar. S, 'Materials Science' R.K. Publishers, Coimbatore, (2008).
5. Palanisamy P.K, 'Materials Science' , Scitech publications (India) Pvt. Ltd., Chennai, Second Edition(2007). M. Arumugam, 'Materials Science' Anuradha Publications, Kumbakonam, (2006)

## 212CYT04 ENGINEERING CHEMISTRY –II

To impart a sound knowledge on principles of Chemistry involving industrial application oriented topics required for all engineering branches.

### Objectives

- \* The student should be conversant with the principles of Electrochemistry  
Electrochemical cells and their applications.
- Principles of corrosion and its inhibition.
- \* Chemistry of fuels and combustion.
- Importance of phase rule, alloys and their industrial application.
- Analytical techniques and their instrumentation.

### UNIT I ELECTROCHEMISTRY

Electrochemical cells-Reversible and irreversible cells-Concentration cells -EMF Measurement of emf- Single electrode potential -Nernst equation( problem)-Reference electrodes-Standard hydrogen electrode-Calomel electrode-Ion selective electrode-Glass electrode-Measurement of pH- Electrochemical series-significance- Potentiometric titration (redox  $\text{Fe}^{2+}$  Vs Dichromate,) - Conductometric titrations (acid-base and precipitation titrations)

### UNIT II CORROSION AND CORROSION CONTROL

Chemical corrosion -Pilling- Bedworth rule-electrochemical corrosion -mechanism Different types of corrosion-Galvanic corrosion-Differential aeration corrosion -pitting corrosion-waterline corrosion -stress corrosion -crevice corrosion-Factors influencing corrosion -corrosion control-sacrificial anode and impressed cathodic current methods-corrosion inhibitors -protective coatings-paints-constituents-functions- metallic coatings- anodic coating -cathodic coating-metal cladding -diffusion coating - electroplating of gold and electroless plating of nickel.

### UNIT III FUELS AND COMBUSTION

Calorific value -Classification-coal -Proximate analysis and Ultimate analysis-Metallurgical Coke-Manufacture by Bee-hive oven and Otto-Hoffmann method-Petroleum processing and fractions-Cracking -Catalytic cracking and methods-Knocking -octane number -cetane number-Synthetic petrol-Fischer -Tropsch and Bergius process-Gaseous fuels-,Water gas-Producer gas., CNG and LPG-Flue gas analysis-Orsat apparatus-Theoretical air for combustion-Problems

### UNIT IV PHASE RULE AND ALLOYS

Statement and Explanation of terms involved with examples- Phase diagram-One Component system-Water system- Condensed phase rule-Construction of phase diagram by Thermal analysis-Simple eutectic system(Lead-silver system only)- Limitations of phase rule-Alloys-importance of Ferrous alloys-Nichrome-Alnico -Stainless steel-Heat treatment of steel -Non-Ferrous alloys -Brass and Bronze

### UNIT V ANALYTICAL TECHNIQUES

Spectroscopy -Atomic and molecular spectroscopy-Absorption spectrum -Emission spectrum - Absorbance-Beer-Lamberts law-Problems-UV Visible spectroscopy -IR spectroscopy-(principle,instrumentation (block diagram only)and applications colorimetry(principle ,instrumentation and applications )-Estimation of iron by colorimetry.Flame photometry-( principle , instrumentation and applications)-Estimation of Sodium by Flame photometry-Atomic absorption spectroscopy(principle , instrumentation and applications)-Estimation of Nickel by Atomic absorption spectroscopy.

**Text Books**

1. P.C.Jain and Monica Jain , "Engineering Chemistry", Dhanpat Rai Pub Co Ltd ,New Delhi (2002)
2. S.S.Dara , " A Text Book of Engineering Chemistry", S.Chand & Co Ltd New Delhi (2006)
3. Dr.Sayeeda Sultana " Engineering chemistry " Vol -II, Professional and Technical publishers ,Coimbatore (2011)

**Reference Books**

1. B.K.Sharma "Engineering Chemistry",Krishna Prakasan Media (P) Ltd Meerut (2001)
2. B.Shiva Sankar "Engineering Chemistry",Tata McGraw-Hill Pub Co Ltd New Delhi (2008)

## 212EMT05 - ENGINEERING MECHANICS

### OBJECTIVE

At the end of this course the student should be able to understand the vectorial and scalar representation of forces and moments, static equilibrium of particles and rigid bodies both in two dimensions and also in three dimensions. Further, he should understand the principle of work and energy. He should be able to comprehend the effect of friction on equilibrium. He should be able to understand the laws of motion, the kinematics of motion and the interrelationship. He should also be able to write the dynamic equilibrium equation. All these should be achieved both conceptually and through solved examples.

### UNIT I      **BASICS & STATICS OF PARTICLES**

Introduction – Units and Dimensions – Laws of Mechanics – Lame’s theorem, Parallelogram and triangular Law of forces – Vectors – Vectorial representation of forces and moments – Vector operations: additions, subtraction, dot product, cross product – Coplanar Forces – Resolution and Composition of forces – Equilibrium of a particle – Forces in space – Equilibrium of a particle in space – Equivalent systems of forces – Principle of transmissibility – Single equivalent force.

### UNIT II      **EQUILIBRIUM OF RIGID BODIES**

Free body diagram – Types of supports and their reactions – requirements of stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis – Vectorial representation of moments and couples – Scalar components of a moment – Varignon’s theorem – Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions – Examples

### UNIT III     **PROPERTIES OF SURFACES AND SOLIDS**

Determination of Areas and Volumes – First moment of area and the Centroid of sections – Rectangle, circle, triangle from integration – T section, I section, - Angle section, Hollow section by using standard formula – second and product moments of plane area – Rectangle, triangle, circle from integration – T section, I section, Angle section, Hollow section by using standard formula – Parallel axis theorem and perpendicular axis theorem – Polar moment of inertia – Principal moments of inertia of plane areas – Principal axes of inertia – Mass moment of inertia – Derivation of mass moment of inertia for rectangular section, prism, sphere from first principle – Relation to area moments of inertia.

### UNIT IV     **DYNAMICS OF PARTICLES**

Displacements, Velocity and acceleration, their relationship – Relative motion – Curvilinear motion – Newton’s law – Work Energy Equation of particles – Impulse and Momentum – Impact of elastic bodies.

### UNIT V     **FRICTION AND ELEMENTS OF RIGID BODY DYNAMICS**

Frictional force – Laws of Coloumb friction – simple contact friction – Rolling resistance – Belt friction.

Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion.

### TEXT BOOK:

1. Beer, F.P and Johnson Jr. E.R. “Vector Mechanics for Engineers”, Vol. 1 Statics and Vol. 2 Dynamics, McGraw-Hill International Edition, (1997).



**REFERENCES:**

1. Rajasekaran, S, Sankarasubramanian, G., "Fundamentals of Engineering Mechanics", Vikas Publishing House Pvt. Ltd., (2000).
2. Hibbeler, R.C., "Engineering Mechanics", Vol. 1 Statics, Vol. 2 Dynamics, Pearson Education Asia Pvt. Ltd., (2000).
3. Palanichamy, M.S., Nagam, S., "Engineering Mechanics – Statics & Dynamics", Tata McGraw-Hill, (2001).
4. Irving H. Shames, "Engineering Mechanics – Statics and Dynamics", IV Edition – Pearson Education Asia Pvt. Ltd., (2003).
5. Ashok Gupta, "Interactive Engineering Mechanics – Statics – A Virtual Tutor (CDROM)", Pearson Education Asia Pvt., Ltd., (2002).

**212EET06 - BASIC ELECTRICAL AND ELECTRONICS ENGINEERING  
(Common to branches under Civil, Mechanical and Technology faculty)**

**UNIT I ELECTRICAL CIRCUITS & MEASUREMENTS**

Ohm's Law – Kirchoff's Laws – Steady State Solution of DC Circuits – Introduction to AC Circuits – Waveforms and RMS Value – Power and Power factor – Single Phase and Three Phase Balanced Circuits.

Operating Principles of Moving Coil and Moving Iron Instruments (Ammeters and Voltmeters), Dynamometer type Watt meters and Energy meters.

**UNIT II ELECTRICAL MECHANICS**

Construction, Principle of Operation, Basic Equations and Applications of DC Generators, DC Motors, Single Phase Transformer, single phase induction Motor.

**UNIT III SEMICONDUCTOR DEVICES AND APPLICATIONS**

Characteristics of PN Junction Diode – Zener Effect – Zener Diode and its Characteristics – Half wave and Full wave Rectifiers – Voltage Regulation.

Bipolar Junction Transistor – CB, CE, CC Configurations and Characteristics – Elementary Treatment of Small Signal Amplifier.

**UNIT IV DIGITAL ELECTRONICS**

Binary Number System – Logic Gates – Boolean Algebra – Half and Full Adders – Flip-Flops – Registers and Counters – A/D and D/A Conversion (single concepts)

**UNIT V FUNDAMENTALS OF COMMUNICATION ENGINEERING**

Types of Signals: Analog and Digital Signals – Modulation and Demodulation: Principles of Amplitude and Frequency Modulations.

Communication Systems: Radio, TV, Fax, Microwave, Satellite and Optical Fibre (Block Diagram Approach only).

**TEXT BOOKS:**

1. V.N. Mittle "Basic Electrical Engineering", Tata McGraw Hill Edition, New Delhi, 1990.
2. R.S. Sedha, "Applied Electronics" S. Chand & Co., 2006.

**REFERENCES:**

1. Muthusubramanian R, Salivahanan S and Muraleedharan K A, "Basic Electrical, Electronics and Computer Engineering", Tata McGraw Hill, Second Edition, (2006).
2. Nagsarkar T K and Sukhija M S, "Basics of Electrical Engineering", Oxford press (2005).
3. Mehta V K, "Principles of Electronics", S.Chand & Company Ltd, (1994).
4. Mahmood Nahvi and Joseph A. Edminister, "Electric Circuits", Schaum' Outline Series, McGraw Hill, (2002).
5. Premkumar N, "Basic Electrical Engineering", Anuradha Publishers, (2003)

**LIST OF EXPERIMENTS**

**1. UNIX COMMANDS**

Study of Unix OS - Basic Shell Commands - Unix Editor

**2. SHELL PROGRAMMING**

Simple Shell program - Conditional Statements - Testing and Loops

**3. C PROGRAMMING ON UNIX**

Dynamic Storage Allocation-Pointers-Functions-File Handling

**HARDWARE / SOFTWARE REQUIREMENTS FOR A BATCH OF 30 STUDENTS**

**Hardware**

- 1 UNIX Clone Server
- 33 Nodes (thin client or PCs)
- Printer – 3 Nos.

**Software**

- OS – UNIX Clone (33 user license or License free Linux)
- Compiler - C

## COMMON TO ALL BRANCHES

### PHYSICS LABORATORY (Any Ten Experiments)

1. Determination of Young's modulus of the material – non uniform bending.
2. Determination of Young's modulus of the material – uniform bending .
3. Determination of viscosity of liquid – Poiseuille's method.
4. Torsional pendulum – Determination of rigidity modulus.
5. Determination of the thermal conductivity of a bad conductor – Lee's Disc method.
6. Determination of the thickness of a thin wire – Air Wedge method.
7. (a) Particle size determination using Diode Laser.  
(b) Determination of Laser Parameters – Wave length, and angle of divergence.  
(c) Determination of acceptance angle in an optical fiber.
8. Spectrometer dispersive power of a prism.
9. Determination of Wave length of mercury spectrum –Spectrometer grating.
10. Determination of Band Gap of a Semiconductor diode.
11. Determination of velocity of sound and compressibility of liquid- Ultrasonic Interferometer.
12. Determination of Hysteresis loss in a ferromagnetic material

- **A minimum of FIVE experiments shall be offered in Each Semester.**
- **Laboratory classes on alternate weeks for physics and chemistry.**
- **The lab examinations will be held only in the second Semester.**

## CHEMISTRY LABORATORY – II

### LIST OF EXPERIMENTS

1. Conductometric titration (Simple acid base)
  2. Conductometric titration (Mixture of weak and strong acidsVs base)
  3. Conductometric titration using  $\text{BaCl}_2$  Vs  $\text{Na}_2 \text{SO}_4$
  4. Potentiometric Titration ( $\text{Fe}^{2+}/\text{KMnO}_4$  or  $\text{K}_2\text{Cr}_2\text{O}_7$ )
  5. PH titration (acid & base)
  6. Determination of water of crystallization of a crystalline salt (Copper sulphate)
  7. Estimation of Ferric iron by spectrophotometry.
  8. Estimation of sodium and potassium by flame photometry.
- Any five experiments.

**List of Exercises using software capable of Drafting and Modeling**

1. Study of capabilities of software for Drafting and Modeling – Coordinate systems (absolute, relative, polar, etc.) – Creation of simple figures like polygon and general multi-line figures.
2. Drawing of a Title Block with necessary text and projection symbol.
3. Drawing of curves like parabola, spiral, involute using Bspline or cubic spline.
4. Drawing of front view and top view of simple solids like prism, pyramid, cylinder, cone, etc, and dimensioning.
5. Drawing front view, top view and side view of objects from the given pictorial views (eg. V-block, Base of a mixie, Simple stool, Objects with hole and curves).
6. Drawing of a plan of residential building ( Two bed rooms, kitchen, hall, etc.)
7. Drawing of a simple steel truss.
8. Drawing sectional views of prism, pyramid, cylinder, cone, etc,
9. Drawing isometric projection of simple objects.
10. Creation of 3-D models of simple objects and obtaining 2-D multi-view drawings from 3-D model.

**Note: Plotting of drawings must be made for each exercise and attached to the records written by students.**

**List of Equipments for a batch of 30 students:**

- |  |          |
|--|----------|
| 1. Pentium IV computer or better hardware, with suitable graphics facility | - 30 No. |
| 2. Licensed software for Drafting and Modeling.<br>Licenses                | - 30     |
| 3. Laser Printer or Plotter to print / plot drawings                       | - 2 No.  |

## **312MAT01 - TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATION (Common to all branches)**

### **OBJECTIVES**

The course objective is to develop the skills of the students in the areas of Transforms and Partial Differential Equations. This will be necessary for their effective studies in a large number of engineering subjects like heat conduction, communication systems, electro-optics and electromagnetic theory. The course will also serve as a prerequisite for post graduate and specialized studies and research.

### **UNIT I      FOURIER SERIES**

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Complex form of Fourier Series – Parseval's identity – Harmonic Analysis

### **UNIT II      FOURIER TRANSFORMS**

Fourier integral theorem (without proof) – Fourier transform pair – Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

### **UNIT III      PARTIAL DIFFERENTIAL EQUATIONS**

Formation of partial differential equations – Lagrange's linear equation – Solutions of standard types of first order partial differential equations - Linear partial differential equations of second and higher order with constant coefficients.

### **UNIT IV      APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS**

Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two-dimensional equation of heat conduction (Insulated edges excluded) – Fourier series solutions in cartesian coordinates.

### **UNIT V      Z -TRANSFORMS AND DIFFERENCE EQUATIONS**

Z-transforms - Elementary properties – Inverse Z-transform – Convolution theorem - Formation of difference equations – Solution of difference equations using Z-transform.

### **TEXT BOOKS**

1. Grewal, B.S, 'Higher Engineering Mathematics' 40<sup>th</sup> Edition, Khanna publishers, Delhi, (2007)

### **REFERENCES**

1. Bali.N.P and Manish Goyal 'A Textbook of Engineering Mathematics', Seventh Edition, Laxmi Publications(P) Ltd. (2007)
2. Ramana.B.V. 'Higher Engineering Mathematics' Tata Mc-GrawHill Publishing Company limited, New Delhi (2007).
3. Glyn James, 'Advanced Modern Engineering Mathematics', Third edition-Pearson Education (2007).
4. Erwin Kreyszig 'Advanced Engineering Mathematics', Eighth edition-Wiley India (2007).

## **312MET02 - MANUFACTURING TECHNOLOGY – I**

### **OBJECTIVE**

To introduce the students the concepts of some basic manufacturing processes and fabrication techniques, such as metal casting, metal joining, metal forming and plastics component manufacture.

### **UNIT I METAL CASTING PROCESSES**

Sand casting – Sand moulds - Type of patterns – Pattern materials – Pattern allowances – Types of Moulding sand – Properties – Core making – Methods of Sand testing – Moulding machines – Types of moulding machines - Melting furnaces – Working principle of Special casting processes – Shell, investment casting – Ceramic mould – Lost Wax process – Pressure die casting – Centrifugal casting – CO<sub>2</sub> process – Sand Casting defects – Inspection methods

### **UNIT II JOINING PROCESSES**

Fusion welding processes – Types of Gas welding – Equipments used – Flame characteristics – Filler and Flux materials - Arc welding equipments - Electrodes – Coating and specifications – Principles of Resistance welding – Spot/butt, seam welding – Percussion welding - Gas metal arc welding – Flux cored – Submerged arc welding – Electro slag welding – TIG welding – Principle and application of special welding processes - Plasma arc welding – Thermit welding – Electron beam welding – Friction welding – Diffusion welding – Weld defects – Brazing and soldering process – Methods and process capabilities – Filler materials and fluxes – Types of Adhesive bonding.

### **UNIT III BULK DEFORMATION PROCESSES**

Hot working and cold working of metals – Forging processes – Open, impression and closed die forging – Characteristics of the process – Types of Forging Machines – Typical forging operations – Rolling of metals – Types of Rolling mills - Flat strip rolling – Shape rolling operations – Defects in rolled parts - Principle of rod and wire drawing - Tube drawing -- Principles of Extrusion – Types of Extrusion – Hot and Cold extrusion -- Equipments used.

### **UNIT IV SHEET METAL PROCESSES**

Sheet metal characteristics - Typical shearing operations, bending and drawing operations – Stretch forming operations -- Formability of sheet metal – Test methods – Working principle and application of special forming processes - Hydro forming – Rubber pad forming – Metal spinning – Introduction to Explosive forming, Magnetic pulse forming, Peen forming, Super plastic forming.

### **UNIT V MANUFACTURING OF PLASTIC COMPONENTS**

Types of plastics - Characteristics of the forming and shaping processes – Moulding of Thermoplastics – Working principles and typical applications of - Injection moulding – Plunger and screw machines – Compression moulding, Transfer moulding - Typical industrial applications – Introduction to Blow moulding – Rotational moulding – Film blowing – Extrusion - Thermoforming, - Bonding of Thermoplastics.

### **TEXT BOOK**

1. Hajra Choudhury, "Elements of Workshop Technology, Vol. I and II", Media Promoters Pvt Ltd., Mumbai, 2001
2. S.Gowri, P.Hariharan, and A.Suresh Babu, "Manufacturing Technology 1", Pearson Education , 2008.



## REFERENCE BOOKS

1. B.S. Magendran Parashar & R.K. Mittal, "Elements of Manufacturing Processes", Prentice Hall of India, 2003.
2. P.N. Rao, "Manufacturing Technology", Tata McGraw-Hill Publishing Limited, II Edition, 2002.
3. P.C. Sharma, "A text book of production technology", S. Chand and Company, IV Edition, 2003.
4. Begman, "Manufacturing Process", John Wiley & Sons, VIII Edition, 2005.
5. Serope Kalpajian, Steven R. Schmid, Manufacturing Engineering and Technology, Pearson Education, Inc. 2002 (Second Indian Reprint).
6. Beddoes. J and Bibby M.J, 'Principles of Metal Manufacturing Processes', Elsevier, 2006.
7. Rajput R.K, 'A text book of Manufacturing Technology', Lakshmi Publications, 2007.

## 312MET03 - ENGINEERING THERMODYNAMICS

### OBJECTIVE

To achieve an understanding of principles of thermodynamics and to be able to use it in accounting for the bulk behaviour of the simple physical systems.

To provide in-depth study of thermodynamic principles, thermodynamics of state, basic thermodynamic relations, Principle of Psychrometry & Properties of pure substances

To enlighten the basic concepts of vapour power cycles.

### UNIT I BASIC CONCEPT AND FIRST LAW

Basic concepts - concept of continuum, macroscopic approach, Thermodynamic systems - closed, open and isolated. Property, state, path and process, quasi-static process, work, modes of work, Zeroth law of thermodynamics - concept of temperature and heat. Concept of ideal and real gases. First law of thermodynamics - application to closed and open systems, internal energy, specific heat capacities, enthalpy, steady flow process with reference to various thermal equipments.

### UNIT II SECOND LAW

Second law of thermodynamics - Kelvin's and Clausius statements of second law. Reversibility and irreversibility. Carnot theorem, Carnot cycle, reversed Carnot cycle, efficiency, COP. Thermodynamic temperature scale, Clausius inequality, concept of entropy, entropy of ideal gas, principle of increase of entropy - availability.

### UNIT III PROPERTIES OF PURE SUBSTANCE AND STEAM POWER CYCLE

Properties of pure substances - Thermodynamic properties of pure substances in solid, liquid and vapour phases, phase rule, P-V, P-T, T-V, T-S, H-S diagrams, PVT surfaces, thermodynamic properties of steam. Calculations of work done and heat transfer in non-flow and flow processes. Standard Rankine cycle, Reheat and regenerative cycle.

### UNIT IV IDEAL AND REAL GASES AND THERMODYNAMIC RELATIONS

Gas mixtures - properties ideal and real gases, equation of state, Avogadro's Law, Vander Waal's equation of state, compressibility factor, compressibility chart - Dalton's law of partial pressure, exact differentials, T-D relations, Maxwell's relations, Clausius Clapeyron equations, Joule-Thomson coefficient.

### UNIT V PSYCHROMETRY

Psychrometry and psychrometric charts, property calculations of air vapour mixtures. Psychrometric process - Sensible heat exchange processes. Latent heat exchange processes. Adiabatic mixing, evaporative cooling

(Use of standard thermodynamic tables, Mollier diagram, Psychrometric chart and Refrigerant property tables are permitted)

### TEXT BOOKS

1. Nag.P.K., "Engineering Thermodynamics", Tata McGraw-Hill, New Delhi, 1998.
2. Cengel, 'Thermodynamics - An Engineering Approach' Third Edition - 2003 - Tata McGraw Hill, New Delhi.

### REFERENCE BOOKS

1. Holman.J.P., "Thermodynamics", 3<sup>rd</sup> Ed. McGraw-Hill, 1995.
2. Venwylen and Sontag, "Classical Thermodynamics", Wiley Eastern, 1987
3. Arora C.P, " Thermodynamics", Tata McGraw-Hill, New Delhi, 2003.
4. Merala C, Pother, Craig W, Somerton, " Thermodynamics for Engineers", Schaum Outline Series, Tata McGraw-Hill, New Delhi, 2004.

## 312MET04 - KINEMATICS OF MACHINERY

### OBJECTIVE

- To understand the concept of machines, mechanisms and related terminologies.
- To analyse a mechanism for displacement, velocity and acceleration at any point in a moving link
- To understand the theory of gears, gear trains and cams
- To understand the role of friction in drives and brakes.

### UNIT I                      BASICS OF MECHANISMS

Definitions – Link, Kinematic pair, Kinematic chain, Mechanism, and Machine. -Degree of Freedom – Mobility - Kutzbach criterion (Gruebler's equation) -Grashoff's law-Kinematic Inversions of four-bar chain and slider crank chain - Mechanical Advantage-Transmission angle.

Description of common Mechanisms - Offset slider mechanism as quick return mechanisms, Pantograph, Straight line generators (Peaucellier and Watt mechanisms), Steering gear for automobile, Hooke's joint, Toggle mechanism, Ratchets and escapements - Indexing Mechanisms.

### UNIT II                      KINEMATIC ANALYSIS

Analysis of simple mechanisms (Single slider crank mechanism and four bar mechanism) - Graphical Methods for displacement, velocity and acceleration; Shaping machine mechanism - Coincident points – Coriolis acceleration - Analytical method of analysis of slider crank mechanism and four bar mechanism. Approximate analytical expression for displacement, velocity and acceleration of piston of reciprocating engine mechanism.

### UNIT III                      KINEMATICS OF CAMS

Classifications - Displacement diagrams - Parabolic, Simple harmonic and Cycloidal motions – Graphical construction of displacement diagrams and layout of plate cam profiles - circular arc and tangent cams - Pressure angle and undercutting.

### UNIT IV                      GEARS

Classification of gears – Gear tooth terminology - Fundamental Law of toothed gearing and involute gearing – Length of path of contact and contact ratio - Interference and undercutting - Gear trains – Simple, compound and Epicyclic gear trains - Differentials.

### UNIT V                      FRICTION

Dry friction – Friction in screw jack – Pivot and collar friction - Plate clutches - Belt and rope drives - Block brakes, band brakes.

### TEXT BOOKS

1. Ambekar A. G., Mechanism and Machine Theory, Prentice Hall of India, New Delhi, 2007.
2. Uicker J.J.,Pennock G.R., Shigley J.E., "Theory of Machines and Mechanisms"(Indian Edition), Oxford University Press, 2003.

### REFERENCE BOOKS

1. Thomas Bevan, "Theory of Machines", CBS Publishers and Distributors, 1984.
2. Ramamurti,V.,' Mechanism and Machine Theory", Second Edition, Narosa Publishing House, 2005
3. Ghosh A and A.K.Mallick, "Theory of Mechanisms and Machines", Affiliated East-West Pvt. Ltd., New Delhi, 1998.
4. Rao J.S and Dukkipati R.V, "Mechanism and Machine Theory", Wiley-Eastern Ltd., New Delhi, 199 2.
5. John Hannah and Stephens R.C, "Mechanics of Machines", Viva Low-Prices Student Edition, 1999

## **BIS Codes of Practice/Useful Websites**

1. IS 2458 : 2001, Vocabulary of Gear Terms – Definitions Related to Geometry
2. IS 2467 : 2002 (ISO 701: 1998), International Gear Notation – Symbols for Geometric Data.
3. IS 5267 : 2002 Vocabulary of Gear Terms – Definitions Related to Worm Gear Geometry.
4. IS 5037 : Part 1 : 2004, Straight Bevel Gears for General Engineering and Heavy Engineering - Part 1: Basic Rack.
5. IS 5037 : Part 2 : 2004, Straight Bevel Gears for General Engineering and Heavy Engineering - Part 2: Module and Diametral Pitches.

WEBSITE: **[www.howstuffworks.com](http://www.howstuffworks.com)**

**312MET05 - FLUID MECHANICS AND MACHINERY**  
**(Common to Aeronautical, Mechanical, Automobile & Production)**

**OBJECTIVES**

- The student is introduced to the mechanics of fluids through a thorough understanding of the properties of the fluids. The dynamics of fluids is introduced through the control volume approach which gives an integrated understanding of the transport of mass, momentum and energy.
- The applications of the conservation laws to flow through pipes and hydraulics machines are studied

**UNIT I INTRODUCTION**

Units & Dimensions. Properties of fluids – Specific gravity, specific weight, viscosity, compressibility, vapour pressure and gas laws – capillarity and surface tension. Flow characteristics: concepts of system and control volume. Application of control volume to continuity equation, energy equation, momentum equation and moment of momentum equation.

**UNIT II FLOW THROUGH CIRCULAR CONDUITS**

Laminar flow through circular conduits and circular annuli. Boundary layer concepts. Boundary layer thickness. Hydraulic and energy gradient. Darcy – Weisbach equation. Friction factor and Moody diagram. Commercial pipes. Minor losses. Flow through pipes in series and in parallel.

**UNIT III DIMENSIONAL ANALYSIS**

Dimension and units: Buckingham's  $\Pi$  theorem. Discussion on dimensionless parameters. Models and similitude. Applications of dimensionless parameters.

**UNIT IV ROTO DYNAMIC MACHINES**

Homologous units. Specific speed. Elementary cascade theory. Theory of turbo machines. Euler's equation. Hydraulic efficiency. Velocity components at the entry and exit of the rotor. Velocity triangle for single stage radial flow and axial flow machines. Centrifugal pumps, turbines, performance curves for pumps and turbines.

**UNIT V POSITIVE DISPLACEMENT MACHINES**

Reciprocating pumps, Indicator diagrams, Work saved by air vessels. Rotary pumps. Classification. Working and performance curves.

**TEXT BOOKS:**

1. Streeter. V. L., and Wylie, E.B., Fluid Mechanics, McGraw Hill, 1983.
2. Rathakrishnan. E, Fluid Mechanics, Prentice Hall of India (II Ed.), 2007.

**REFERENCES:**

1. Ramamritham. S, Fluid Mechanics, Hydraulics and Fluid Machines, Dhanpat Rai & Sons, Delhi, 1988.
2. Kumar. K.L., Engineering Fluid Mechanics (VII Ed.) Eurasia Publishing House (P) Ltd., New Delhi, 1995.
3. Bansal, R.K., Fluid Mechanics and Hydraulics Machines, Laxmi Publications (P) Ltd., New Delhi.

**312MET06 - ELECTRICAL DRIVES AND CONTROLS**  
**(Common to Mechanical & Production)**

**OBJECTIVES**

- To understand the basic concepts of different types of electrical machines and their performance.
- To study the different methods of starting D.C motors and induction motors.
- To study the conventional and solid-state drives

**UNIT I INTRODUCTION**

Basic Elements – Types of Electric Drives – factors influencing the choice of electrical drives – heating and cooling curves – Loading conditions and classes of duty – Selection of power rating for drive motors with regard to thermal overloading and Load variation factors

**UNIT II DRIVE MOTOR CHARACTERISTICS**

Mechanical characteristics – Speed-Torque characteristics of various types of load and drive motors – Braking of Electrical motors – DC motors: Shunt, series and compound - single phase and three phase induction motors.

**UNIT III STARTING METHODS**

Types of D.C Motor starters – Typical control circuits for shunt and series motors – Three phase squirrel cage and slip ring induction motors.

**UNIT IV CONVENTIONAL AND SOLID STATE SPEED CONTROL OF D.C. DRIVES**

Speed control of DC series and shunt motors – Armature and field control, Ward-Leonard control system - Using controlled rectifiers and DC choppers –applications.

**UNIT V CONVENTIONAL AND SOLID STATE SPEED CONTROL OF A.C. DRIVES**

Speed control of three phase induction motor – Voltage control, voltage / frequency control, slip power recovery scheme – Using inverters and AC voltage regulators – applications.

**TEXT BOOKS**

1. VEDAM SUBRAHMANYAM, "Electric Drives (concepts and applications)", Tata McGraw-Hill, 2001
2. NAGRATH.I.J. & KOTHARI.D.P, "Electrical Machines", Tata McGraw-Hill, 1998

**REFERENCE BOOKS**

1. PILLAI.S.K "A first course on Electric drives", Wiley Eastern Limited, 1998
2. M.D.SINGH, K.B.KHANCHANDANI, "Power Electronics", Tata McGraw-Hill, 1998
3. H.Partab, "Art and Science and Utilisation of electrical energy", Dhanpat Rai and Sons, 1994

**312MEP01 - MANUFACTURING TECHNOLOGY LAB – I  
(Only for Mechanical)**

**OBJECTIVE**

To gain hands on experience on working of general purpose machine tools and on various manufacturing processes.

**UNIT I LATHE**

- 1.1. Facing, plain turning and step turning
- 1.2. Taper turning using compound rest, Tailstock set over, etc
- 1.3. Single and Multi-start V thread, cutting and knurling
- 1.4. Boring and internal thread cutting.

**UNIT II WELDING EXERCISES**

- 2.1. Horizontal, Vertical and Overhead welding.
- 2.2. Gas Cutting, Gas Welding
- 2.3. Brazing - for demonstration purpose

**UNIT III SHEET METAL WORK**

- 3.1. Fabrication of sheet metal tray
- 3.2. Fabrication of a funnel

**UNIT IV PREPARATION OF SAND MOULD**

- 4.1. Mould with solid, split patterns
- 4.2. Mould with loose-piece pattern
- 4.3. Mould with Core

**UNIT V PLASTIC MOULDING**

- 5.1. Injection Moulding- for demonstration purpose

**LIST OF EQUIPMENTS**

<b>1.</b>	<b><u>Centre Lathe with accessories</u></b>	<b><u>15</u></b>
<b>2.</b>	<b><u>Welding</u></b>	
2.1	Arc welding machine	04
2.2	Gas welding machine	01
2.3	Brazing machine	01
<b>3.</b>	<b><u>Sheet Metal Work facility</u></b>	
3.1	Hand Shear 300mm	01
3.2	Bench vice	05
3.3	Standard tools and calipers for sheet metal work	05
<b>4</b>	<b><u>Sand moulding Facility</u></b>	
4.1	Moulding Table	05
4.2	Moulding boxes, tools and patterns	05
<b>5</b>	<b><u>Plastic Moulding</u></b>	
5.1	Injection Moulding Machine	01

**312MEP02 - FLUID MECHANICS AND MACHINERY LAB**  
**(Common to Mechanical & Production)**

**LIST OF EXPERIMENTS**

1. Determination of the Coefficient of discharge of given Orifice meter.
2. Determination of the Coefficient of discharge of given Venturi meter.
3. Calculation of the rate of flow using Rota meter.
4. Determination of friction factor for a given set of pipes.
5. Conducting experiments and drawing the characteristic curves of centrifugal pump / submergible pump
6. Conducting experiments and drawing the characteristic curves of reciprocating pump.
7. Conducting experiments and drawing the characteristic curves of Gear pump.
8. Conducting experiments and drawing the characteristic curves of Pelton wheel.
9. Conducting experiments and drawing the characteristics curves of Francis turbine.
10. Conducting experiments and drawing the characteristic curves of Kaplan turbine.

**LIST OF EQUIPMENT**  
**(for a batch of 30 students)**

1. Orifice meter setup
2. Venturi meter setup
3. Rotameter setup
4. Pipe Flow analysis setup
5. Centrifugal pump/submergible pump setup
6. Reciprocating pump setup
7. Gear pump setup
8. Pelton wheel setup
9. Francis turbine setup
10. Kaplan turbine setup



**312MEP03 - ELECTRICAL ENGINEERING LABORATORY**  
**(Common to Mechanical & Production)**

**LIST OF EXPERIMENTS**

1. Load test on DC Shunt & DC Series motor
2. O.C.C & Load characteristics of DC Shunt and DC Series generator
3. Speed control of DC shunt motor (Armature, Field control)
4. Load test on single phase transformer
5. O.C & S.C Test on a single phase transformer
6. Regulation of an alternator by EMF & MMF methods.
7. V curves and inverted V curves of synchronous Motor
8. Load test on three phase squirrel cage Induction motor
9. Speed control of three phase slip ring Induction Motor
10. Load test on single phase Induction Motor.
11. Study of DC & AC Starters

**LIST OF EQUIPMENT**  
**(for batch of 30 students)**

<b>Equipment</b>	<b>-</b>	<b>No.</b>	
1. DC Shunt motor	-		2
2. DC Series motor	-		1
3. DC shunt motor-DC Shunt Generator set	-		1
4. DC Shunt motor-DC Series Generator set	-		1
5. Single phase transformer	-		2
6. Three phase alternator	-		2
7. Three phase synchronous motor	-		1
8. Three phase Squirrel cage Induction motor	-		1
9. Three phase Slip ring Induction motor	-		1
10. Single phase Induction motor	-		1

## SEMESTER-IV

### 412MET01 - STATISTICS AND NUMERICAL METHODS (Common to Mechanical, Automobile & Production)

#### UNIT I TESTING OF HYPOTHESIS

Sampling distributions - Tests for single mean, Proportion, Difference of means (large and small samples) - Tests for single variance and equality of variances - chi-square test for goodness of fit - Independence of attributes.

#### UNIT II DESIGN OF EXPERIMENTS

Completely randomized design - Randomized block design - Latin square design -  $2^2$ -factorial design.

#### UNIT III SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS

Newton-Raphson method- Gauss Elimination method - Pivoting - Gauss-Jordan methods - Iterative methods of Gauss-Jacobi and Gauss-Seidel - Matrix Inversion by Gauss-Jordan method - Eigenvalues of a matrix by Power method .

#### UNIT IV INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION

Lagrange's and Newton's divided difference interpolation -Newton's forward and backward difference interpolation - Approximation of derivatives using interpolation polynomials - Numerical integration using Trapezoidal and Simpson's 1/3 rules.

#### UNIT V NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS

Taylor's series method - Euler's method - Modified Euler's method - Fourth order Runge-Kutta method for solving first and second order equations - Milne's predictor-corrector methods for solving first order equations - Finite difference methods for solving second order equation.

#### TEXT BOOKS

1. R.A. Johnson and C.B. Gupta, "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 7<sup>th</sup> edition, 2007 (For units 3, 4 and 5).
2. Grewal, B.S. and Grewal, J.S., " Numerical methods in Engineering and Science", 6<sup>th</sup> Edition, Khanna Publishers, New Delhi, 2004.

#### BOOKS FOR REFERENCES:

1. R.E. Walpole, R.H. Myers, S.L. Myers, and K Ye, "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia , 8<sup>th</sup> edition, 2007.
2. M.R. Spiegel, J. Schiller and R.A. Srinivasan, "Schaum's Outlines Probability and Statistics", Tata McGraw Hill edition, 2004.
3. Chapra, S. C and Canale, R. P. "Numerical Methods for Engineers", 5<sup>th</sup> Edition, Tata McGraw-Hill, New Delhi, 2007.
4. Gerald, C. F. and Wheatley, P. O., "Applied Numerical Analysis", 6<sup>th</sup> Edition, Pearson Education Asia, New Delhi, 2006.

## 412MET02 - HEAT & MASS TRANSFER

### UNIT I CONDUCTION

Basic Concepts – Mechanism of Heat Transfer – Conduction, Convection and Radiation – Fourier Law of Conduction - General Differential equation of Heat Conduction -- Cartesian and Cylindrical Coordinates – One Dimensional Steady State Heat Conduction – Conduction through Plane Wall, Cylinders and Spherical systems – Composite Systems – Conduction with Internal Heat Generation – Extended Surfaces – Unsteady Heat Conduction – Lumped Analysis – Use of Heislers Chart.

### UNIT II CONVECTION

Basic Concepts –Heat Transfer Coefficients – Boundary Layer Concept – Types of Convection – Forced Convection – Dimensional Analysis – External Flow – Flow over Plates, Cylinders and Spheres – Internal Flow – Laminar and Turbulent Flow – Combined Laminar and Turbulent – Flow over Bank of tubes – Free Convection – Dimensional Analysis – Flow over Vertical Plate, Horizontal Plate, Inclined Plate, Cylinders and Spheres.

### UNIT III PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS

Nusselts theory of condensation-pool boiling, flow boiling, correlations in boiling and condensation. Types of Heat Exchangers – Heat Exchanger Analysis – LMTD Method and NTU - Effectiveness – Overall Heat Transfer Coefficient – Fouling Factors.

### UNIT IV RADIATION

Basic Concepts, Laws of Radiation – Stefan Boltzman Law, Kirchoffs Law –Black Body Radiation –Grey body radiation -Shape Factor Algebra – Electrical Analogy – Radiation Shields –Introduction to Gas Radiation

### UNIT V MASS TRANSFER

Basic Concepts – Diffusion Mass Transfer – Fick’s Law of Diffusion – Steady state Molecular Diffusion – Convective Mass Transfer – Momentum, Heat and Mass Transfer Analogy – Convective Mass Transfer Correlations

### TEXT BOOKS

1. Sachdeva R C, “Fundamentals of Engineering Heat and Mass Transfer” New Age International, 1995.
2. Frank P. Incropera and David P. DeWitt, “Fundamentals of Heat and Mass Transfer”, John Wiley and Sons, 1998.

### REFERENCE BOOKS

1. Yadav R “Heat and Mass Transfer” Central Publishing House, 1995.
2. Ozisik M.N, “Heat Transfer”, McGraw-Hill Book Co., 1994.
3. Nag P.K, “ Heat Transfer”, Tata McGraw-Hill, New Delhi, 2002
4. Holman J.P “Heat and Mass Transfer” Tata McGraw-Hill, 2000.
5. Kothandaraman C.P “Fundamentals of Heat and Mass Transfer” New Age International, New Delhi, 1998

## 412MET03 - MANUFACTURING TECHNOLOGY – II

### OBJECTIVE

To understand the concept and basic mechanics of metal cutting, working of standard machine tools such as lathe, shaping and allied machines, milling, drilling and allied machines, grinding and allied machines and broaching

To understand the basic concepts of computer numerical control (CNC) machine tool and CNC programming.

### UNIT I THEORY OF METAL CUTTING

Introduction: material removal processes, types of machine tools – theory of metal cutting: chip formation, orthogonal cutting, cutting tool materials, tool wear, tool life, surface finish, cutting fluids.

### Unit II CENTRE LATHE AND SPECIAL PURPOSE LATHES

Centre lathe, constructional features, cutting tool geometry, various operations, taper turning methods, thread cutting methods, special attachments, machining time and power estimation. Capstan and turret lathes – automats – single spindle, Swiss type, automatic screw type, multi spindle - Turret Indexing mechanism, Bar feed mechanism.

### UNIT III OTHER MACHINE TOOLS

Reciprocating machine tools: shaper, planer, slotter - Milling : types, milling cutters, operations - Hole making : drilling - Quill mechanism , Reaming, Boring, Tapping - Sawing machine: hack saw, band saw, circular saw; broaching machines: broach construction – push, pull, surface and continuous broaching machines

### UNIT IV ABRASIVE PROCESSES AND GEAR CUTTING

Abrasive processes: grinding wheel – specifications and selection, types of grinding process – cylindrical grinding, surface grinding, centreless grinding – honing, lapping, super finishing, polishing and buffing, abrasive jet machining - Gear cutting, forming, generation, shaping, hobbing.

### UNIT V CNC MACHINE TOOLS AND PART PROGRAMMING

Numerical control (NC) machine tools – CNC: types, constructional details, special features – design considerations of CNC machines for improving machining accuracy – structural members – slide ways – linear bearings – ball screws – spindle drives and feed drives. Part programming fundamentals – manual programming – computer assisted part programming.

### TEXT BOOKS

1. Hajra Choudry, "Elements of Work Shop Technology – Vol. II", Media Promoters. 2002
2. HMT – "Production Technology", Tata McGraw-Hill, 1998.

### REFERENCE BOOKS

1. Rao, P.N. "Manufacturing Technology", Metal Cutting and Machine Tools, Tata McGraw-Hill, New Delhi, 2003.
2. P.C. Sharma, "A Text Book of Production Engineering", S. Chand and Co. Ltd, IV edition, 1993.
3. Shrawat N.S. and Narang J.S, 'CNC Machines', Dhanpat Rai & Co., 2002.
4. P.N.Rao, 'CAD/CAM Principles and Applications', TATA Mc Craw Hill, 2007.
5. M.P.Groover and Zimers Jr., 'CAD/CAM' Prentice Hall of India Ltd., 2004.
6. Milton C.Shaw, 'Metal Cutting Principles', Oxford University Press, Second Edition, 2005.
7. Rajput R.K, 'Atext book of Manufacturing Technology', Lakshmi Publications, 2007.
8. Philip F.Ostwald and Jairo Munoz, 'Manufacturing Processes and systems', John Wiley and Sons, 9<sup>th</sup> Edition,2002.
9. Mikell P.Groover, 'Fundamentals of Modern Manufacturing,Materials, Processes and Systems', John Wiley and Sons, 9<sup>th</sup> Edition,2007.
10. Chapman. W. A. J and S.J. Martin, Workshop Technology, Part III, Viva Books Private Ltd., 1998

## **412MET04 - ENGINEERING MATERIALS AND METALLURGY (Common to Mechanical & Automobile)**

### **OBJECTIVE**

To impart knowledge on the structure, properties, treatment, testing and applications of metals and non-metallic materials so as to identify and select suitable materials for various engineering applications.

### **Review (Not for Exam):**

Crystal structure – BCC, FCC and HCP structure – unit cell – crystallographic planes and directions, miller indices – crystal imperfections, point, line, planar and volume defects – Grain size, ASTM grain size number.

### **UNIT I CONSTITUTION OF ALLOYS AND PHASE DIAGRAMS**

Constitution of alloys – Solid solutions, substitutional and interstitial – phase diagrams, Isomorphous, eutectoid, eutectic, peritectic, and peritectoid reactions, Iron – Iron carbide equilibrium diagram. Classification of steel and cast Iron, microstructure, properties and applications.

### **UNIT II HEAT TREATMENT**

Definition – Full annealing, stress relief, recrystallisation and spheroidizing –normalising, hardening and tempering of steel. Isothermal transformation diagrams – cooling curves superimposed on I.T. diagram, CCR - Hardenability, Jominy end quench test – Austempering, martempering – case hardening - carburising, nitriding, cyaniding, carbonitriding, flame and induction hardening.

### **UNIT III MECHANICAL PROPERTIES AND TESTING**

Mechanism of plastic deformation, slip and twinning – Types of fracture – Testing of materials under tension, compression and shear loads – Hardness tests (Brinell, Vickers and Rockwell), Impact test - Izod and Charpy, Fatigue and creep tests, fracture toughness tests.

### **UNIT-IV : FERROUS AND NON FERROUS METALS**

Effect of alloying elements on steel (Mn, Si, Cr, Mo, V, Ti & W) - stainless and tool steels – HSLA - maraging steels – Cast Irons - Grey, White malleable, spheroidal – Graphite, Alloy cast irons, Copper and Copper alloys - Brass, Bronze and Cupronickel – Aluminum and Al-Cu alloy – precipitation hardening– Bearing alloys.

### **UNITV NON-METALLIC MATERIALS**

Polymers – types of polymer, commodity and engineering polymers – Properties and applications of PE, PP, PS, PVC, PMMA, PET, PC, PA, ABS, PI, PAI, PPO, PPS, PEEK, PTFE Polymers – Urea and Phenol Formaldehydes – Engineering Ceramics –Introduction to Fibre reinforced plastics.

### **TEXT BOOKS**

1. Kenneth G.Budinski and Michael K.Budinski "Engineering Materials" Prentice-Hall of India Private Limited, 4<sup>th</sup> Indian Reprint 2002.

### **REFERENCE BOOKS**

1. William D Callister "Material Science and Engineering", John Wiley and Sons 2007.
2. Raghavan.V "Materials Science and Engineering", Prentice Hall of India Pvt., Ltd., 2007.
3. Sydney H.Avner "Introduction to Physical Metallurgy" McGraw Hill Book Company, 2007.
4. Dieter G. E., Mechanical Metallurgy, Mc Graw Hill Book Company, 1988.
5. O.P. Khanna , A text book of Materials Science and Metallurgy, Khanna Publishers, 2003.
6. Vijaya. M.S. and G. Rangarajan, Material Science, Tata McGraw-Hill , 2007

**412MET05 - STRENGTH OF MATERIALS**  
**(Common to Mechanical, Automobile & Production)**

**OBJECTIVES**

- To gain knowledge of simple stresses, strains and deformation in components due to external loads.
- To assess stresses and deformations through mathematical models of beams, twisting bars or combinations of both.
- Effect of component dimensions and shape on stresses and deformations are to be understood.
- The study would provide knowledge for use in the design courses

**UNIT I            STRESS STRAIN DEFORMATION OF SOLIDS**

Rigid and Deformable bodies – Strength, Stiffness and Stability – Stresses; Tensile, Compressive and Shear – Deformation of simple and compound bars under axial load – Thermal stress – Elastic constants – Strain energy and unit strain energy – Strain energy in uniaxial loads.

**UNIT II            BEAMS - LOADS AND STRESSES**

Types of beams: Supports and Loads – Shear force and Bending Moment in beams – Cantilever, Simply supported and Overhanging beams – Stresses in beams – Theory of simple bending – Stress variation along the length and in the beam section – Effect of shape of beam section on stress induced – Shear stresses in beams – Shear flow

**UNIT III           TORSION**

Analysis of torsion of circular bars – Shear stress distribution – Bars of Solid and hollow circular section – Stepped shaft – Twist and torsion stiffness – Compound shafts – Fixed and simply supported shafts – Application to close-coiled helical springs – Maximum shear stress in spring section including Wahl Factor – Deflection of helical coil springs under axial loads – Design of helical coil springs – stresses in helical coil springs under torsion loads

**UNITIV            BEAMDEFLECTION**

Elastic curve of Neutral axis of the beam under normal loads – Evaluation of beam deflection and slope: Double integration method, Macaulay Method, and Moment-area Method –Columns – End conditions – Equivalent length of a column – Euler equation – Slenderness ratio – Rankine formula for columns

**UNIT V            ANALYSIS OF STRESSES IN TWO DIMENSIONS**

Biaxial state of stresses – Thin cylindrical and spherical shells – Deformation in thin cylindrical and spherical shells – Biaxial stresses at a point – Stresses on inclined plane – Principal planes and stresses – Mohr's circle for biaxial stresses – Maximum shear stress - Strain energy in bending and torsion.

**TEXT BOOKS**

1. Popov E.P, "Engineering Mechanics of Solids", Prentice-Hall of India, New Delhi, 1997
2. Beer F. P. and Johnston R, "Mechanics of Materials", McGraw-Hill Book Co, Third Edition, 2002.

**REFERENCES**

1. Nash W.A, "Theory and problems in Strength of Materials", Schaum Outline Series, McGraw-Hill Book Co, New York, 1995
2. Kazimi S.M.A, "Solid Mechanics", Tata McGraw-Hill Publishing Co., New Delhi, 1981.
3. Ryder G.H, "Strength of Materials, Macmillan India Ltd", Third Edition, 2002
4. Ray Hulse, Keith Sherwin & Jack Cain, "Solid Mechanics", Palgrave ANE Books, 2004.
5. Singh D.K "Mechanics of Solids" Pearson Education 2002.
6. Timoshenko S.P, "Elements of Strength of Materials", Tata McGraw-Hill, New Delhi, 1997.

**412MET06 - ELECTRONICS AND MICROPROCESSORS**  
**(Common to Mechanical, Automobile & Production)**

**OBJECTIVE**

To enable the students to understand the fundamental concepts of Semi Conductors, Transistors, Rectifiers, Digital Electronics and 8085 Microprocessors

**UNIT I SEMICONDUCTORS AND RECTIFIERS**

Classification of solids based on energy band theory-Intrinsic semiconductors-Extrinsic semiconductors-P type and N type-PN junction-Zenor effect-Zenor diode characteristics-Half wave and full wave rectifiers -Voltage regulation

**UNIT II TRANSISTORS AND AMPLIFIERS**

Bipolar junction transistor- CB, CE, CC configuration and characteristics-Biasing circuits-Class A, B and C amplifiers- Field effect transistor-Configuration and characteristic of FET amplifier- SCR, Diac, Triac, UJT-Characteristics and simple applications-Switching transistors-Concept of feedback-Negative feedback-Application in temperature and motor speed control.

**UNIT III DIGITAL ELECTRONICS**

Binary number system - AND, OR, NOT, NAND, NOR circuits-Boolean algebra-Exclusive OR gate - Flip flops-Half and full adders-Registers-Counters-A/D and D/A conversion.

**UNIT IV 8085 MICROPROCESSOR**

Block diagram of microcomputer-Architecture of 8085-Pin configuration-Instruction set-Addressing modes-Simple programs using arithmetic and logical operations.

**UNIT V INTERFACING AND APPLICATIONS OF MICROPROCESSOR**

Basic interfacing concepts - Interfacing of Input and Output devices-Applications of microprocessor Temperature control, Stepper motor control, traffic light control.

**TEXT BOOKS**

1. Milman and Halkias, "Integrated Electronics", Tata McGraw-Hill publishers, 1995.
2. Ramesh Goankar, "Microprocessor Architecture", Programming and Applications with 8085, Wiley Eastern, 1998.

**REFERENCE BOOKS**

1. Malvino and Leach, "Digital Principles and Applications", Tata McGraw-Hill, 1996
2. Mehta V.K, "Principles of Electronics", S. Chand and Company Ltd., 1994
3. Douglas V.Hall, "Microprocessor and Interfacing", Programming and Hardware, Tata McGraw-Hill, 1999.
4. Salivahanan S, Suresh Kumar N, Vallavaraj A, "Electronic Devices and Circuits" First Edition, Tata McGraw-Hill, 1999.

## 412MEP01 - MANUFACTURING TECHNOLOGY LAB II

### OBJECTIVE

To give a practical hands on exposure to students in the various metal cutting operations using commonly used machine tools

### EXERCISES

1. Two or More Measurements in Metal Cutting Experiment (Example: Shear Angle, Cutting Force, Tool Wear etc.)
2. One or More Exercises in Shaper, Slotter, Planner, Drilling, Milling Machines (Example: Round to Square, Dovetail in shaper, Internal keyway cutting in Slotter, Round to square in Planner, Drilling, reaming and tapping in Drilling machine, Gear Milling and Keyway milling in Milling machine.)
3. Two or More Exercises in Grinding / Abrasive machining (Example: Surface Grinding, Cylindrical Grinding.)
4. Two or More Exercises in Assembly of Machined Components for different fits. (Example: Parts machined using Lathes, Shapers, Drilling, Milling, and Grinding Machines etc.)
5. One or More Exercises in Capstan or Turret Lathes
6. One or More Exercises in Gear Machining (Example: Gear Milling, Gear Hobbing etc.)

### LIST OF EQUIPMENT

(For a batch of 30 students)

1.	Centre Lathes	-	2 Nos.
2.	Turret and Capstan Lathes	-	1 No
3.	Horizontal Milling Machine	-	1 No
4.	Vertical Milling Machine	-	1 No
5.	Surface Grinding Machine	-	1 No.
6.	Cylindrical Grinding Machine	-	1 No.
7.	Shaper	-	2 Nos.
8.	Slotter	-	1 No.
9.	Planner	-	1 No.
10.	Radial Drilling Machine	-	1 No.
11.	Tool Dynamometer	-	1 No
12.	Gear Hobbing Machine	-	1 No
13.	Tool Makers Microscope	-	1 No



**412MEP02 - STRENGTH OF MATERIALS LAB  
(Common to Auto, Mechanical & Production)**

**OBJECTIVE**

To supplement the theoretical knowledge gained in Mechanics of Solids with practical testing for determining the strength of materials under externally applied loads. This would enable the student to have a clear understanding of the design for strength and stiffness

**LIST OF EXPERIMENTS**

1. Tension test on a mild steel rod
2. Double shear test on Mild steel and Aluminium rods
3. Torsion test on mild steel rod
4. Impact test on metal specimen
5. Hardness test on metals - Brinnell and Rockwell Hardness Number
6. Deflection test on beams
7. Compression test on helical springs
8. Strain Measurement using Rosette strain gauge
9. Effect of hardening- Improvement in hardness and impact resistance of steels.
10. Tempering- Improvement Mechanical properties Comparison
  - (i) Unhardened specimen
  - (ii) Quenched Specimen and
  - (iii) Quenched and tempered specimen.
11. Microscopic Examination of Hardened samples and
  - (i) Hardened and tempered samples.

**LIST OF EQUIPMENT**

(for a batch of 30 students)

- |  |   |
|--|---|
| 1. Universal Tensile Testing machine with double                     | 1 |
| 2. shear attachment – 40 Ton Capacity                                |   |
| 3. Torsion Testing Machine (60 NM Capacity)                          | 1 |
| 4. Impact Testing Machine (300 J Capacity)                           | 1 |
| 5. Brinell Hardness Testing Machine                                  | 1 |
| 6. Rockwell Hardness Testing Machine                                 | 1 |
| 7. Spring Testing Machine for tensile and compressive loads (2500 N) | 1 |
| 8. Metallurgical Microscopes   | 3 |
| Muffle Furnace (800 °C)  |   |

## 412MEP03 - COMPUTER AIDED MACHINE DRAWING LABORATORY

### OBJECTIVE

- i) To make the students understand and interpret drawings of machine components so as to prepare assembly drawings either manually and using standard CAD packages.
- ii) To familiarize the students with Indian Standards on drawing practices and standard components.

### DRAWING STANDARDS

Code of practice for Engineering Drawing, BIS specifications – Welding symbols, riveted joints, keys, fasteners – Reference to hand book for the selection of standard components like bolts, nuts, screws, keys etc.

### 2-D DRAWINGS

Limits, Fits – Tolerancing of individual dimensions- Specification of Fits- Manual Preparation of production drawings and reading of part and assembly drawings.

### CAD PRACTICE (USING APPLICATION PACKAGES)

Drawing, Editing, Dimensioning, Plotting Commands, Layering Concepts, Hatching, Detailing, Assembly, basic principles of GD&T (geometric dimensioning & tolerancing)

### ASSEMBLY DRAWING (MANUAL & USING APPLICATION PACKAGES)

Manual parts drawing and preparation of assembled views given part details for components followed by practicing the same using CAD packages.

### Suggested Assemblies:

Shaft couplings – Plummer block – Screw jack- Lathe Tailstock – Universal Joint – Machine Vice – Stuffing box- safety Valves - Non-return valves- Connecting rod -Piston and crank shaft- Multi plate clutch- Preparation of Bill of materials and tolerance data sheet

Use of standard CAD application packages is recommended from the point of view of requirement by industries. However to encourage our national efforts in indigenous development of software packages with focus on open source, students may be encouraged to work with "CollabCAD Software", developed by:

National Informatics Centre (CAD Group), Govt. of India, A-Block,  
C.G.O. Complex, Lodhi Road, New Delhi 110003, 2003"  
[www.collabcad.com](http://www.collabcad.com)

### REFERENCE BOOKS

1. BHATT.N.D. and PANCHAL.V.M., "Machine Drawing", Charotar Publishing House, 388001, 38<sup>th</sup> Edition, 2003.
2. P.S.G. Design Data Book
3. Luzadder, Warren.J., and Duff, Jon.M. "Fundamentals of Engineering Drawing", Prentice Hall India Pvt. Ltd., Eastern Economy Edition, Eleventh Edition,

**EQUIPMENT NEEDED ( FOR A BATCH OF 30 STUDENTS)**

- |                               |           |
|-------------------------------|-----------|
| <b>1. Computer System</b>     | <b>30</b> |
| 17" Graphics Terminal         |           |
| Pentium IV Processor          |           |
| 80 GB HDD                     |           |
| 512 MB RAM                    |           |
| Advanced graphics accelerator |           |
| <b>2. Laser Printer</b>       | <b>01</b> |
| <b>3. Plotter (A2 size)</b>   | <b>01</b> |

**Software**

30 seats of latest/recent versions of AutoCAD/CATIA/SOLIDWORKS/SOLID EDGE/NX/PRO-E/COLLABCAD or equivalent software

**FIFTH SEMESTER**  
**512MET01 - ENVIRONMENTAL SCIENCE AND ENGINEERING**  
**(Common to Auto, Aero and Mechanical)**

**AIM:**

- The aim of this course is to create awareness in every engineering graduate about the importance of environment, the effect of technology on the environment and ecological balance and make them sensitive to the environment problems in every professional Endeavour that they participates.

**OBJECTIVE:**

- At the end of this course the student is expected to understand what constitutes the environment, what are precious resources in the environment, how to conserve these resources, what is the role of a human being in maintaining a clean environment and useful environment for the future generations and how to maintain ecological balance and preserve bio-diversity. The role of government and nongovernment organization in environment managements.

**UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY**

Definition, scope and importance of environment – need for public awareness – concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and exsitu conservation of biodiversity. Field study of common plants, insects, birds Field study of simple ecosystems – pond, river, hill slopes, etc.

**UNIT II ENVIRONMENTAL POLLUTION**

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – soil waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides. Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

**UNIT III NATURAL RESOURCES**

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

#### **UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT**

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of nongovernmental organization- environmental ethics: Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment production act – Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act – enforcement machinery involved in environmental legislation- central and state pollution control boards- Public awareness.

#### **UNIT V HUMAN POPULATION AND THE ENVIRONMENT**

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare – role of information technology in environment and human health – Case studies.

#### **TEXT BOOKS:**

1. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2<sup>nd</sup> edition, Pearson Education (2004).
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, (2006).

#### **REFERENCES**

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media.
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT LTD, New Delhi, 2007.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press (2005).

## 512MET02 - THERMAL ENGINEERING

### OBJECTIVE:

- To integrate the concepts, laws and methodologies from the first course in thermodynamics into analysis of cyclic processes
- To apply the thermodynamic concepts into various thermal application like IC engines, Steam Turbines, Compressors and Refrigeration and Air conditioning systems.

### UNIT I GAS POWER CYCLES

Otto, Diesel, Dual, Brayton cycles, Calculation of mean effective pressure, and air standard efficiency -Actual and theoretical PV diagram of four stroke and two stroke engines.

### UNIT II INTERNAL COMBUSTION ENGINES

Classification - Components and their function - Valve timing diagram and port timing diagram - Comparison of two stroke and four stroke engines - Carburettor system, Diesel pump and injector system. Performance calculation - Comparison of petrol and diesel engine - Lubrication system and Cooling system - Battery and Magneto Ignition System - Formation of exhaust emission in SI and CI engines.

### UNIT III STEAM NOZZLES AND TURBINES

Flow of steam through nozzles, shapes of nozzles, effect of friction, critical pressure ratio, supersaturated flow, Impulse and Reaction principles, compounding, velocity diagram for simple and multi-stage turbines, speed regulations -Governors.

### UNIT IV AIR COMPRESSOR

Classification and working principle of various types of compressors, work of compression with and without clearance, Volumetric efficiency, Isothermal efficiency and Isentropic efficiency of reciprocating compressors, Multistage air compressor and inter cooling -work of multistage air compressor.

### UNIT V REFRIGERATION AND AIR CONDITIONING

Vapour compression refrigeration cycle- super heat, sub cooling - Performance calculations - working principle of vapour absorption system, Ammonia -Water, Lithium bromide -water systems (Description only) - Alternate refrigerants - Comparison between vapour compression and absorption systems - Air conditioning system: Types, Working Principles - Psychrometry, Psychrometric chart - Cooling Load calculations - Concept of RSHF, GSHF, ESHF - (Use of standard thermodynamic tables, Mollier diagram, Psychrometric chart and refrigerant property tables are permitted in the examination).

### TEXT BOOKS:

1. Sarkar, B.K, "Thermal Engineering" Tata McGraw-Hill Publishers, 2007
2. Kothandaraman.C.P., Domkundwar.S, Domkundwar. A.V., "A course in thermal engineering," Dhanpat Rai & sons, Fifth edition, 2002

### REFERENCES:

1. Rajput. R. K., "Thermal Engineering" S.Chand Publishers, 2000
2. Arora.C.P, "Refrigeration and Air Conditioning," Tata McGraw-Hill Publishers 1994
3. Ganesan V.. "Internal Combustion Engines", Third Edition, Tata McGraw-Hill 2007
4. Rudramoorthy, R, "Thermal Engineering", Tata McGraw-Hill, New Delhi, 2003

## 512MET03 - DYNAMICS OF MACHINERY

### OBJECTIVE:

- To understand the method of static force analysis and dynamic force analysis of mechanisms
- To study the undesirable effects of unbalance in rotors and engines.
- To understand the concept of vibratory systems and their analysis
- To understand the principles of governors and gyroscopes.

### UNIT I FORCE ANALYSIS AND FLYWHEELS

Static force analysis of mechanisms – D 'Alemberts principle - Inertia force and Inertia torque – Dynamic force analysis - Dynamic Analysis in Reciprocating Engines – Gas Forces - Equivalent masses - Bearing loads - Crank shaft Torque–Engine shaking Forces - Turning moment diagrams - Flywheels of engines and punch press.

### UNIT II BALANCING

Static and dynamic balancing - Balancing of rotating masses - Balancing a single cylinder Engine – Primary and secondary unbalanced forces - Balancing Multi-cylinder Engines – Firing order – Pivoted cradle balancing machines.

### UNIT III FREE VIBRATION

Basic features of vibratory systems - Basic elements and lumping of parameters - Degrees of freedom - Single degree of freedom - Free vibration - Equations of motion - natural frequency - Types of Damping - Damped free vibration – Whirling of shafts and critical speed - Torsional systems; Natural frequency of two and three rotor systems.

### UNIT IV FORCED VIBRATION

Response to periodic forcing - Harmonic Forcing – Forced vibration caused by unbalance - Support motion – Force transmissibility and amplitude transmissibility - Vibration isolation.

### UNIT V MECHANISMS FOR CONTROL

Governors - Types - Centrifugal governors - Gravity controlled and spring controlled centrifugal governors –Characteristics - Effect of friction - Controlling Force – Quality of governors – effect of friction. Gyroscopes - Gyroscopic couple - Gyroscopic stabilization - Gyroscopic effects in Automobiles and ships.

### TEXT BOOKS:

1. Ambekar A. G., Mechanism and Machine Theory, Prentice Hall of India, New Delhi, 2007.

### REFERENCES

1. Thomas Bevan, "Theory of Machines", CBS Publishers and Distributors, 1984.
2. Ghosh A. and Mallick A.K., "Theory of Mechanisms and Machines", Affiliated East-West Press Pvt. Ltd., New Delhi, 1988.
3. Shigley J.E. and Uicker J.J., "Theory of Machines and Mechanisms", McGraw-Hill, Inc., 1995.
4. Rao J.S. and Duggipati R.V., "Mechanism and Machine Theory ", Wiley-Eastern Limited, New Delhi, 1992.
5. John Hannah and Stephens R.C., "Mechanics of Machines", Viva low-Priced Student Edition, 1999.
6. Sadhu Singh "Theory of Machines" Pearson Education, 2002.

### STANDARDS:

1. IS 11717 : 2000, Vocabulary on Vibration and Shock
2. IS 13301 : 1992, Guidelines for vibration isolation for machine foundations
3. IS 10000 : Part 7 : 1980, Methods of tests for internal combustion engines: Part 7 Governing tests for constant speed engines and selection of engines for use with electrical generators
4. IS 13274 : 1992, Mechanical vibration - Balancing – Vocabulary
5. IS 13277 : 1992, Balancing machine - Description and evaluation

## 512MET04 - DESIGN OF MACHINE ELEMENTS

### OBJECTIVE:

- To familiarise the various steps involved in the Design Process
- To understand the principles involved in evaluating the shape and dimensions of a component to satisfy functional and strength requirements.
- To learn to use standard practices and standard data
- To learn to use catalogues and standard machine components

### UNIT I STEADY STRESSES AND VARIABLE STRESSES IN MACHINE MEMBERS

Introduction to the design process - factor influencing machine design, selection of materials based on mechanical properties -- Preferred numbers, fits and tolerances – Direct, Bending and torsional stress equations – Impact and shock loading – calculation of principle stresses for various load combinations, eccentric loading – Design of curved beams – crane hook and 'C' frame - Factor of safety - theories of failure – stress concentration – design for variable loading – Soderberg, Goodman and Gerber relations.

### UNIT II DESIGN OF SHAFTS AND COUPLINGS

Design of solid and hollow shafts based on strength, rigidity and critical speed – Design of keys, key ways and splines - Design of crankshafts -- Design of rigid and flexible couplings.

### UNIT III DESIGN OF TEMPORARY AND PERMANENT JOINTS

Threaded fasteners - Design of bolted joints including eccentric loading, Knuckle joints, Cotter joints – Design of welded joints, riveted joints for structures - theory of bonded joints.

### UNIT IV DESIGN OF ENERGY STORING ELEMENTS

Design of various types of springs, optimization of helical springs -- rubber springs - Design of flywheels considering stresses in rims and arms, for engines and punching machines.

### UNIT V DESIGN OF BEARINGS AND MISCELLANEOUS ELEMENTS

Sliding contact and rolling contact bearings -- Design of hydrodynamic journal bearings, McKee's Eqn., Sommerfield Number, Raimondi & Boyd graphs, -- Selection of Rolling Contact bearings -- Design of Seals and Gaskets -- Design of Connecting Rod.

**Note:** (Use of P S G Design Data Book is permitted in the University examination)

### TEXT BOOKS:

1. Shigley J.E and Mischke C. R., "Mechanical Engineering Design", Sixth Edition, Tata McGraw-Hill , 2003.
2. Bhandari V.B, "Design of Machine Elements", Second Edition, Tata McGraw-Hill Book Co, 2007.

### REFERENCES:

1. Sundararajamoorthy T. V, Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2003.
2. Orthwein W, "Machine Component Design", Jaico Publishing Co, 2003.
3. Ugural A.C, "Mechanical Design – An Integral Approach, McGraw-Hill Book Co, 2004.
4. Spotts M.F., Shoup T.E "Design and Machine Elements" Pearson Education, 2004.

### STANDARDS:

1. IS 10260: Part 1: 1982 Terms, definitions and classification of Plain bearings Part 1: Construction.
2. IS 10260: Part 1: 1982 Terms, definitions and classification of Plain bearings Part 2: Friction and Wear.
3. IS 10260: Part 1: 1982 Terms, definitions and classification of Plain bearings Part 3: Lubrication.



## **512MET05 - ENGINEERING METROLOGY AND MEASUREMENTS (Common to Mechanical and Automobile)**

### **OBJECTIVE:**

- To understand the basic principles of measurements
- To learn the various linear and angular measuring equipments, their principle of operation and applications
- To learn about various methods of measuring Mechanical parameters

### **UNIT I CONCEPT OF MEASUREMENT**

General concept – Generalised measurement system-Units and standards-measuring instruments: sensitivity, stability, range, accuracy and precision-static and dynamic response-repeatability-systematic and random errors-correction, calibration - Introduction to Dimensional and Geometric Toleranceing – interchangeability.

### **UNIT II LINEAR AND ANGULAR MEASUREMENT**

Definition of metrology-Linear measuring instruments: Vernier, micrometer, Slip gauges and classification, - Tool Makers Microscope - interferometry, optical flats, - Comparators: limit gauges Mechanical, pneumatic and electrical comparators, applications. Angular measurements: -Sine bar, Sine center, bevel protractor and angle Decker..

### **UNIT III FORM MEASUREMENT**

Measurement of screw threads: Thread gauges, floating carriage micrometermeasurement of gear tooth thickness: constant chord and base tangent method-Gleason gear testing machine – radius measurements-surface finish: equipment and parameters, straightness, flatness and roundness measurements.

### **UNIT IV LASER AND ADVANCES IN METROLOGY**

Precision instruments based on laser-Principles- laser interferometer-application in measurements and machine tool metrology- Coordinate measuring machine (CMM): need, construction, types, applications.- computer aided inspection.

### **UNIT V MEASUREMENT OF MECHANICAL PARAMETERS**

Force, torque, power:-mechanical, pneumatic, hydraulic and electrical type-Pressure measurement - Flow: Venturi, orifice, rotameter, pitot tube-Temperature: bimetallic strip, thermocouples, pyrometer, electrical resistance thermistor.

### **TEXT BOOKS:**

1. Jain R.K., "Engineering Metrology", Khanna Publishers, 2005.
2. Alan S. Morris, "The Essence of Measurement", Prentice Hall of India, 1997.

### **REFERENCES**

1. Gupta S.C, "Engineering Metrology", Dhanpat rai Publications, 2005
2. Jayal A.K, "Instrumentation and Mechanical Measurements", Galgotia Publications 2000.
3. Beckwith, Marangoni, Lienhard, "Mechanical Measurements", Pearson Education, 2006.
4. Donald Deckman, "Industrial Instrumentation", Wiley Eastern, 1985.

**512MET06 - APPLIED HYDRAULICS AND PNEUMATICS  
(COMMON TO MECHANICAL AND MECHATRONICS - VI SEMESTER)**

**OBJECTIVE:**

- To know the advantages and applications of Fluid Power Engineering and Power Transmission System.
- To learn the Applications of Fluid Power System in automation of Machine Tools and others Equipments.

**UNIT I FLUID POWER SYSTEMS AND FUNDAMENTALS**

Introduction to fluid power, Advantages of fluid power, Application of fluid power system. Types of fluid power systems, Properties of hydraulic fluids – General types of fluids – Fluid power symbols. Basics of Hydraulics-Applications of Pascals Law- Laminar and Turbulent flow – Reynold's number – Darcy's equation – Losses in pipe, valves and fittings.

**UNIT II HYDRAULIC SYSTEM & COMPONENTS**

Sources of Hydraulic Power: Pumping theory – Pump classification – Gear pump, Vane Pump, piston pump, construction and working of pumps – pump performance – Variable displacement pumps. Fluid Power Actuators: Linear hydraulic actuators – Types of hydraulic cylinders – Single acting, Double acting special cylinders like tandem, Rodless, Telescopic, Cushioning mechanism, Construction of double acting cylinder, Rotary actuators – Fluid motors, Gear, Vane and Piston motors.

**UNIT III DESIGN OF HYDRAULIC CIRCUITS**

Construction of Control Components : Directional control valve – 3/2 way valve – 4/2 way valve – Shuttle valve – check valve – pressure control valve – pressure reducing valve, sequence valve, Flow control valve – Fixed and adjustable, electrical control solenoid valves, Relays, ladder diagram. Accumulators and Intensifiers: Types of accumulators – Accumulators circuits, sizing of accumulators, intensifier – Applications of Intensifier – Intensifier circuit.

**UNIT IV PNEUMATIC SYSTEMS AND COMPONENTS**

Pneumatic Components: Properties of air – Compressors – Filter, Regulator, Lubricator Unit – Air control valves, Quick exhaust valves, pneumatic actuators. Fluid Power Circuit Design, Speed control circuits, synchronizing circuit, Penumo hydraulic circuit, Sequential circuit design for simple applications using cascade method.

**UNIT V DESIGN OF PNEUMATIC CIRCUITS**

Servo systems – Hydro Mechanical servo systems, Electro hydraulic servo systems and proportional valves. Fluidics – Introduction to fluidic devices, simple circuits, Introduction to Electro Hydraulic Pneumatic logic circuits, ladder diagrams, PLC applications in fluid power control. Fluid power circuits; failure and troubleshooting.

**TEXT BOOKS:**

1. Anthony Esposito, "Fluid Power with Applications", Pearson Education 2005.
2. Majumdar S.R., "Oil Hydraulics Systems- Principles and Maintenance", Tata McGraw-Hill, 2001.

**REFERENCES:**

1. Srinivasan.R, "Hydraulic and Pneumatic controls", Vijay Nicole, 2006.
2. Shanmugasundaram.K, "Hydraulic and Pneumatic controls", Chand & Co, 2006.
3. Majumdar S.R., "Pneumatic systems – Principles and maintenance", Tata McGraw Hill, 1995
4. Anthony Lal, "Oil hydraulics in the service of industry", Allied publishers, 1982.
5. Harry L. Stevart D.B, "Practical guide to fluid power", Taraoeala sons and Port Ltd. Broadey, 1976.
7. Michael J, Prinches and Ashby J. G, "Power Hydraulics", Prentice Hall, 1989.
8. Dudelyt, A. Pease and John T. Pippenger, "Basic Fluid Power", Prentice Hall, 1987.

## 512MEP01 - THERMAL ENGINEERING LABORATORY – I

### LIST OF EXPERIMENTS

#### I.C ENGINE LAB AND FUELS LAB

1. Valve Timing and Port Timing Diagrams.
2. Performance Test on 4-stroke Diesel Engine.
3. Heat Balance Test on 4-stroke Diesel Engine.
4. Morse Test on Multicylinder Petrol Engine.
5. Retardation Test to find Frictional Power of a Diesel Engine.
6. Determination of Viscosity – Red Wood Viscometer.
7. Determination of Flash Point and Fire Point.

#### STEAM LAB

1. Study of Steam Generators and Turbines.
2. Performance and Energy Balance Test on a Steam Generator.
3. Performance and Energy Balance Test on Steam Turbine.

### LIST OF EQUIPMENT

(for a batch of 30 students)

- |   |       |
|---|-------|
| 1. I.C Engine – 2 stroke and 4 stroke model.                  | 1 set |
| 2. Red Wood Viscometer.                                       | 1 No. |
| 3. Apparatus for Flash and Fire Point.                        | 1 No. |
| 4. 4-stroke Diesel Engine with mechanical loading.            | 1 No. |
| 5. 4-stroke Diesel Engine with hydraulic loading.             | 1 No. |
| 6. 4-stroke Diesel Engine with electrical loading.            | 1 No. |
| 7. Multi-cylinder Petrol Engine.                              | 1 No. |
| 8. Single cylinder Petrol Engine.                             | 1 No. |
| 9. Data Acquisition system with any one of the above engines. | 1 No. |
| 10. Steam Boiler with turbine setup.                          | 1 No. |

## 512MEP02 - DYNAMICS LABORATORY

### OBJECTIVES:

- To supplement the principles learnt in kinematics and Dynamics of Machinery.
- To understand how certain measuring devices are used for dynamic testing.

### LIST OF EXPERIMENTS

1. a) Study of gear parameters.  
b) Experimental study of velocity ratios of simple, compound, Epicyclic and differential gear trains.
2. a) Kinematics of Four Bar, Slider Crank, Crank Rocker, Double crank, Double rocker, Oscillating cylinder Mechanisms.  
b) Kinematics of single and double universal joints.
3. a) Determination of Mass moment of inertia of Fly wheel and Axle system.  
b) Determination of Mass Moment of Inertia of axisymmetric bodies using Turn Table apparatus.  
c) Determination of Mass Moment of Inertia using bifilar suspension and compound pendulum.
4. Motorized gyroscope – Study of gyroscopic effect and couple.
5. Governor - Determination of range sensitivity, effort etc., for Watts, Porter, Proell, and Hartnell Governors.
6. Cams – Cam profile drawing, Motion curves and study of jump phenomenon
7. a) Single degree of freedom Spring Mass System – Determination of natural Frequency and verification of Laws of springs – Damping coefficient determination.  
b) Multi degree freedom suspension system – Determination of influence coefficient.
8. a) Determination of torsional natural frequency of single and Double Rotor systems.- Undamped and Damped Natural frequencies.  
b) Vibration Absorber – Tuned vibration absorber.
9. Vibration of Equivalent Spring mass system – undamped and damped vibration.
10. Whirling of shafts – Determination of critical speeds of shafts with concentrated loads.
11. a) Balancing of rotating masses. (b) Balancing of reciprocating masses.
12. a) Transverse vibration of Free-Free beam – with and without concentrated masses.  
b) Forced Vibration of Cantilever beam – Mode shapes and natural frequencies.  
c) Determination of transmissibility ratio using vibrating table.  
Students should be familiar with the use of the following device/equipments depending upon availability.

- Tachometers – Contact and non contact
- Dial gauge
- Stroboscope
- Accelerometers – Vibration pickups
- Displacement meters.
- Oscilloscope
- Vibration Shaker
- F.F.T. Analyzer, and (9) Dynamic Balancing Machine.

## **LIST OF EQUIPMENT**

(For a batch of 30 students)

1. Cam analyzer.
2. Motorised gyroscope.
3. Governor apparatus - Watt, Porter, Proell and Hartnell governors.
4. Whirling of shaft apparatus.
5. Dynamic balancing machine.
6. Static and dynamic balancing machine.
7. Vibrating table
8. Vibration test facilities apparatus
9. Gear Model
10. Kinematic Models to study various mechanisms

## 512MEP03 - METROLOGY AND MEASUREMENT LABORATORY

### LIST OF EXPERIMENTS

1. Calibration of Vernier / Micrometer / Dial Gauge
2. Checking Dimensions of part using slip gauges
3. Measurements of Gear Tooth Dimensions
4. Measurement of Angle using sine bar / sine center / tool makers microscope
5. Measurement of straightness and flatness
6. Measurement of thread parameters
7. Setting up of comparators for inspection (Mechanical / Pneumatic / Electrical)
8. Measurement of Temperature using Thermocouple / Pyrometer
9. Measurement of Displacement
10. Measurement of Force
11. Measurement of Torque
12. Measurement of Vibration / Shock

### LIST OF EQUIPMENT

(For a batch of 30 students)

- |  |     |
|--|-----|
| 1. Micrometer                                      | - 5 |
| 2. Vernier Caliper                                 | - 5 |
| 3. Vernier Height Gauge                            | - 2 |
| 4. Vernier depth Gauge                             | - 2 |
| 5. Slip Gauge Set                                  | - 1 |
| 6. Gear Tooth Vernier                              | - 1 |
| 7. Sine Bar  | - 1 |
| 8. Sine Center                                     | - 1 |
| 9. Bevel Protractor                                | - 1 |
| 10. Floating Carriage Micrometer                   | - 1 |
| 11. Profile Projector / Tool Makers Microscope     | - 1 |
| 12. Mechanical / Electrical / Pneumatic Comparator | - 1 |
| 13. Autocollimator                                 | - 1 |
| 14. Temperature Measuring Setup                    | - 1 |
| 15. Displacement Measuring Setup                   | - 1 |
| 16. Force Measuring Setup                          | - 1 |
| 17. Torque Measuring Setup                         | - 1 |
| 18. Vibration / Shock Measuring Setup              | - 1 |

## 512MEP04 - CAD/CAM LABORATORY

### OBJECTIVES:

- To understand and handle design problems in a systematic manner.
- To gain practical experience in handling 2D drafting and 3D modeling software systems.
- To apply CAD in real life applications.
- To understand the concepts G and M codes and manual part programming.
- To expose students to modern control systems (Fanuc, Siemens etc)
- To know the application of various CNC machines
- To expose students to modern CNC application machines EDM, EDM wire cut and Rapid Prototyping

### 3D GEOMETRIC MODELING

Creation of 3D Models - Wire Frame, Surface, Solid modeling Techniques Using CAD Packages - CSG, B-Rep Approaches in Solid Modeling - Feature Based Modeling Technique - Assembly - Detailing - Exposure to Industrial Components - Application of GD&T.

### STL FILE GENERATION – REVERSE ENGINEERING

Manual CNC Part Programming: Manual CNC Part Programming Using Standard G and M Codes - Tool Path Simulation – Exposure to Various Standard Control Systems- Machining simple components by Using CNC machines.

### COMPUTER AIDED PART PROGRAMMING

CL Data Generation by Using CAM Software– Post Process Generation for Different Control System – Machining of Computer Generated Part Program by Using Machining Center and Turning Center.

### STUDY OF EXPERIMENTS

Multi-axial Machining in CNC Machining Center –EDM – EDM Wire Cut – Rapid Prototyping.

#### (Requirement for a batch of 30 students)

S. No.	Description of Equipment	Quantity required
<b>HARDWARE</b>		
1.	Computer Server	1
2.	Computer nodes or systems (High end CPU with at least 1 GB main memory) networked to the server	30
3.	A3 size plotter	1
4.	Laser Printer	1
5.	Trainer CNC Lathe	1
6.	Trainer CNC milling	1
<b>SOFTWARE</b>		
7.	CAD/CAM software (Pro-E or IDEAS or Unigraphics or CATIA)	15 licenses
8.	CAM Software (CNC Programming and tool path simulation for FANUC /Sinumeric and Heiden controller)	15 licenses
9.	Licensed operating system	Adequate

## SIXTH SEMESTER

### 612MET01 - PRINCIPLES OF MANAGEMENT

#### UNIT I OVERVIEW OF MANAGEMENT

Definition - Management - Role of managers - Evolution of Management thought - Organization and the environmental factors - Trends and Challenges of Management in Global Scenario.

#### UNIT II PLANNING

Nature and purpose of planning - Planning process - Types of plans - Objectives - - Managing by objective (MBO) Strategies - Types of strategies - Policies - Decision Making - Types of decision - Decision Making Process - Rational Decision Making Process - Decision Making under different conditions.

#### UNIT III ORGANIZING

Nature and purpose of organizing - Organization structure - Formal and informal groups / organization - Line and Staff authority - Departmentation - Span of control - Centralization and Decentralization - Delegation of authority - Staffing - Selection and Recruitment - Orientation - Career Development - Career stages - Training - - Performance Appraisal.

#### UNIT IV DIRECTING

Creativity and Innovation - Motivation and Satisfaction - Motivation Theories - Leadership Styles - Leadership theories - Communication - Barriers to effective communication - Organization Culture - Elements and types of culture - Managing cultural diversity.

#### UNIT V CONTROLLING

Process of controlling - Types of control - Budgetary and non-budgetary control techniques - Managing Productivity - Cost Control - Purchase Control - Maintenance Control - Quality Control - Planning operations.

#### TEXT BOOKS:

1. Stephen P. Robbins and Mary Coulter, 'Management', Prentice Hall of India, 8th edition.
2. Charles W L Hill, Steven L McShane, 'Principles of Management', Mcgraw Hill Education, Special Indian Edition, 2007.

#### REFERENCES:

1. Hellriegel, Slocum & Jackson, ' Management - A Competency Based Approach', Thomson South Western, 10th edition, 2007.
2. Harold Koontz, Heinz Wehrich and Mark V Cannice, 'Management - A global & Entrepreneurial Perspective', Tata Mcgraw Hill, 12th edition, 2007.
3. Andrew J. Dubrin, 'Essentials of Management', Thomson Southwestern, 7th edition, 2007.



## 612MET02 - GAS DYNAMICS AND JET PROPULSION

### AIM:

- To impart knowledge to the students on compressible flow through ducts, jet propulsion and space propulsion.

### OBJECTIVE:

- To understand the basic difference between incompressible and compressible flow.
- To understand the phenomenon of shock waves and its effect on flow. To gain some basic knowledge about jet propulsion and Rocket Propulsion.

### UNIT I BASIC CONCEPTS AND ISENTROPIC FLOWS

Energy and momentum equations of compressible fluid flows – Stagnation states, Mach waves and Mach cone – Effect of Mach number on compressibility – Isentropic flow through variable ducts – Nozzle and Diffusers – Use of Gas tables.

### UNIT II FLOW THROUGH DUCTS

Flows through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) – variation of flow properties – Use of tables and charts – Generalised gas dynamics.

### UNIT III NORMAL AND OBLIQUE SHOCKS

Governing equations – Variation of flow parameters across the normal and oblique shocks – Prandtl – Meyer relations – Use of table and charts – Applications.

### UNIT IV JET PROPULSION

Theory of jet propulsion – Thrust equation – Thrust power and propulsive efficiency – Operation principle, cycle analysis and use of stagnation state performance of ram jet, turbojet, turbofan and turbo prop engines.

### UNIT V SPACE PROPULSION

Types of rocket engines – Propellants-feeding systems – Ignition and combustion – Theory of rocket propulsion – Performance study – Staging – Terminal and characteristic velocity – Applications – space flights.

### TEXT BOOKS:

1. Anderson, J.D., Modern Compressible flow, McGraw Hill, 3rd Edition, 2003.
2. H. Cohen, G.E.C. Rogers and Saravanamutto, Gas Turbine Theory, Longman Group Ltd., 1980.
3. S.M. Yahya, fundamentals of Compressible Flow, New Age International (P) Limited, New Delhi, 1996.

### REFERENCES:

1. P. Hill and C. Peterson, Mechanics and Thermodynamics of Propulsion, Addison – Wesley Publishing company, 1992.
2. N.J. Zucrow, Aircraft and Missile Propulsion, vol.1 & II, John Wiley, 1975.
3. N.J. Zucrow, Principles of Jet Propulsion and Gas Turbines, John Wiley, New York, 1970.
4. G.P. Sutton, Rocket Propulsion Elements, John wiley, 1986, New York.
5. A.H. Shapiro, Dynamics and Thermodynamics of Compressible fluid Flow, , John wiley, 1953, New York.
6. V. Ganesan, Gas Turbines, Tata McGraw Hill Publishing Co., New Delhi, 1999.
7. PR.S.L. Somasundaram, Gas Dynamics and Jet Propulsions, New Age International Publishers, 1996.
8. V. Babu, Fundamentals of Gas Dynamics, ANE Books India, 2008.

## 612MET03 - DESIGN OF TRANSMISSION SYSTEMS

### OBJECTIVE:

- To gain knowledge on the principles and procedure for the design of power Transmission components. To understand the standard procedure available for Design of Transmission slip terms To learn to use standard data and catalogues

### UNIT I DESIGN OF TRANSMISSION SYSTEMS FOR FLEXIBLE ELEMENTS

Selection of V belts and pulleys-selection of Flat belts and pulleys-Wire ropes and pulleys – Selection of Transmission chains and Sprockets. Design of pulleys and sprockets.

### UNIT II SPUR GEARS AND PARALLEL AXIS HELICAL GEARS

Gear Terminology-Speed ratios and number of teeth-Force analysis -Tooth stresses - Dynamic effects - Fatigue strength - Factor of safety - Gear materials – Module and Face width-power rating calculations based on strength and wear considerations - Parallel axis Helical Gears – Pressure angle in the normal and transverse plane- Equivalent number of teeth-forces and stresses. Estimating the size of the helical gears.

### UNIT III BEVEL, WORM AND CROSS HELICAL GEARS

Straight bevel gear: Tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of pair of straight bevel gears.

Worm Gear: Merits and demerits- terminology. Thermal capacity, materials-forces and stresses, efficiency, estimating the size of the worm gear pair.

Cross helical: Terminology-helix angles-Estimating the size of the pair of cross helical gears.

### UNIT IV DESIGN OF GEAR BOXES

Geometric progression - Standard step ratio - Ray diagram, kinematics layout -Design of sliding mesh gear box -Constant mesh gear box. – Design of multi speed gear box.

### UNIT V DESIGN OF CAM CLUTCHES AND BRAKES

Cam Design: Types-pressure angle and under cutting base circle determination-forces and surface stresses. Design of plate clutches –axial clutches-cone clutches-internal expanding rim clutches-internal and external shoe brakes.

**NOTE:** (Usage of P.S.G Design Data Book is permitted in the University examination)

### TEXT BOOKS:

- Shigley J.E and Mischke C. R., "Mechanical Engineering Design", Sixth Edition, Tata McGraw-Hill, 2003.
- Sundararajamoorthy T. V, Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2003.

### REFERENCES:

- Maitra G.M., Prasad L.V., "Hand book of Mechanical Design", II Edition, Tata McGraw-Hill, 1985.
- Bhandari, V.B., "Design of Machine Elements", Tata McGraw-Hill Publishing Company Ltd., 1994.
- Prabhu. T.J., "Design of Transmission Elements", Mani Offset, Chennai, 2000,
- Hamrock B.J., Jacobson B., Schmid S.R., "Fundamentals of Machine Elements", McGraw-Hill Book Co., 1999.
- Ugural A,C, "Mechanical Design, An Integrated Approach", McGraw-Hill, 2003.

### STANDARDS:

- IS 4460: Parts 1 to 3 : 1995, Gears – Spur and Helical Gears – Calculation of Load Capacity.
- IS 7443: 2002, Methods of Load Rating of Worm Gears
- IS 15151: 2002, Belt Drives – Pulleys and V-Ribbed belts for Industrial applications – PH, PJ, PK, PL and PM Profiles : Dimensions
- IS 2122: Part 1: 1973, Code of practice for selection, storage, installation and maintenance of belting for power transmission : Part 1 Flat Belt Drives.
- IS 2122: Part 2: 1991, Code of practice for selection, storage, installation and

maintenance of belting for power transmission : Part 2 V-Belt Drives.

**612MET04 - AUTOMOBILE ENGINEERING  
(COMMON TO MECHANICAL AND PRODUCTION)**

**UNIT I VEHICLE STRUCTURE AND ENGINES**

Types of automobiles , vehicle construction and different layouts ,chassis, frame and body, resistances to vehicle motion and need for a gearbox, components of engine-their forms ,functions and materials.

**UNIT II ENGINE AUXILIARY SYSTEMS**

Electronically controlled gasoline injection system for SI engines., Electronically controlled diesel injection system ( Unit injector system, Rotary distributor type and common rail direct injection system), Electronic ignition system ,Turbo chargers, Engine emission control by three way catalytic converter system .

**UNIT III TRANSMISSION SYSTEMS**

Clutch-types and construction ,gear boxes- manual and automatic, gear shift mechanisms, Over drive, transfer box, fluid flywheel –torque converter , propeller shaft, slip joints, universal joints ,Differential, and rear axle, Hotchkiss Drive and Torque Tube Drive.

**UNIT IV STEERING, BRAKES AND SUSPENSION SYSTEMS**

Steering geometry and types of steering gear box-Power Steering, Types of Front Axle, Types of Suspension Systems , Pneumatic and Hydraulic Braking Systems, Antilock Braking System and Traction Control.

**UNIT V ALTERNATIVE ENERGY SOURCES**

Use of Natural Gas, Liquefied Petroleum Gas. Bio-diesel, Bio-ethanol , Gasohol and Hydrogen in Automobiles- Engine modifications required –Performance ,Combustion and Emission Characteristics of SI and CI engines with these alternate fuels - Electric and Hybrid Vehicles, Fuel Cell

**Note:** A Practical Training in dismantling and assembling of engine parts and transmission systems may be given to the students.

**TEXT BOOKS:**

1. Kirpal Singh, " Automobile Engineering Vols 1 & 2 ", Standard Publishers, Seventh Edition ,1997, New Delhi.
2. Jain,K.K.,and Asthana .R.B, "Automobile Engineering" Tata McGraw Hill Publishers, New Delhi, 2002.

**REFERENCES:**

1. Newton ,Steeds and Garet," Motor Vehicles ", Butterworth Publishers,1989
2. Joseph Heitner, "Automotive Mechanics," , Second Edition ,East-West Press ,1999
3. Martin W. Stockel and Martin T Stockle , " Automotive Mechanics Fundamentals," The Goodheart –Will Cox Company Inc, USA ,1978.
4. Heinz Heisler , 'Advanced Engine Technology," SAE International Publications USA,1998.
5. Ganesan V.." Internal Combustion Engines" , Third Edition, Tata Mcgraw-Hill ,2007.

## 612MET05 - FINITE ELEMENT ANALYSIS

### **INTRODUCTION** (Not for examination)

Solution to engineering problems – mathematical modeling – discrete and continuum modeling – need for numerical methods of solution – relevance and scope of finite element methods – engineering applications of FEA.

### **UNIT I FINITE ELEMENT FORMULATION OF BOUNDARY VALUE PROBLEMS**

Weighted residual methods – general weighted residual statement – weak formulation of the weighted residual statement – comparisons – piecewise continuous trial function example of a bar finite element – functional and differential forms – principle of stationary total potential – Rayleigh Ritz method – piecewise continuous trial functions – finite element method – application to bar element.

### **UNIT II ONE DIMENSIONAL FINITE ELEMENT ANALYSIS**

General form of total potential for 1-D applications – generic form of finite element equations – linear bar element – quadratic element – nodal approximation – development of shape functions – element matrices and vectors – example problems – extension to plane truss – development of element equations – assembly – element connectivity – global equations – solution methods – beam element – nodal approximation – shape functions – element matrices and vectors – assembly – solution – example problems.

### **UNIT III TWO DIMENSIONAL FINITE ELEMENT ANALYSIS**

Introduction – approximation of geometry and field variable – 3 noded triangular elements – four noded rectangular elements – higher order elements – generalized coordinates approach to nodal approximations – difficulties – natural coordinates and coordinate transformations – triangular and quadrilateral elements – iso-parametric elements – structural mechanics applications in 2-dimensions – elasticity equations – stress strain relations – plane problems of elasticity – element equations – assembly – need for quadrature formulae – transformations to natural coordinates – Gaussian quadrature – example problems in plane stress, plane strain and axisymmetric applications.

### **UNIT IV DYNAMIC ANALYSIS USING FINITE ELEMENT METHOD**

Introduction – vibrational problems – equations of motion based on weak form – longitudinal vibration of bars – transverse vibration of beams – consistent mass matrices – element equations – solution of eigenvalue problems – vector iteration methods – normal modes – transient vibrations – modeling of damping – mode superposition technique – direct integration methods.

### **UNIT V APPLICATIONS IN HEAT TRANSFER & FLUID MECHANICS**

One dimensional heat transfer element – application to one-dimensional heat transfer problems – scalar variable problems in 2-Dimensions – Applications to heat transfer in 2-Dimension – Application to problems in fluid mechanics in 2-D.

### **TEXT BOOK:**

1. P.Seshu, "Text Book of Finite Element Analysis", Prentice-Hall of India Pvt. Ltd., New Delhi, 2007. ISBN-978-203-2315-5

### **REFERENCES:**

1. J.N.Reddy, "An Introduction to the Finite Element Method", McGraw-Hill International Editions(Engineering Mechanics Series), 1993. ISBN-0-07-051355-4
2. Chandrupatla & Belagundu, "Introduction to Finite Elements in Engineering", 3rd Edition, Prentice-Hall of India, Eastern Economy Editions. ISBN-978-81-203-2106-9.
3. David V.Hutton,"Fundamentals of Finite Element Analysis", Tata McGraw-Hill Edition 2005. ISBN-0-07-239536-2
4. Cook,Robert.D., Plesha,Michael.E & Witt,Robert.J. "Concepts and Applications of Finite Element Analysis",Wiley Student Edition, 2004. ISBN-10 81-265-1336-5

**ELECTIVE I & II**  
**612MET06 - MARKETING MANAGEMENT**  
**(COMMON TO MECHANICAL, PRODUCTION AND MECHATRONICS)**

**OBJECTIVE**

- To understand the various processes involved in Marketing and its Philosophy.
- To learn the Psychology of consumers.
- To formulate strategies for advertising, pricing and selling

**UNIT I MARKETING PROCESS**

Definition, Marketing process, dynamics, needs, wants and demands, marketing concepts, environment, mix, types. Philosophies, selling versus marketing, organizations, industrial versus consumer marketing, consumer goods, industrial goods, product hierarchy

**UNIT II BUYING BEHAVIOUR AND MARKET SEGMENTATION**

Cultural, demographic factors, motives, types, buying decisions, segmentation factors - demographic -Psycho graphic and geographic segmentation, process, patterns.

**UNIT III PRODUCT PRICING AND MARKETING RESEARCH**

Objectives, pricing, decisions and pricing methods, pricing management. Introduction, uses, process of marketing research.

**UNIT IV MARKETING PLANNING AND STRATEGY FORMULATION**

Components of marketing plan-strategy formulations and the marketing process, implementations, portfolio analysis, BCG, GEC grids.

**UNIT V ADVERTISING, SALES PROMOTION AND DISTRIBUTION**

Characteristics, impact, goals, types, and sales promotions- point of purchase- unique selling proposition. Characteristics, wholesaling, retailing, channel design, logistics, and modern trends in retailing.

**TEXT BOOKS:**

1. Govindarajan. M, "Marketing management – concepts, cases, challenges and trends", Prentice hall of India, second edition 2007.
2. Philip Kotler, Koshy Jha "Marketing Management", Pearson Education ,Indian adapted edition.2007.

**REFERENCES:**

1. Ramasamy and Nama kumari, "Marketing Environment: Planning, implementation and control the Indian context", 1990.
2. Czinkota&Kotabe, "Marketing management", Thomson learning, Indian edition 2007.
3. Adrain palmer, " Introduction to marketing theory and practice", Oxford university press IE 2004.
4. Donald S. Tull and Hawkins, "Marketing Reasearch", Prentice Hall of Inida-1997.
5. Philip Kotler and Gary Armstrong "Principles of Marketing" Prentice Hall of India, 2000.
6. Steven J.Skinner, "Marketing", All India Publishers and Distributes Ltd. 1998.
7. Graeme Drummond and John Ensor, Introduction to marketing concepts, Elsevier, Indian Reprint, 2007.

## **612MET07 - QUALITY CONTROL AND RELIABILITY ENGINEERING (COMMON TO MECHANICAL, AUTOMOBILE AND PRODUCTION)**

### **OBJECTIVE:**

- To introduce the concept of SQC
- To understand process control and acceptance sampling procedure and their application.
- To learn the concept of reliability.

### **UNIT I INTRODUCTION AND PROCESS CONTROL FOR VARIABLES**

Introduction, definition of quality, basic concept of quality, definition of SQC, benefits and limitation of SQC, Quality assurance, Quality control: Quality cost-Variation in process causes of variation -Theory of control chart- uses of control chart – Control chart for variables – X chart, R chart and  $\bar{x}$  chart -process capability – process capability studies and simple problems. Six sigma concepts.

### **UNIT II PROCESS CONTROL FOR ATTRIBUTES**

Control chart for attributes –control chart for non conformings– p chart and np chart – control chart for nonconformities– C and U charts, State of control and process out of control identification in charts, pattern study.

### **UNIT III ACCEPTANCE SAMPLING**

Lot by lot sampling – types – probability of acceptance in single, double, multiple sampling techniques – O.C. curves – producer's Risk and consumer's Risk. AQL, LTPD, AOQL concepts- standard sampling plans for AQL and LTPD- uses of standard sampling plans.

### **UNIT IV LIFE TESTING - RELIABILITY**

Life testing – Objective – failure data analysis, Mean failure rate, mean time to failure, mean time between failure, hazard rate – Weibull model, system reliability, series, parallel and mixed configuration – simple problems. Maintainability and availability – simple problems. Acceptance sampling based on reliability test – O.C Curves.

### **UNIT V QUALITY AND RELIABILITY**

Reliability improvements – techniques- use of Pareto analysis – design for reliability – redundancy unit and standby redundancy – Optimization in reliability – Product design – Product analysis – Product development – Product life cycles.

**Note:** Use of approved statistical table permitted in the examination.

### **TEXT BOOKS**

1. Douglas.C.Montgomery, " Introduction to Statistical quality control" John wiley 4th edition 2001.
2. L.S.Srinath, "Reliability Engineering", Affiliated East west press, 1991.

### **REFERENCES**

1. John.S. Oakland. "Statistical process control", Elsevier, 5th edition, 2005
2. Connor, P.D.T.O., " Practical Reliability Engineering", John Wiley, 1993
3. Grant, Eugene .L "Statistical Quality Control", McGraw-Hill, 1996
4. Monohar Mahajan, "Statistical Quality Control", Dhanpat Rai & Sons, 2001.
5. R.C.Gupta, "Statistical Quality control", Khanna Publishers, 1997.
6. Besterfield D.H., "Quality Control", Prentice Hall, 1993.
7. Sharma S.C., "Inspection Quality Control and Reliability", Khanna Publishers, 1998.
8. Danny Samson, "Manufacturing & Operations Strategy", Prentice Hall, 1991

## **612MET08 - REFRIGERATION AND AIR CONDITIONING**

### **AIM:**

- To reach the underlying principles of operation in different Refrigeration & Air conditioning systems and components.

### **OBJECTIVES:**

- To provide knowledge on various refrigeration cycles, system components and refrigerants. To provide knowledge on design aspects of Refrigeration & Air conditioning Systems.

### **UNIT I REFRIGERATION CYCLE**

Review of thermodynamic principles of refrigeration. Carnot refrigeration cycle – Vapour compression refrigeration cycle – use of P.H. charts – multistage and multiple evaporator systems – cascade system – COP comparison. Air Refrigeration cycles.

### **UNIT II REFRIGERANTS AND SYSTEM COMPONENTS**

Compressors – reciprocating and rotary (elementary treatment), Types of condensers, evaporators, cooling towers – Functional aspects. Refrigerants – properties – selection of refrigerants, Alternate Refrigerants, Cycling controls.

### **UNIT III PSYCHROMETRY**

Psychrometric processes use of psychrometric charts – Grand and Room Sensible Heat Factors – bypass factor – air washers, requirements of comfort air conditioning, summer and Winter Air conditioning.

### **UNIT IV AIR CONDITIONING SYSTEMS**

Cooling load calculation working principles of – Centralized Air conditioning systems, Split, Ductable split, Packaged Air conditioning, VAV & VRV Systems. Duct Design by equal friction method, Indoor Air quality concepts.

### **UNIT V UNCONVENTIONAL REFRIGERATION CYCLES**

Vapor Absorption system – Ejector jet, Steam jet refrigeration, thermo electric refrigeration. APPLICATIONS – ice plant – food storage plants – milk – chilling plants.

### **TEXT BOOKS:**

1. Manohar Prasad, "Refrigeration and Air Conditioning", Wiley Eastern Ltd., 1983.
2. Arora C.P., "Refrigeration and Air Conditioning", Tata McGraw Hill, New Delhi, 1988.

### **REFERENCES:**

1. Roy. J. Dossat, "Principles of Refrigeration", Pearson Education 1997.
2. Jordon and Priester, "Refrigeration and Air Conditioning", Prentice Hall of India Pvt. Ltd., New Delhi, 1985.
3. Stoecker N.F. and Jones, "Refrigeration and Air Conditioning", TMH, New Delhi, 1981.

## 612MET09 - RENEWABLE SOURCES OF ENERGY

### AIM:

- To instruct the importance of renewable energy and its utilization for the thermal and electrical energy needs and also the environmental aspects of these resources.

### OBJECTIVE:

At the end of the course, the student expected to do Understand and analyze the pattern of renewable energy resources Suggest methodologies / technologies for its utilization Economics of the utilization and environmental merits.

### UNIT I SOLAR ENERGY

Solar Radiation – Measurements of solar Radiation and sunshine – Solar Thermal Collectors – Flat Plate and Concentrating Collectors – Solar Applications – fundamentals of photo Voltaic Conversion – solar Cells – PV Systems – PV Applications.

### UNIT II WIND ENERGY

Wind Data and Energy Estimation – wind Energy Conversion Systems – Wind Energy generators and its performance – Wind Energy Storage – Applications – Hybrid systems.

### UNIT III BIO - ENERGY

Biomass, Biogas, Source, Composition, Technology for utilization – Biomass direct combustion – Biomass gasifier – Biogas plant – Digesters – Ethanol production – Bio diesel production and economics.

### UNIT IV OTEC, TODAL, GEOTHERMAL AND HYDEL ENERGY

Tidal energy – Wave energy – Data, Technology options – Open and closed OTEC Cycles – Small hydro, turbines – Geothermal energy sources, power plant and environmental issues.

### UNIT V NEW ENERGY SOURCES

Hydrogen, generation, storage, transport and utilization, Applications: power generation, transport – Fuel cells – technologies, types – economics and the power generation.

### TEXT BOOK:

1. G.D. Rai, Non Conventional Energy Sources, Khanna Publishers, New Delhi, 1999.
2. S.P. Sukhatme, Solar Energy, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 1997.

### REFERENCES:

1. Godfrey Boyle, Renewable Energy, Power for a Sustainable Future, Oxford University Press, U.K., 1996.
2. Twidell, J.W. & Weir, A., Renewable Energy Sources, EFN Spon Ltd., UK, 1986.
3. G.N. Tiwari, solar Energy – Fundamentals Design , Modelling and applications, Narosa Publishing House, New Delhi, 2002.
4. L.L. Freris, Wind Energy Conversion systems, Prentice Hall, UK, 1990.



## **612MET10 - INDUSTRIAL TRIBOLOGY**

### **UNIT I SURFACES AND FRICTION**

Topography of Engineering surfaces- Contact between surfaces - Sources of sliding Friction – Adhesion-Ploughing- Energy dissipation mechanisms Friction Characteristics of metals - Friction of non metals. Friction of lamellar solids - friction of Ceramic materials and polymers - Rolling Friction - Source of Rolling Friction – Stick slip motion - Measurement of Friction.

### **UNIT II WEAR**

Types of wear - Simple theory of Sliding Wear Mechanism of sliding wear of metals - Abrasive wear – Materials for Adhesive and Abrasive wear situations - Corrosive wear - Surface Fatigue wear situations - Brittle Fracture - wear - Wear of Ceramics and Polymers - Wear Measurements.

### **UNIT III LUBRICANTS AND LUBRICATION TYPES**

Types and properties of Lubricants - Testing methods - Hydrodynamic Lubrication – Elasto-hydrodynamic lubrication- Boundary Lubrication - Solid Lubrication- Hydrostatic Lubrication.

### **UNIT IV FILM LUBRICATION THEORY**

Fluid film in simple shear - Viscous flow between very close parallel plates - Shear stress variation Reynolds Equation for film Lubrication - High speed unloaded journal bearings - Loaded journal bearings – Reaction torque on the bearings - Virtual Co-efficient of friction - The Sommerfield diagram.

### **UNIT V SURFACE ENGINEERING AND MATERIALS FOR BEARINGS**

Surface modifications - Transformation Hardening, surface fusion - Thermo chemical processes – Surface coatings - Plating and anodizing - Fusion Processes – Vapour Phase processes - Materials for rolling Element bearings - Materials for fluid film bearings - Materials for marginally lubricated and dry bearings.

### **TEXT BOOK:**

1. A.Harnoy " Bearing Design in Machinery "Marcel Dekker Inc,NewYork,2003

### **REFERENCES:**

1. M.M.Khonsari & E.R.Booser, " Applied Tribology",John Willey &Sons,New York,2001
2. E.P.Bowden and D.Tabor., "Friction and Lubrication ", Heinemann Educational Books Ltd., 1974.
3. A.Cameron, " Basic Lubrication theory ", Longman, U.K., 1981.
4. M.J.Neale (Editor), " Tribology Handbook ", Newnes. Butter worth, Heinemann, U.K., 1995.

## **612MET11 - VIBRATION AND NOISE CONTROL (COMMON TO MECHANICAL AND AUTOMOBILE)**

### **OBJECTIVES:**

- The student will be able to understand the sources of vibration and noise in automobiles and make design modifications to reduce the vibration and noise and improve the life of the components

### **UNIT I BASICS OF VIBRATION**

Introduction, classification of vibration: free and forced vibration, undamped and damped vibration, linear and non linear vibration, response of damped and undamped systems under harmonic force, analysis of single degree and two degree of freedom systems, torsional vibration, determination of natural frequencies.

### **UNIT II BASICS OF NOISE**

Introduction, amplitude, frequency, wavelength and sound pressure level, addition, subtraction and averaging decibel levels, noise dose level, legislation, measurement and analysis of noise, measurement environment, equipment, frequency analysis, tracking analysis, sound quality analysis.

### **UNIT III AUTOMOTIVE NOISE SOURCES**

Noise Characteristics of engines, engine overall noise levels, assessment of combustion noise, assessment of mechanical noise, engine radiated noise, intake and exhaust noise, engine accessory contributed noise, transmission noise, aerodynamic noise, tyre noise, brake noise.

### **UNIT IV CONTROL TECHNIQUES**

Vibration isolation, tuned absorbers, untuned viscous dampers, damping treatments, application dynamic forces generated by IC engines, engine isolation, crank shaft damping, modal analysis of the mass elastic model shock absorbers.

### **UNIT V SOURCE OF NOISE AND CONTROL**

Methods for control of engine noise, combustion noise, mechanical noise, predictive analysis, palliative treatments and enclosures, automotive noise control principles, sound in enclosures, sound energy absorption, sound transmission through barriers.

### **TEXT BOOKS:**

1. Singiresu S.Rao - "Mechanical Vibrations" - Pearson Education, ISBN -81-297-0179-0 - 2004.
2. Kewal Pujara "Vibrations and Noise for Engineers", Dhanpat Rai & Sons, 1992.

### **REFERENCES:**

1. Bernard Challen and Rodica Baranescu - "Diesel Engine Reference Book" - Second edition - SAE International - ISBN 0-7680-0403-9 - 1999.
2. Julian Happian-Smith - "An Introduction to Modern Vehicle Design"- Butterworth-Heinemann, ISBN 0750-5044-3 - 2004
3. John Fenton - "Handbook of Automotive body Construction and Design Analysis - Professional Engineering Publishing, ISBN 1-86058-073- 1998.

## **612MET12 - UNCONVENTIONAL MANUFACTURING PROCESSES (COMMON TO MECHANICAL AND PRODUCTION)**

### **OBJECTIVE:**

- To learn about various unconventional machining processes, the various process parameters and their influence on performance and their applications

### **UNIT I INTRODUCTION**

Unconventional machining Process – Need – classification – Brief overview .

### **UNIT II MECHANICAL ENERGY BASED PROCESSES**

Abrasive Jet Machining – Water Jet Machining – Abrasive Water Jet Machining - Ultrasonic Machining. (AJM, WJM, AWJM and USM). Working Principles – equipment used – Process parameters – MRR-Variation in techniques used – Applications.

### **UNIT III ELECTRICAL ENERGY BASED PROCESSES**

Electric Discharge Machining (EDM)- working Principle-equipments-Process Parameters-Surface Finish and MRR- electrode / Tool – Power and control Circuits-Tool Wear – Dielectric – Flushing – Wire cut EDM – Applications.

### **UNIT IV CHEMICAL AND ELECTRO-CHEMICAL ENERGY BASED PROCESSES**

Chemical machining and Electro-Chemical machining (CHM and ECM)-Etchantsmaskant-techniques of applying maskants-Process Parameters – Surface finish and MRR-Applications. Principles of ECM-equipments-Surface Roughness and MRRElectrical circuit-Process Parameters-ECG and ECH - Applications.

### **UNIT V THERMAL ENERGY BASED PROCESSES**

Laser Beam machining and drilling (LBM), plasma arc machining (PAM) and Electron Beam Machining (EBM). Principles – Equipment –Types - Beam control techniques – Applications.

### **TEXT BOOK:**

1. Vijay.K. Jain "Advanced Machining Processes" Allied Publishers Pvt. Ltd., New Delhi, 2007

### **REFERENCES:**

1. Benedict. G.F. "Nontraditional Manufacturing Processes" Marcel Dekker Inc., New York (1987).
2. Pandey P.C. and Shan H.S. "Modern Machining Processes" Tata McGraw-Hill, New Delhi (2007).
3. Mc Geough, "Advanced Methods of Machining" Chapman and Hall, London (1998).
4. Paul De Garmo, J.T.Black, and Ronald.A.Kohser, "Material and Processes in Manufacturing" Prentice Hall of India Pvt. Ltd., New Delhi ,8th Edition,2001.

## 612MEP01 - THERMAL ENGINEERING LABORATORY - II

### LIST OF EXPERIMENTS

#### HEAT TRANSFER

1. Thermal conductivity measurement by guarded plate method
2. Thermal conductivity of pipe insulation using lagged pipe apparatus
3. Natural convection heat transfer from a vertical cylinder
4. Forced convection inside tube
5. Heat transfer from pin-fin (natural & forced convection modes)
6. Determination of Stefan-Boltzmann constant
7. Determination of emissivity of a grey surface
8. Effectiveness of parallel/counter flow heat exchanger

#### REFRIGERATION AND AIR CONDITIONING

1. Determination of COP of a refrigeration system
2. Experiments on air-conditioning system
3. Performance test on single/two stage reciprocating air compressor.

### LIST OF EQUIPMENT

(For a batch of 30 students)

- |  |         |
|--|---------|
| 1. 1. Guarded plate apparatus                        | - 1 No. |
| 2. 2. Lagged pipe apparatus                          | - 1 No. |
| 3. 3. Natural convection-vertical cylinder apparatus | - 1 No. |
| 4. 4. Forced convection inside tube apparatus        | - 1 No. |
| 5. 5. Pin-fin apparatus                              | - 1 No. |
| 6. 6. Stefan-Boltzmann apparatus                     | - 1 No. |
| 7. 7. Emissivity measurement apparatus               | - 1 No. |
| 8. 8. Parallel/counter flow heat exchanger apparatus | - 1 No. |
| 9. 9. Single/two stage reciprocating air compressor. | - 1 No. |
| 10. 10. Refrigeration test rig                       | - 1 No. |
| 11. 11. Air-conditioning test rig                    | - 1 No. |

**612MEP02 - DESIGN AND FABRICATION PROJECT  
(COMMON TO MECHANICAL AND PRODUCTION)**

The objective of this project is to provide opportunity for the students to implement their skills acquired in the previous semesters to practical problems. The students in convenient groups of not more than 4 members have to take one small item for design and fabrication. Every project work shall have a guide who is the member of the faculty of the institution and if possible with an industry guide also. The item chosen may be small machine elements (Example-screw jack, coupling, machine vice, cam and follower, governor etc), attachment to machine tools, tooling (jigs, fixtures etc), small gear box, automotive appliances, agricultural implements, simple heat exchangers, small pumps, hydraulic /pneumatic devices etc. The students are required to design and fabricate the chosen item in the college and demonstrate its working apart from submitting the project report. The report should contain assembly drawing, parts drawings, process charts relating to fabrication.

## **612MEP03 - COMMUNICATION SKILLS LABORATORY (Fifth / Sixth Semester)**

Globalisation has brought in numerous opportunities for the teeming millions, with more focus on the students' overall capability apart from academic competence. Many students, particularly those from non-English medium schools, find that they are not preferred due to their inadequacy of communication skills and soft skills, despite possessing sound knowledge in their subject area along with technical capability. Keeping in view their pre-employment needs and career requirements, this course on Communication Skills Laboratory will prepare students to adapt themselves with ease to the industry environment, thus rendering them as prospective assets to industries. The course will equip the students with the necessary communication skills that would go a long way in helping them in their profession.

### **OBJECTIVES:**

- To equip students of engineering and technology with effective speaking and listening skills in English.
- To help them develop their soft skills and interpersonal skills, which will make the transition from college to workplace smoother and help them excel in their job.
- To enhance the performance of students at Placement Interviews, Group Discussions and other recruitment exercises.

### **I. PC based session (Weightage 40%)**

#### **A. ENGLISH LANGUAGE LAB**

##### **1. LISTENING COMPREHENSION:**

Listening and typing – Listening and sequencing of sentences – Filling in the blanks - Listening and answering questions.

##### **2. READING COMPREHENSION:**

Filling in the blanks - Close exercises – Vocabulary building - Reading and answering questions.

##### **3. SPEAKING:**

Phonetics: Intonation – Ear training - Correct Pronunciation – Sound recognition exercises – Common Errors in English.

Conversations: Face to Face Conversation – Telephone conversation – Role play activities (Students take on roles and engage in conversation)

#### **B. DISCUSSION OF AUDIO-VISUAL MATERIALS (Samples are available to learn and practice)**

##### **1. RESUME / REPORT PREPARATION / LETTER WRITING**

Structuring the resume / report - Letter writing / Email Communication - Samples.

##### **2. PRESENTATION SKILLS:**

Elements of effective presentation – Structure of presentation – Presentation tools – Voice Modulation – Audience analysis - Body language – Video samples.

##### **3. SOFT SKILLS:**

Time management – Articulateness – Assertiveness – Psychometrics – Innovation and Creativity - Stress Management & Poise - Video Samples.

##### **4. GROUP DISCUSSION:**

Why is GD part of selection process ? - Structure of GD – Moderator – led and other GDs - Strategies in GD – Team work - Body Language - Mock GD –Video samples.

##### **5. INTERVIEW SKILLS:**

Kinds of interviews – Required Key Skills – Corporate culture – Mock interviews- Video samples.

## II. Practice Session (Weightage – 60%)

### 1. Resume / Report Preparation / Letter writing:

Students prepare their own resume and report.

### 2. Presentation Skills: Students make presentations on given topics.

### 3. Group Discussion: Students participate in group discussions.

### 4. Interview Skills: Students participate in Mock Interviews

## TEXT BOOKS

1. Anderson, P.V, **Technical Communication**, Thomson Wadsworth, Sixth Edition, New Delhi, 2007.
2. Prakash, P, **Verbal and Non-Verbal Reasoning**, Macmillan India Ltd., Second Edition, New Delhi, 2004.

## REFERENCES:

1. John Seely, The Oxford Guide to Writing and Speaking, Oxford University Press, New Delhi, 2004.
2. Evans, D, Decisionmaker, Cambridge University Press, 1997.
3. Thorpe, E, and Thorpe, S, Objective English, Pearson Education, Second Edition, New Delhi, 2007.
4. Turton, N.D and Heaton, J.B, Dictionary of Common Errors, Addison Wesley Longman Ltd., Indian reprint 1998.

## LAB REQUIREMENTS:

1. Teacher console and systems for students.
2. English Language Lab Software
3. Career Lab Software

### Requirement for a batch of 60 students

S. No.	Description of Equipment	Quantity required
1.	<b>Server</b>	1 No.
	PIV system	
	1 GB RAM / 40 GB HDD	
	OS: Win 2000 server	
	Audio card with headphones (with mike) JRE 1.3	
2.	Client Systems	60 No.
	<b>PIII or above</b>	
	<b>256 or 512 MB RAM / 40 GB HDD</b>	
	<b>OS: Win 2000</b>	
	Audio card with headphones (with mike) JRE 1.3	
3.	<b>Handicam Video Camera (with video lights and mic input)</b>	1 No.
4.	Television - 29"	1 No.
5.	Collar mike	1 No.
6.	Cordless mikes	1 No.
7.	Audio Mixer	1 No.
8.	DVD Recorder / Player	1 No.
9.	LCD Projector with MP3 /CD /DVD provision for audio / video facility - <b>Desirable</b>	1 No.

**SEVENTH SEMESTER  
712MET01 - TOTAL QUALITY MANAGEMENT**

**UNIT I INTRODUCTION**

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of manufacturing and service quality - Basic concepts of TQM - Definition of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM.

**UNIT II TQM PRINCIPLES**

Leadership - Strategic quality planning, Quality statements - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement - PDSA cycle, 5s, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.

**UNIT III TQM TOOLS & TECHNIQUES I**

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 & TECHNIQUES II**

Quality circles - Quality Function Deployment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Cost of Quality - Performance measures.

**UNIT V QUALITY SYSTEMS**

Need for ISO 9000- ISO 9000-2000 Quality System - Elements, Documentation, Quality auditing- QS 9000 - ISO 14000 - Concepts, Requirements and Benefits - Case studies of TQM implementation in manufacturing and service sectors including IT.

**TEXT BOOK:**

1. Dale H. Besterfield, et., "Total Quality Management", Pearson Education Asia, Third Edition, Indian Reprint (2006).

**REFERENCE BOOKS:**

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 6th Edition, South-Western (Thomson Learning), 2005.
2. Oakland, J.S. "TQM - Text with Cases", Butterworth - Heinemann Ltd., Oxford, 3<sup>rd</sup> Edition, 2003.
3. Suganthi, L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.
4. Janakiraman, B and Gopal, R.K, "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. L



**712MET02 - MECHATRONICS  
(COMMON TO MECHANICAL AND PRODUCTION- VI SEMESTER)**

**UNIT I MECHATRONICS, SENSORS AND TRANSDUCERS**

Introduction to Mechatronics Systems – Measurement Systems – Control Systems – Microprocessor based Controllers. Sensors and Transducers – Performance Terminology – Sensors for Displacement, Position and Proximity; Velocity, Motion, Force, Fluid Pressure, Liquid Flow, Liquid Level, Temperature, Light Sensors – Selection of Sensors.

**UNIT II ACTUATION SYSTEMS**

Pneumatic and Hydraulic Systems – Directional Control Valves – Rotary Actuators. Mechanical Actuation Systems – Cams – Gear Trains – Ratchet and pawl – Belt and Chain Drives – Bearings. Electrical Actuation Systems – Mechanical Switches – Solid State Switches – Solenoids – Construction and working principle of DC and AC Motors – speed control of AC and DC drives, Stepper Motors-switching circuitries for stepper motor – AC & DC Servo motors.

**UNIT III SYSTEM MODELS AND CONTROLLERS**

Building blocks of Mechanical, Electrical, Fluid and Thermal Systems, Rotational – Transnational Systems, Electromechanical Systems – Hydraulic – Mechanical Systems. Continuous and discrete process Controllers – Control Mode – Two – Step mode – Proportional Mode – Derivative Mode – Integral Mode – PID Controllers – Digital Controllers – Velocity Control – Adaptive Control – Digital Logic Control – Micro Processors Control.

**UNIT IV PROGRAMMING LOGIC CONTROLLERS**

Programmable Logic Controllers – Basic Structure – Input / Output Processing – Programming – Mnemonics – Timers, Internal relays and counters – Shift Registers – Master and Jump Controls – Data Handling – Analogs Input / Output – Selection of a PLC.

**UNIT V DESIGN OF MECHATRONICS SYSTEM**

Stages in designing Mechatronics Systems – Traditional and Mechatronic Design - Possible Design Solutions. Case studies of Mechatronics systems- Pick and place Robot- Autonomous mobile robot-Wireless surveillance balloon- Engine Management system- Automatic car park barrier.

**TEXT BOOKS:**

1. Bolton, W, "Mechatronics" , Pearson education, second edition, fifth Indian Reprint, 2003.
2. Smali, A and Mrad, F , "Mechatronics integrated technologies for intelligent machines", Oxford university press, 2008.

**REFERENCES:**

1. Rajput. R.K, A textbook of mechatronics, S. Chand & Co, 2007
2. Michael B. Hstand and David G. Alciatore, " Introduction to Mechatronics and Measurement Systems", McGraw-Hill International Editions, 2000.
3. Bradley D. A., Dawson D., Buru N.C. and. Loader A.J, "Mechatronics", Chapman and Hall, 1993.
4. Dan Neculescu, "Mechatronics", Pearson Education Asia, 2002 (Indian Reprint).
5. Lawrence J. Kamm, "Understanding Electro – Mechanical Engineering", An Introduction to Mechatronics, Prentice – Hall of India Pvt., Ltd., 2000.
6. Nitaigour Premchand Mahadik, "Mechatronics", Tata McGraw-Hill publishing Company Ltd, 2003

## 712MET03 - COMPUTER INTEGRATED MANUFACTURING

### OBJECTIVE:

- This course will enable the student
- To gain knowledge about the basic fundamental of CAD.
- To gain knowledge on how computers are integrated at various levels of planning and manufacturing understand computer aided planning and control and computer monitoring.

### UNIT I COMPUTER AIDED DESIGN

Concept of CAD as drafting and designing facility, desirable features of CAD package, drawing features in CAD – Scaling, rotation, translation, editing, dimensioning, labeling, Zoom, pan, redraw and regenerate, typical CAD command structure, wire frame modeling, surface modeling and solid modeling (concepts only) in relation to popular CAD packages.

### UNIT II COMPONENTS OF CIM

CIM as a concept and a technology, CASA/Sme model of CIM, CIM II, benefits of CIM, communication matrix in CIM, fundamentals of computer communication in CIM – CIM data transmission methods – serial, parallel, asynchronous, synchronous, modulation, demodulation, simplex and duplex. Types of communication in CIM – point to point (PTP), star and multiplexing. Computer networking in CIM – the seven layer OSI model, LAN model, MAP model, network topologies – star, ring and bus, advantages of networks in CIM.

### UNIT III GROUP TECHNOLOGY AND COMPUTER AIDED PROCESS PLANNING

History Of Group Technology – role of G.T in CAD/CAM Integration – part familiesclassification and coding – DCLASS and MCLASS and OPTIZ coding systems – facility design using G.T – benefits of G.T – cellular manufacturing.Process planning - role of process planning in CAD/CAM Integration – approaches to computer aided process planning – variant approach and generative approaches – CAPP and CMPP systems.

### UNIT IV SHOP FLOOR CONTROL AND INTRODUCTION TO FMS

shop floor control – phases – factory data collection system – automatic identification methods – Bar code technology – automated data collection system. FMS – components of FMS – types – FMS workstation – material handling and storage system –FMS layout-computer control systems – applications and benefits.

### UNIT V COMPUTER AIDED PLANNING AND CONTROL AND COMPUTER MONITORING

Production planning and control – cost planning and control – inventory management – material requirements planning (MRP) – shop floor control. Lean and Agile Manufacturing. Types of production monitoring systems – structure model of manufacturing – process control and strategies – direct digital control.

### TEXT BOOK:

1. Mikell. P. Groover "Automation, Production Systems and Computer Integrated Manufacturing", Pearson Education 2001.

### REFERENCES:

1. Mikell. P. Groover and Emory Zimmers Jr., "CAD/CAM", Prentice hall of India Pvt. Ltd., 1998.
2. James A. Regh and Henry W. Kreabber, "Computer Integrated Manufacturing", Pearson Education second edition, 2005.
3. Chris McMahan and Jimmie Browne, "CAD CAM Principles, Practice and Manufacturing Management", Pearson Education second edition, 2005.
4. Ranky, Paul G., "Computer Integrated Manufacturing", Prentice hall of India Pvt. 2005.
5. Yorem Koren, " Computer Integrated Manufacturing", McGraw Hill, 2005.
6. P N Rao, " CAD/CAM Principles and Applications", TMH Publications, 2007.

## 712MET04 - POWER PLANT ENGINEERING

### OBJECTIVE:

- To understand the various components , operations and applications of different types of power plants.

### UNIT I INTRODUCTION TO POWER PLANTS AND BOILERS

Layout of Steam , Hydel , Diesel , MHD, Nuclear and Gas turbine Power Plants Combined Power cycles – comparison and selection , Load duration Curves, Steam boilers and cycles – High pressure and Super Critical Boilers – Fluidised Bed Boilers.

### UNIT II STEAM POWER PLANT

Fuel and ash handling ,Combustion Equipment for burning coal, Mechanical Stokers. Pulveriser, Electrostatic Precipitator, Draught- Different Types, Surface condenser types, cooling Towers.

### UNIT III NUCLEAR AND HYDEL POWER PLANTS

Nuclear Energy-Fission , Fusion Reaction, Types of Reactors, Pressurized water reactor ,Boiling water reactor, Waste disposal and safety Hydel Power plant- Essential elements, Selection of turbines, governing of Turbines- Micro hydel developments.

### UNIT IV DIESEL AND GAS TURBINE POWER PLANTS

Types of diesel plants, components, Selection of Engine type, applications-Gas turbine power plant- Fuels- Gas turbine material – open and closed cycles- reheating – Regeneration and intercooling – combines cycle.

### UNIT V OTHER POWER PLANTS AND ECONOMICS OF POWER PLANTS

Geo thermal- OTEC- tidal- Pumped storage –Solar central receiver system Cost of electric Energy- Fixed and operating costs-Energy rates- Types tariffs- Economics of load sharing, comparison of various power plants.

### TEXT BOOKS:

1. Arora S.C and Domkundwar S, "A Course in Power Plant Engineering", Dhanpat Rai , 2001
2. Nag P.K , "Power Plant Engineering". Third edition Tata McGraw- Hill ,2007

### REFERENCES:

1. EI-Wakil M.M ,Power "Plant Technology," Tata McGraw-Hill 1984
2. K.K.Ramalingam , " Power Plant Engineering ", Scitech Publications, 2002
3. G.R,Nagpal , "Power Plant Engineering", Khanna Publishers 1998
4. G.D.Rai, "Introduction to Power Plant Technology" Khanna Publishers,1995

**ELECTIVE III & IV**  
**712MET05 - PROCESS PLANNING AND COST ESTIMATION**  
**(COMMON TO MECHANICAL AND PRODUCTION - CORE)**

**OBJECTIVE:**

- To introduce the process planning concepts to make cost estimation for various products after process planning.

**UNIT I WORK STUDY AND ERGONOMICS**

Method study – Definition – Objectives-Motion economy- Principles – Tools and Techniques- Applications – Work measurements- purpose – use – procedure – tools and techniques- Standard time –Ergonomics – principles – applications.

**UNIT II PROCESS PLANNING**

Definition – Objective – Scope – approaches to process planning- Process planning activities – Finished part requirements- operating sequences- machine selection – material selection parameters- Set of documents for process planning- Developing manufacturing logic and knowledge- production time calculation – selection of cost optimal processes.

**UNIT III INTRODUCTION TO COST ESTIMATION**

Objective of cost estimation- costing – cost accounting- classification of cost- Elements of cost.

**UNIT IV COST ESTIMATION**

Types of estimates – methods of estimates – data requirements and sources- collection of cost- allowances in estimation.

**UNIT V PRODUCTION COST ESTIMATION**

Estimation of material cost, labour cost and over heads, allocation of overheads – Estimation for different types of jobs.

**TEXT BOOKS:**

1. Sinha.B.P., "Mechanical Estimating and Costing", Tata McGraw-Hill, Publishing Co., 1995.

**REFERENCES:**

1. Phillip.F Ostwalal and Jairo Munez, "Manufacturing Processes and systems", John Wiley, 9th Edition, 1998
2. Russell.R.S and Tailor, B.W, "Operations Management", PHI, 4th Edition, 2003.
3. Chitale.A.V. and Gupta.R.C., "Product Design and Manufacturing", PHI, 2nd Edition, 2002.

**712MET06 - ROBOTICS  
(COMMON TO MECHANICAL, AUTOMOBILE AND PRODUCTION - CORE)**

**OBJECTIVES:**

- To understand the basic concepts associated with the design and functioning and applications of Robots To study about the drives and sensors used in Robots
- To learn about analyzing robot kinematics and robot programming

**UNIT I FUNDAMENTALS OF ROBOT**

Robot – Definition – Robot Anatomy – Co-ordinate Systems, Work Envelope, types and classification – Specifications – Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load – Robot Parts and Functions – Need for Robots – Different Applications.

**UNIT II ROBOT DRIVE SYSTEMS AND END EFFECTORS**

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

**UNIT III SENSORS AND MACHINE VISION**

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

**UNIT IV ROBOT KINEMATICS AND ROBOT PROGRAMMING**

Forward Kinematics, Inverse Kinematics and Differences; Forward Kinematics and Reverse Kinematics of Manipulators with Two, Three Degrees of Freedom (In 2 Dimensional), Four Degrees of Freedom (In 3 Dimensional) – Deviations and Problems. Teach Pendant Programming, Lead through programming, Robot programming Languages – VAL Programming – Motion Commands, Sensor Commands, End effector commands, and Simple programs.

**UNIT V IMPLEMENTATION AND ROBOT ECONOMICS**

RGV, AGV; Implementation of Robots in Industries – Various Steps; Safety Considerations for Robot Operations; Economic Analysis of Robots – Pay back Method, EUAC Method, Rate of Return Method.

**TEXT BOOK:**

1. M.P.Groover, "Industrial Robotics – Technology, Programming and Applications", McGraw-Hill, 2001

**REFERENCES:**

1. Fu.K.S. Gonzalz.R.C., and Lee C.S.G., "Robotics Control, Sensing, Vision and Intelligence", McGraw-Hill Book Co., 1987
2. Yoram Koren, "Robotics for Engineers", McGraw-Hill Book Co., 1992
3. Janakiraman.P.A., "Robotics and Image Processing", Tata McGraw-Hill, 1995

## 712MET07 - DESIGN OF JIGS, FIXTURES & PRESS TOOLS

### OBJECTIVES:

- To understand the functions and design principles of Jigs, fixtures and press tools
- To gain proficiency in the development of required views of the final design.

### UNIT I LOCATING AND CLAMPING PRINCIPLES:

Objectives of tool design- Function and advantages of Jigs and fixtures – Basic elements – principles of location – Locating methods and devices – Redundant Location – Principles of clamping – Mechanical actuation – pneumatic and hydraulic actuation Standard parts – Drill bushes and Jig buttons – Tolerances and materials used.

### UNIT II JIGS AND FIXTURES

Design and development of jigs and fixtures for given component- Types of Jigs – Post, Turnover, Channel, latch, box, pot, angular post jigs – Indexing jigs – General principles of milling, Lathe, boring, broaching and grinding fixtures – Assembly, Inspection and Welding fixtures – Modular fixturing systems- Quick change fixtures.

### UNIT III PRESS WORKING TERMINOLOGIES AND ELEMENTS OF CUTTING DIES

Press Working Terminologies - operations – Types of presses – press accessories – Computation of press capacity – Strip layout – Material Utilization – Shearing action – Clearances – Press Work Materials – Center of pressure- Design of various elements of dies – Die Block – Punch holder, Die set, guide plates – Stops – Strippers – Pilots – Selection of Standard parts – Design and preparation of four standard views of simple blanking, piercing, compound and progressive dies.

### UNIT IV BENDING FORMING AND DRAWING DIES

Difference between bending, forming and drawing – Blank development for above operations – Types of Bending dies – Press capacity – Spring back – knockouts – direct and indirect – pressure pads – Ejectors – Variables affecting Metal flow in drawing operations – draw die inserts – draw beads- ironing – Design and development of bending, forming, drawing reverse re-drawing and combination dies – Blank development for ax- symmetric, rectangular and elliptic parts – Single and double action dies.

### UNIT V MISCELLANEOUS TOPICS

Bulging, Swaging, Embossing, coining, curling, hole flanging, shaving and sizing, assembly, fine Blanking dies – recent trends in tool design- computer Aids for sheet metal forming Analysis – basic introduction - tooling for numerically controlled machines- setup reduction for work holding – Single minute exchange of dies – Poka Yoke - Course should be supplemented with visits to industries. (Use of Approved design Data Book permitted).

### TEXT BOOKS:

1. Joshi, P.H. "Jigs and Fixtures", Second Edition, Tata McGraw Hill Publishing Co., Ltd., New Delhi, 2004.
2. Donaldson, Lecain and Goold "Tool Design", III rd Edition Tata McGraw Hill, 2000.

### REFERENCES:

1. K. Venkataraman, "Design of Jigs Fixtures & Press Tools", Tata McGraw Hill, New Delhi, 2005.
2. Kempster, "Jigs and Fixture Design", Hoddes and Stoughton – Third Edition 1974.
3. Joshi, P.H. "Press Tools" – Design and Construction", Wheels publishing, 1996.
4. Hoffman "Jigs and Fixture Design" – Thomson Delmar Learning, Singapore, 2004.
5. ASTME Fundamentals of Tool Design Prentice Hall of India.
6. Design Data Hand Book, PSG College of Technology, Coimbatore.

## 712MET08 - COMPOSITE MATERIALS

### OBJECTIVES:

- To understand the fundamentals of composite material strength and its mechanical behavior Understanding the analysis of fiber reinforced Laminate design for different combinations of plies with different orientations of the fiber.
- Thermo-mechanical behavior and study of residual stresses in Laminates during processing. Implementation of Classical Laminate Theory (CLT) to study and analysis for residual stresses in an isotropic layered structure such as electronic chips.

### UNIT I INTRODUCTION, LAMINA CONSTITUTIVE EQUATIONS & MANUFACTURING

Definition –Need – General Characteristics, Applications. Fibers – Glass, Carbon, Ceramic and Aramid fibers. Matrices – Polymer, Graphite, Ceramic and Metal Matrices – Characteristics of fibers and matrices. Lamina Constitutive Equations: Lamina Assumptions – Macroscopic Viewpoint. Generalized Hooke's Law. Reduction to Homogeneous Orthotropic Lamina – Isotropic limit case, Orthotropic Stiffness matrix ( $Q_{ij}$ ), Typical Commercial material properties, Rule of Mixtures. Generally Orthotropic Lamina –Transformation Matrix, Transformed Stiffness. Manufacturing: Bag Moulding – Compression Moulding – Pultrusion – Filament Winding – Other Manufacturing Processes.

### UNIT II FLAT PLATE LAMINATE CONSTITUTE EQUATIONS

Definition of stress and Moment Resultants. Strain Displacement relations. Basic Assumptions of Laminated anisotropic plates. Laminate Constitutive Equations – Coupling Interactions, Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates. Laminate Structural Moduli. Evaluation of Lamina Properties from Laminate Tests. Quasi-Isotropic Laminates. Determination of Lamina stresses within Laminates.

### UNIT III LAMINA STRENGTH ANALYSIS

Introduction - Maximum Stress and Strain Criteria. Von-Misses Yield criterion for Isotropic Materials. Generalized Hill's Criterion for Anisotropic materials. Tsai-Hill's Failure Criterion for Composites. Tensor Polynomial (Tsai-Wu) Failure criterion. Prediction of laminate Failure.

### UNIT IV THERMAL ANALYSIS

Assumption of Constant C.T.E's. Modification of Hooke's Law. Modification of Laminate Constitutive Equations. Orthotropic Lamina C.T.E's. C.T.E's for special Laminate Configurations – Unidirectional, Off-axis, Symmetric Balanced Laminates, Zero C.T.E laminates, Thermally Quasi-Isotropic Laminates.

### UNIT V ANALYSIS OF LAMINATED FLAT PLATES

Equilibrium Equations of Motion. Energy Formulations. Static Bending Analysis. Buckling Analysis. Free Vibrations – Natural Frequencies.

### TEXT BOOK:

1. Gibson, R.F., Principles of Composite Material Mechanics, McGraw-Hill, 1994, Second Edition - CRC press in progress.
2. Hyer, M.W., "Stress Analysis of Fiber – Reinforced Composite Materials", McGraw-Hill, 1998.

### REFERENCES:

1. Issac M. Daniel and Ori Ishai, "Engineering Mechanics of Composite Materials", Oxford University Press-2006, First Indian Edition - 2007
2. Mallick, P.K., Fiber –"Reinforced Composites: Materials, Manufacturing and Design", Maneel Dekker Inc, 1993.
3. Halpin, J.C., "Primer on Composite Materials, Analysis", Techomic Publishing Co., 1984.
4. Agarwal, B.D., and Broutman L.J., "Analysis and Performance of Fiber Composites", John Wiley and Sons, New York, 1990.
5. Mallick, P.K. and Newman, S., (edition), "Composite Materials Technology: Processes and Properties", Hansen Publisher, Munish, 1990.

## **712MET09 - THERMAL TURBOMACHINES**

### **AIM:**

To instruct the importance of the principles of various turbomachines.

### **OBJECTIVE:**

To understand the various systems, principles, operations and applications of different types of turbo machinery components.

### **UNIT I PRINCIPLES**

Energy transfer between fluid and rotor-classification of fluid machinery,-dimensionless parameters-specific speed-applications-stage velocity triangles-work and efficiency.

### **UNIT II CENTRIFUGAL FANS AND BLOWERS**

Types- stage and design parameters-flow analysis in impeller blades-volute and diffusers, losses, characteristic curves and selection, fan drives and fan noise.

### **UNIT III CENTRIFUGAL COMPRESSOR**

Construction details, impeller flow losses, slip factor, diffuser analysis, losses and performance curves.

### **UNIT IV AXIAL FLOW COMPRESSOR**

Stage velocity diagrams, enthalpy-entropy diagrams, stage losses and efficiency, work done simple stage design problems and performance characteristics.

### **UNIT V AXIAL AND RADIAL FLOW TURBINES**

Stage velocity diagrams, reaction stages, losses and coefficients, blade design principles, testing and performance characteristics.

### **TEXT BOOK:**

1. Yahya, S.H., Turbines, Compressors and Fans, Tata McGraw-Hill Publishing Company, 1996.

### **REFERENCES:**

1. Bruneck, Fans, Pergamom Press, 1973.
2. Earl Logan, Jr., Hand book of Turbomachinery, Marcel Dekker Inc., 1992.
3. Dixon, S.I., Fluid Mechanics and Thermodynamics of Turbomachinery, Pergamon Press, 1990.
4. Shepherd, D.G., Principles of Turbomachinery, Macmillan, 1969.
5. Stepanpff, A.J., Blowers and Pumps, John Wiley and Sons Inc. 1965.
6. Ganesan, V., Gas Turbines, Tata McGraw Hill Pub. Co., 1999.
7. Gopalakrishnan .G and Prithvi Raj .D, A Treatise on Turbomachines, Scifech Publications (India) Pvt. Ltd., 2002.



## 712MET10 - COMPUTATIONAL FLUID DYNAMICS

### AIM:

To impart the knowledge of numerical techniques to the solution of fluid dynamics and heat transfer problems.

### OBJECTIVE:

- To introduce Governing Equations of viscous fluid flows
- To introduce numerical modeling and its role in the field of fluid flow and heat transfer
- To enable the students to understand the various discretization methods, solution procedures and turbulence modeling.
- To create confidence to solve complex problems in the field of fluid flow and heat transfer by using high speed computers.

### PREREQUISITE:

Fundamental Knowledge of partial differential equations, Heat Transfer and Fluid Mechanics.

### UNIT I GOVERNING EQUATIONS AND BOUNDARY CONDITIONS

Basics of computational fluid dynamics – Governing equations of fluid dynamics – Continuity, Momentum and Energy equations – Chemical species transport – Physical boundary conditions – Time-averaged equations for Turbulent Flow – Turbulent-Kinetic Energy Equations – Mathematical behaviour of PDEs on CFD - Elliptic, Parabolic and Hyperbolic equations.

### UNIT II FINITE DIFFERENCE METHOD

Derivation of finite difference equations – Simple Methods – General Methods for first and second order accuracy – solution methods for finite difference equations – Elliptic equations – Iterative solution Methods – Parabolic equations – Explicit and Implicit schemes – Example problems on elliptic and parabolic equations.

### UNIT III FINITE VOLUME METHOD (FVM) FOR DIFFUSION

Finite volume formulation for steady state One, Two and Three -dimensional diffusion problems. One dimensional unsteady heat conduction through Explicit, Crank – Nicolson and fully implicit schemes.

### UNIT IV FINITE VOLUME METHOD FOR CONVECTION DIFFUSION

Steady one-dimensional convection and diffusion – Central, upwind differencing schemes-properties of discretization schemes – Conservativeness, Boundedness, Transportiveness, Hybrid, Power-law, QUICK Schemes.

### UNIT V CALCULATION FLOW FIELD BY FVM

Representation of the pressure gradient term and continuity equation – Staggered grid – Momentum equations – Pressure and Velocity corrections – Pressure Correction equation, SIMPLE algorithm and its variants. Turbulence models, mixing length model, Two equation (k- $\epsilon$ ) models – High and low Reynolds number models

### TEXT BOOKS:

1. T.J. Chung, Computational Fluid Dynamics, Cambridge University, Press, 2002.
2. Versteeg, H.K., and Malalasekera, W., An Introduction to Computational Fluid Dynamics: The finite volume Method, Longman, 1998.
3. Ghoshdastidar, P.S., computer Simulation of flow and heat transfer, Tata McGraw Hill Publishing Company Ltd., 1998.

### REFERENCES:

1. Patankar, S.V. Numerical Heat Transfer and Fluid Flow, Hemisphere Publishing Corporation, 2004.
2. Muralidhar, K., and Sundararajan, T., computational Fluid Flow and Heat Transfer, Narosa Publishing House, NewDelhi, 1995.
3. Ghoshdastidar P.S., Heat Transfer, Oxford University Press, 2005.
4. Prodip Niyogi, Chakrabarty .S.K., Laha .M.K. Introduction to Computational Fluid Dynamics, Pearson Education, 2005.
5. Introduction to Computational Fluid Dynamics Anil W. Date Cambridge University

## **712MET11 - NUCLEAR ENGINEERING**

### **OBJECTIVE**

To gain some fundamental knowledge about nuclear physics, nuclear reactor, nuclear fuels, reactors and safe disposal of nuclear wastes.

### **UNIT I NUCLEAR PHYSICS**

Nuclear model of an atom-Equivalence of mass and energy-binding- radio activity-half life-neutron interactions-cross sections.

### **UNIT II NUCLEAR REACTIONS AND REACTION MATERIALS**

Mechanism of nuclear fission and fusion- radio activity- chain reactions-critical mass and composition-nuclear fuel cycles and its characteristics-uranium production and purification-Zirconium, thorium, beryllium.

### **UNIT III REPROCESSING**

Reprocessing: nuclear fuel cycles-spent fuel characteristics-role of solvent extraction in reprocessing-solvent extraction equipment.

### **UNIT IV NUCLEAR REACTOR**

Nuclear reactors: types of fast breeding reactors-design and construction of fast breeding reactors-heat transfer techniques in nuclear reactors- reactor shielding. Fusion reactors.

### **UNIT V SAFETY AND DISPOSAL**

Safety and disposal: Nuclear plant safety-safety systems-changes and consequences of accident-criteria for safety-nuclear waste-types of waste and its disposal-radiation hazards and their prevention-weapons proliferation.

### **TEXT BOOKS**

1. Thomas J.Cannoly, "Fundamentals of nuclear Engineering" John Wiley 1978.

### **REFERENCES**

1. Collier J.G., and Hewitt G.F, "Introduction to Nuclear power", Hemisphere publishing, New York. 1987
2. Wakil M.M.El., "Power Plant Technology" – McGraw-Hill International, 1984.

## **712MEP01 - COMPUTER AIDED SIMULATION AND ANALYSIS LABORATORY**

### **LIST OF EXPERIMENTS**

#### **A. SIMULATION**

1. Simulation of Air conditioning system with condenser temperature and evaporator temperatures as input to get COP using C /MAT Lab.
2. Simulation of Hydraulic / Pneumatic cylinder using C / MAT Lab.
3. Simulation of cam and follower mechanism using C / MAT Lab.

#### **B. ANALYSIS (SIMPLE TREATMENT ONLY)**

1. Stress analysis of a plate with a circular hole.
2. Stress analysis of rectangular L bracket
3. Stress analysis of an axi-symmetric component
4. Stress analysis of beams (Cantilever, Simply supported, Fixed ends)
5. Mode frequency analysis of a 2 D component
6. Mode frequency analysis of beams (Cantilever, Simply supported, Fixed ends)
7. Harmonic analysis of a 2D component
8. Thermal stress analysis of a 2D component
9. Conductive heat transfer analysis of a 2D component
10. Convective heat transfer analysis of a 2D component

### **LIST OF EQUIPMENTS**

(For a batch of 30 students)

1. Computer System 30
2. 17" VGA Color Monitor
3. Pentium IV Processor
4. 40 GB HDD
5. 512 MB RAM
6. Color Desk Jet Printer 01
7. Software
8. Suitable analysis software 30 licenses
9. C / MATLAB 5 licenses.

**712MEP02 - MECHATRONICS LABORATORY  
(COMMON TO MECHANICAL AND PRODUCTION VI SEMESTER)**

**LIST OF EXPERIMENTS**

1. Design and testing of fluid power circuits to control
  - (i) velocity
  - (ii) direction and
  - (iii) force of single and double acting actuators
2. Design of circuits with logic sequence using Electro pneumatic trainer kits.
3. Simulation of basic Hydraulic, Pneumatic and Electric circuits using software
4. Circuits with multiple cylinder sequences in Electro pneumatic using PLC
5. Speed Control of AC & DC drives
6. Servo controller interfacing for DC motor
7. PID controller interfacing
8. Stepper motor interfacing with 8051 Micro controller
  - (i) full step resolution
  - (ii) half step resolution
9. Modeling and analysis of basic electrical, hydraulic and pneumatic systems using LAB VIEW.
10. Computerized data logging system with control for process variables like pressure flow and temperature.

**TOTAL: 45 PERIODS**

**LIST OF EQUIPMENT**

(For a batch of 30 students)

1. Basic Pneumatic Trainer Kit with manual and electrical controls/  
PLC Control each - 1 No.
2. Basic Hydraulic Trainer Kit - 1 No.
3. Hydraulics and Pneumatics Systems Simulation Software /  
Automation studio sets - 10 No
4. 8051 - Microcontroller kit with stepper motor and drive circuit sets - 2 No.
5. LAB VIEW software with Sensors to measure Pressure,  
Flow rate, direction, speed, velocity and force.seats - 2 No.

## **EIGHTH SEMESTER**

### **812MET01 - ENGINEERING ECONOMICS AND COST ANALYSIS (COMMON TO MECHANICAL, PRODUCTION, AUTOMOBILE)**

#### **OBJECTIVES:**

To learn about the basics of economics and cost analysis related to engineering so as to take economically sound decisions.

#### **UNIT I INTRODUCTION TO ECONOMICS**

Introduction to Economics- Flow in an economy, Law of supply and demand, Concept of Engineering Economics – Engineering efficiency, Economic efficiency, Scope of engineering economics- Element of costs, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost, Break-even analysis- V ratio, Elementary economic Analysis – Material selection for product Design selection for a product, Process planning.

#### **UNIT II VALUE ENGINEERING**

Make or buy decision, Value engineering – Function, aims, Value engineering procedure. Interest formulae and their applications –Time value of money, Single payment compound amount factor, Single payment present worth factor, Equal payment series sinking fund factor, Equal payment series payment Present worth factor- equal payment series capital recovery factor-Uniform gradient series annual equivalent factor, Effective interest rate, Examples in all the methods.

#### **UNIT III CASH FLOW**

Methods of comparison of alternatives – present worth method (Revenue dominated cash flow diagram), Future worth method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), Annual equivalent method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), rate of return method, Examples in all the methods.

#### **UNIT IV REPLACEMENT AND MAINTENANCE ANALYSIS**

Replacement and Maintenance analysis – Types of maintenance, types of replacement problem, determination of economic life of an asset, Replacement of an asset with a new asset – capital recovery with return and concept of challenger and defender, Simple probabilistic model for items which fail completely.

#### **UNIT V DEPRECIATION**

Depreciation- Introduction, Straight line method of depreciation, declining balance method of depreciation-Sum of the years digits method of depreciation, sinking fund method of depreciation/ Annuity method of depreciation, service output method of depreciation- Evaluation of public alternatives- introduction, Examples, Inflation adjusted decisions – procedure to adjust inflation, Examples on comparison of alternatives and determination of economic life of asset.

#### **TEXT BOOKS:**

1. Panneer Selvam, R, "Engineering Economics", Prentice Hall of India Ltd, New Delhi, 2001.
2. Suma Damodaran, " Managerial economics", Oxford university press 2006.

#### **REFERENCES:**

1. Chan S.Park, "Contemporary Engineering Economics", Prentice Hall of India, 2002.
2. Donald.G. Newman, Jerome.P.Lavelle, "Engineering Economics and analysis" Engg. Press, Texas, 2002
3. Degarmo, E.P., Sullivan, W.G and Canada, J.R, "Engineering Economy", Macmillan, New York, 1984
4. Grant.E.L., Ireson.W.G., and Leavenworth, R.S, "Principles of Engineering Economy", Ronald Press, New York,1976.
5. Smith, G.W., "Engineering Economy", Iowa State Press, Iowa, 1973.
6. Truett & Truett, " Managerial economics- Analysis, problems & cases " Wiley India 8<sup>th</sup> edition 2004.
7. Luke M Froeb / Brian T Mccann, " Managerial Economics – A problem solving approach" Thomson learning 2007.

**ELECTIVE V & VI**  
**812MET02 - PROFESSIONAL ETHICS IN ENGINEERING**

**UNIT I ENGINEERING ETHICS**

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Professions and Professionalism – Professional Ideals and Virtues – Uses of Ethical Theories.

**UNIT II ENGINEERING AS SOCIAL EXPERIMENTATION**

Engineering as Experimentation – Engineers as responsible Experimenters – Research Ethics – Codes of Ethics – Industrial Standards – A Balanced Outlook on Law – The Challenger Case Study.

**UNIT III ENGINEER'S RESPONSIBILITY FOR SAFETY**

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis – Reducing Risk – The Government Regulator's Approach to Risk – Chernobyl Case Studies and Bhopal.

**UNIT IV RESPONSIBILITIES AND RIGHTS**

Collegiality and Loyalty – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

**UNIT V GLOBAL ISSUES**

Multinational Corporations – Business Ethics – Environmental Ethics – Computer Ethics – Role in Technological Development – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Honesty – Moral Leadership – Sample Code of Conduct.

**TEXT BOOKS:**

1. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw Hill, New York (2005).
2. Charles E Harris, Michael S Pritchard and Michael J Rabins, "Engineering Ethics – Concepts and Cases", Thompson Learning, (2000).

**REFERENCES:**

1. Charles D Fleddermann, "Engineering Ethics", Prentice Hall, New Mexico, (1999).
2. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, (2003)
3. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, (2001).
4. Prof. (Col) P S Bajaj and Dr. Raj Agrawal, "Business Ethics – An Indian Perspective", Biztantra, New Delhi, (2004)
5. David Ermann and Michele S Shauf, "Computers, Ethics and Society", Oxford University Press, (2003).

## 812MET03 - FUNDAMENTALS OF NANOSCIENCE

### UNIT I INTRODUCTION

Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nanostructured materials- nano particles- quantum dots, nanowires-ultra-thinfilms-multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

### UNIT II PREPARATION METHODS

Bottom-up Synthesis-Top-down Approach: Precipitation, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

### UNIT III PATTERNING AND LITHOGRAPHY FOR NANOSCALE DEVICES

Introduction to optical/UV electron beam and X-ray Lithography systems and processes, Wet etching, dry (Plasma /reactive ion) etching, Etch resists-dip pen lithography.

### UNIT IV PREPARATION ENVIRONMENTS

Clean rooms: specifications and design, air and water purity, requirements for particular processes, Vibration free environments: Services and facilities required. Working practices, sample cleaning, Chemical purification, chemical and biological contamination, Safety issues, flammable and toxic hazards, biohazards.

### UNIT V CHARACTERISATION TECHNIQUES

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA, SIMS-Nanoindentation.

### TEXT BOOKS:

1. A.S. Edelstein and R.C. Cammearata, eds., "Nanomaterials: Synthesis, Properties and Applications", Institute of Physics Publishing, Bristol and Philadelphia, 1996.
2. N John Dinardo, "Nanoscale charecterisation of surfaces & Interfaces", 2nd Edition, Weinheim Cambridge, Wiley-VCH, 2000

### REFERENCES:

1. G Timp (Editor), "Nanotechnology", AIP press/Springer, 1999
2. Akhlesh Lakhtakia (Editor), "The Hand Book of Nano Technology, Nanometer Structure", Theory, Modeling and Simulations", Prentice-Hall of India (P) Ltd, New Delhi, 2007.

## **812MET04 - ENTREPRENEURSHIP DEVELOPMENT** (COMMON TO ALL BRANCHES)

### **OBJECTIVE:**

- Study of this subject provides an understanding of the scope of an entrepreneur, key areas of development, financial assistance by the institutions, methods of taxation and tax benefits, etc.

### **UNIT I ENTREPRENEURSHIP**

Entrepreneur – Types of Entrepreneurs – Difference between Entrepreneur and Intrapreneur – Entrepreneurship in Economic Growth, Factors Affecting Entrepreneurial Growth.

### **UNIT II MOTIVATION**

Major Motives Influencing an Entrepreneur – Achievement Motivation Training, self Rating, Business Game, Thematic Apperception Test – Stress management, Entrepreneurship Development Programs – Need, Objectives.

### **UNIT III BUSINESS**

Small Enterprises – Definition, Classification – Characteristics, Ownership Structures – Project Formulation – Steps involved in setting up a Business – identifying, selecting a Good Business opportunity, Market Survey and Research, Techno Economic Feasibility Assessment – Preparation of Preliminary Project Reports – Project Appraisal – Sources of Information – Classification of Needs and Agencies.

### **UNIT IV FINANCING AND ACCOUNTING**

Need – Sources of Finance, Term Loans, Capital Structure, Financial Institution, management of working Capital, Costing, Break Even Analysis, Network Analysis Techniques of PERT/CPM – Taxation – Income Tax, Excise Duty – Sales Tax.

### **UNIT V SUPPORT TO ENTREPRENEURS**

Sickness in small Business – Concept, Magnitude, causes and consequences, Corrective Measures – Government Policy for Small Scale Enterprises – Growth Strategies in small industry – Expansion, Diversification, Joint Venture, Merger and Sub Contracting.

### **TEXT BOOKS:**

1. S.S.Khanka "Entrepreneurial Development" S.Chand & Co. Ltd. Ram Nagar New Delhi, 1999.
2. Kuratko & Hodgetts, "Enterprenuership – Theory, process and practices", Thomson learning 6th edition.

### **REFERENCES:**

1. Hisrich R D and Peters M P, "Entrepreneurship" 5th Edition Tata McGraw-Hill, 2002.
2. Mathew J Manimala," Enterprenuership theory at cross roads: paradigms and praxis" Dream tech 2nd edition 2006.
3. Rabindra N. Kanungo "Entrepreneurship and innovation", Sage Publications, New Delhi, 1998.
4. EDII " Faulty and External Experts – A Hand Book for New Entrepreneurs Publishers: Entrepreneurship Development" Institute of India, Ahmadabad, 1986.



## **812MET05 - PRODUCTION PLANNING AND CONTROL**

### **OBJECTIVE:**

- To understand the various components and functions of production planning and control such as work study, product planning, process planning, production scheduling, Inventory Control.
- To know the recent trends like manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).
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### **UNIT I INTRODUCTION**

Objectives and benefits of planning and control-Functions of production control-Types of production-job- batch and continuous-Product development and design-Marketing aspect - Functional aspects-Operational aspect-Durability and dependability aspectaesthetic aspect. Profit consideration-Standardization, Simplification & specialization- Break even analysis-Economics of a new design.

### **UNIT II WORK STUDY**

Method study, basic procedure-Selection-Recording of process - Critical analysis, Development - Implementation - Micro motion and memo motion study - work measurement - Techniques of work measurement - Time study - Production study - Work sampling - Synthesis from standard data - Predetermined motion time standards.

### **UNIT III PRODUCT PLANNING AND PROCESS PLANNING**

Product planning-Extending the original product information-Value analysis-Problems in lack of product planning-Process planning and routing-Pre requisite information needed for process planning-Steps in process planning-Quantity determination in batch production-Machine capacity, balancing-Analysis of process capabilities in a multi product system.

### **UNIT IV PRODUCTION SCHEDULING**

Production Control Systems-Loading and scheduling-Master Scheduling-Scheduling rules-Gantt charts-Perpetual loading-Basic scheduling problems - Line of balance - Flow production scheduling-Batch production scheduling-Product sequencing - Production Control systems-Periodic batch control-Material requirement planning kanban - Dispatching-Progress reporting and expediting-Manufacturing lead time-Techniques for aligning completion times and due dates.

### **UNIT V INVENTORY CONTROL AND RECENT TRENDS IN PPC**

Inventory control-Purpose of holding stock-Effect of demand on inventories-Ordering procedures. Two bin system -Ordering cycle system-Determination of Economic order quantity and economic lot size-ABC analysis-Recorder procedure-Introduction to computer integrated production planning systems-elements of JUST IN TIME SYSTEMS-Fundamentals of MRP II and ERP.

### **TEXT BOOK:**

1. Martand Telsang, "Industrial Engineering and Production Management", S. Chand and Company, First edition, 2000.
2. James.B.Dilworth,"Operations management - Design, Planning and Control for manufacturing and services" Mcgraw Hill International edition1992.

**REFERENCES:**

1. Samson Eilon, "Elements of production planning and control", Universal Book Corpn.1984
2. Elwood S.Buffa, and Rakesh K.Sarin, "Modern Production / Operations Management", 8th Ed. John Wiley and Sons, 2000.
3. Kanishka Bedi, " Production and Operations management", Oxford university press, 2nd Edition 2007.
4. Melynk, Denzler, " Operations management – A value driven approach" Irwin Mcgrawhill.
5. Norman Gaither, G. Frazier, " operations management" Thomson learning 9th edition IE, 2007
6. K.C.Jain & L.N. Aggarwal, "Production Planning Control and Industrial Management", Khanna Publishers, 1990.
7. S.N.Chary, "Theory and Problems in Production & Operations Management", Tata McGraw Hill, 1995.
8. Upendra Kachru, " Production and operations management – Text and cases" Excel books 1st edition 2007.

**812MET06 - MAINTENANCE ENGINEERING  
(COMMON TO MECHANICAL AND PRODUCTION)**

**OBJECTIVES:**

- To enable the student to understand the principles, functions and practices adapted in industry for the successful management of maintenance activities.
- To explain the different maintenance categories like Preventive maintenance, condition monitoring and repair of machine elements.
- To illustrate some of the simple instruments used for condition monitoring in industry.

**UNIT I PRINCIPLES AND PRACTICES OF MAINTENANCE PLANNING**

Basic Principles of maintenance planning – Objectives and principles of planned maintenance activity – Importance and benefits of sound Maintenance systems – Reliability and machine availability – MTBF, MTTR and MWT – Factors of availability – Maintenance organization – Maintenance economics.

**UNIT II MAINTENANCE POLICIES – PREVENTIVE MAINTENANCE**

Maintenance categories – Comparative merits of each category – Preventive maintenance, maintenance schedules, repair cycle - Principles and methods of lubrication – TPM.

**UNIT III CONDITION MONITORING**

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**

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**

Repair methods for Material handling equipment - Equipment records –Job order systems -Use of computers in maintenance.

**TEXT BOOKS:**

1. Srivastava S.K., "Industrial Maintenance Management", - S. Chand and Co., 1981
2. Bhattacharya S.N., "Installation, Servicing and Maintenance", S. Chand and Co., 1995.

**REFERENCES:**

1. White E.N., "Maintenance Planning", I Documentation, Gower Press, 1979.
2. Garg M.R., "Industrial Maintenance", S. Chand & Co., 1986.
3. Higgins L.R., "Maintenance Engineering Hand book", McGraw Hill, 5th Edition, 1988.
3. Armstrong, "Condition Monitoring", BSIRSA, 1988.
4. Davies, "Handbook of Condition Monitoring", Chapman &Hall, 1996.
5. "Advances in Plant Engineering and Management", Seminar Proceedings - IIPE, 1996.

**812MET07 - OPERATIONS RESEARCH  
(COMMON TO MECHANICAL, METALLURGY, AUTOMOBILE & MECHATRONICS)**

**OBJECTIVE:**

- To create awareness about optimisation in utilization of resources.
- To understand and apply operations research techniques to industrial operations.

**UNIT I LINEAR MODEL**

The phases of OR study – formation of an L.P model- graphical solution – simplex algorithm – artificial variables technique– Big M method, two phase method, Duality in LPP. Transportation problems- VAM – MODI technique, Assignment problems.

**UNIT II NETWORK MODELS**

Shortest route – minimal spanning tree - maximum flow models – project network- CPM and PERT network-critical path scheduling.

**UNIT II INVENTORY MODEL**

Types of Inventory- EOQ –ERL- Deterministic inventory problems – Price breaks - Stochastic inventory problems- selective inventory control techniques.

**UNIT II REPLACEMENT MODELS**

Replacement of items that deteriorate with time – value of money changing with time – not charging with time – optimum replacement policy – individual and group replacement. Sequencing problem: models with n jobs with 2 machines – problem with n jobs with m machines.

**UNIT III QUEUING THEORY**

Queuing models – queuing systems and structures – notation –parameter – single server and multiserver models – Poisson input – exponential service – constant rate service – infinite population.

**TEXT BOOK:**

1. Wayne.L.Winston, Operations research applications and algorithms, Thomson learning,4th edition 2007.
2. Taha H.A, "Operation Research", Pearson Education, sixth edition, 2003

**REFERENCES:**

1. Frederick.S.Hiller and Gerald.J.Lieberman, "Operations research concepts and cases", TMH (SIE) 8th edition.
2. J.K.Sharma, "Operations research theory and applications", Macmillan India .3rd edition 2007,
3. Hira and Gupta " Problems in Operations Research", S.Chand and Co,2002.
4. Panneerselvam, "Operations Research" Prentice Hall of India, 2003.
5. G Srinivasan, "Operations research principles and applications", PHI (EEE) 2007.
6. Wagner, "Operations Research", Prentice Hall of India, 2000.

## **812MET08 - DESIGN OF PRESSURE VESSELS AND PIPING**

### **AIM:**

- To give exposure to various types of process equipments and their design.

### **OBJECTIVES:**

- To understand the different types of stresses and their effects in pressure vessel.
- To understand the piping layout and the stresses acting on it.

### **UNIT I CYLINDRICAL SHELL AND VARIOUS CLOSURES**

Membrane theory for thin shells, stresses in cylindrical, spherical and conical shells, dilation of above shells, general theory of membrane stresses in vessel under internal pressure and its application to ellipsoidal and torispherical end closures. Bending of circular plates and determination of stresses in simply supported and clamped circular plate. Introduction to ASME code and formulae.

### **UNIT II JUNCTION STRESSES, OPENING AND REINFORCEMENTS**

Discontinuity stresses. Stress concentration in plate having circular hole due to bi-axial loading. Theory of reinforced opening and reinforcement limits.

### **UNIT III SUPPORT DESIGN**

Supports for vertical & horizontal vessels. Design of base plate and support lugs. Types of anchor bolt, its material and allowable stresses. Design of saddle supports.

### **UNIT IV BUCKLING IN VESSELS**

Buckling of vessels under external pressure. Elastic buckling of long cylinders, buckling modes, Collapse under external pressure. Design for stiffening rings. Buckling under combined external pressure and axial loading.

### **UNIT V PIPING STRESS ANALYSIS**

Flow diagram, Piping layout and piping stress analysis. Flexibility factor and stress intensification factor. Design of piping system as per B31.1 piping code. Piping components – bends, tees, bellows and valves. Types of piping supports and their behaviour.

### **TEXT BOOKS:**

1. Harvey J F , 'Pressure vessel design' CBS publication
2. Brownell. L. E & Young. E. D , 'Process equipment design', Wiley Eastern Ltd., India.

### **REFERENCES:**

1. ASME Pressure Vessel and Boiler code, Section VIII Div 1 & 2, 2003
2. American standard code for pressure piping , B 31.1
3. Henry H Bednar, Pressure vessel Design Hand book,CBS publishers and Distributors.
4. Stanley M Wales, Chemical Process equipment, selection and design, Butterworths, series in Chemical Engineering,1988
5. William.j.,Bees,"Approximate methods in the Design and Analysis of pressure vessels and piping", ASME Pressure vessels and piping conference,1997.

## **812MET09 - ADVANCED I.C.ENGINES**

### **UNIT I SPARK IGNITION ENGINES**

Air-fuel ratio requirements, Design of carburetor –fuel jet size and venture size, Stages of combustion-normal and abnormal combustion, Factors affecting knock, Combustion chambers, Introduction to thermodynamic analysis of SI Engine combustion process.

### **UNIT II COMPRESSION IGNITION ENGINES**

Stages of combustion-normal and abnormal combustion – Factors affecting knock, Direct and Indirect injection systems, Combustion chambers, Turbo charging , Introduction to Thermodynamic Analysis of CI Engine Combustion process.

### **UNIT III ENGINE EXHAUST EMISSION CONTROL**

Formation of NOX , HC/CO mechanism , Smoke and Particulate emissions, Green House Effect , Methods of controlling emissions , Three way catalytic converter and Particulate Trap, Emission (HC,CO, NO and NOX, ) measuring equipments, Smoke and Particulate measurement, Indian Driving Cycles and emission norms.

### **UNIT IV ALTERNATE FUELS**

Alcohols, Vegetable oils and bio-diesel, Bio-gas, Natural Gas, Liquefied Petroleum Gas, Hydrogen, Properties, Suitability, Engine Modifications, Performance, Combustion and Emission Characteristics of SI and CI Engines using these alternate fuels.

### **UNIT V RECENT TRENDS**

Homogeneous Charge Compression Ignition Engine, Lean Burn Engine ,Stratified Charge Engine, Surface Ignition Engine , Four Valve and Overhead cam Engines, Electronic Engine Management, Common Rail Direct Injection Diesel Engine, Gasoline Direct Injection Engine , Data Acquisition System –pressure pick up, charge amplifier PC for Combustion and Heat release analysis in Engines.

### **TEXT BOOK:**

1. Heinz Heisler , 'Advanced Engine Technology,' SAE International Publications USA,1998.
2. Ganesan V." Internal Combustion Engines" , Third Edition, Tata Mcgraw-Hill 2007.

### **REFERENCES:**

1. John B Heywood," Internal Combustion Engine Fundamentals", Tata McGraw-Hill 1988.
2. Patterson D.J. and Henein N.A,"Emissions from combustion engines and their control," Ann Arbor Science publishers Inc, USA, 1978
3. Gupta H.N, "Fundamentals of Internal Combustion Engines" ,Prentice Hall of India, 2006.
4. Ulrich Adler ," Automotive Electric / Electronic Systems, Published by Robert Bosh GmbH,1995.

## **812MET10 - DESIGN OF HEAT EXCHANGERS**

### **AIM:**

To build up necessary background for the design of various types of heat exchangers.

### **OBJECTIVES:**

- To learn the sizing of heat exchangers, thermal and mechanical stress analysis for various heat exchange applications.

### **UNIT I DIFFERENT CLASSIFICATION OF HEAT EXCHANGERS**

Parallel flow, counter flow and cross flow; shell and tube and plate type; single pass and multipass; once through steam generators etc;

### **UNIT II PROCESS DESIGN OF HEAT EXCHANGERS**

Heat transfer correlations, Overall heat transfer coefficient, LMTD, sizing of finned tube heat exchangers, U tube heat exchangers, fouling factors, pressure drop calculations.

### **UNIT III MECHANICAL DESIGN OF SHELL AND TUBE TYPE**

Thickness calculation, Tubesheet design using TEMA formula, concept of equivalent plate for analysing perforated analysis, flow induced vibration risks including acoustic issues and remedies, tube to tubesheet joint design, buckling of tubes, thermal stresses.

### **UNIT IV COMPACT AND PLATE HEAT EXCHANGER**

Types – Merits and Demerits – Design of compact heat exchangers, plate heat exchangers, performance influencing parameters, limitations.

### **UNIT V CONDENSORS AND COOLING TOWERS**

Design of surface and evaporative condensers – cooling tower –performance characteristics.

### **TEXT BOOKS / REFERENCES:**

1. T.Taborek, G.F.Hewitt and N.Afgan, Heat Exchangers, Theory and Practice, McGraw-Hill Book Co.1980.
2. Walker, Industrial Heat Exchangers- A Basic Guide, Mc Graw Hill Book Co. 1980
3. Nicholas Cheremistoff, Cooling Tower, Ann Arbor Science Pub 1981
4. Arthur, P. Frass, Heat Exchanger Design, John Wiley and Sons, 1988
5. J.P. Gupta, Fundamentals of heat exchangers and pressure vessel technology, Hemisphere publishing corporation, Springer-Verlag (outside NA), 1986
6. Donald Q. Kern and Alban D. Kraus, "Extended surface hear transfer" Mc Graw Hill Book Co., 1972
7. E.A.D. Sanders, Heat Exchangers, Selection Design and Construction Layman Scientific & Technical; co published with John Wiley & sons, 1988

## **812MEP01 – PROJECT WORK**

### **OBJECTIVE:**

- The objective of the project work is to enable the students in convenient groups of not more than 4 members on a project involving theoretical and experimental studies related to the branch of study.
- Every project work shall have a guide who is the member of the faculty of the institution.
- Six periods per week shall be allotted in the time table and this time shall be utilized by the students to receive the directions from the guide, on library reading, laboratory work, computer analysis or field work as assigned by the guide and also to present in periodical seminars on the progress made in the project.
- The aim of the project work is to deepen comprehension of principles by applying them to a new problem which may be the design and manufacture of a device, a research investigation, a computer or management project or a design problem.
- The progress of the project is evaluated based on a minimum of three reviews.
- The review committee may be constituted by the Head of the Department.
- Each student shall finally produce a comprehensive report covering background information, literature survey, problem statement, project work details and conclusion.
- This final report shall be typewritten form as specified in the guidelines.
- The continuous assessment shall be made as prescribed in the regulations (vide clause 10.3 of Regulations 2004 for B.E., B.Tech. programmes)

**Registrar**