**118ENT01**                      **TECHNICAL ENGLISH**                      L  T  P  C
                                                                           2  0  0  2

**COURSE OBJECTIVES:**

The Course prepares first semester Engineering and Technology students to:

- Develop strategies and skills to enhance their ability to read and comprehend engineering and technology texts.
- Foster their ability to write convincing job applications and effective reports.
- Develop their speaking skills to make technical presentations, participate in group discussions.
- Strengthen their listening skill which will help them comprehend lectures and talks in their areas of specialization.

**UNIT I**                                                                              **9**

Listening - Ink talks and gap exercises - Speaking – Asking for and giving directions - Reading – short technical texts from journals and newspapers - Writing - definitions – instructions – checklists – recommendations - Vocabulary Development - technical vocabulary - Language Development – parts of speech – articles – word formation.

**UNIT II**                                                                             **9**

Listening - longer technical talks - Speaking – process description - Reading – longer technical texts – Writing – graphical representation - Vocabulary Development - vocabulary used in formal letters/emails and reports - Language Development – tenses - voices - numerical adjectives – question tags.

**UNIT III**                                                                            **9**

Listening - listening to classroom lectures - Speaking – introduction to technical presentations - Reading – longer texts both general and technical and practice in speed reading – Writing – process description using sequence words and sentences - Vocabulary Development - Misspelled words – one-word substitution - Language Development - embedded sentences – singular and plural nouns - compound nouns - editing

**UNIT IV**                                                                             **9**

Listening - Listening to documentaries and making notes - Speaking – mechanics of presentations - Reading – reading comprehension – Writing - email etiquettes - job application – cover letter –Résumé preparation - essay writing - Vocabulary Development – synonyms and antonyms –paraphrasing - Language Development – modals – conditionals.

**UNIT V**                                                                              **9**

Listening - TED talks - Speaking – brainstorming and debate – Reading – reading and understanding technical articles – Writing – reports - minutes of a meeting - Vocabulary Development- verbal analogies - phrasal verbs - Language Development - concord - reported speech.

**TOTAL HOURS: 45 PERIODS**

**COURSE OUTCOMES:**

At the end of the course learners will be able to:

CO1:  Read technical texts and write area- specific texts effortlessly.
CO2:  Listen and comprehend lectures and talks in their area of specialization successfully.
CO3:  Speak appropriately and effectively in varied formal and informal contexts.
CO4:  Understand the basic grammatical structures and its applications.
CO5:  Write reports and winning job applications.

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## TEXT BOOKS

1. Board of editors. Fluency in English A Course book for Engineering and Technology. Orient Blackswan, Hyderabad: 2016.
2. Sudharshana. N. P and Saveetha. C. English for Technical Communication. Cambridge University Press: New Delhi, 2016.
3. Uttham Kumar. N. Technical English I (with work book). Sahana Publications, Coimbatore, 2016.

## REFERENCE BOOKS

1. Raman, Meenakshi and Sharma, Sangeetha- Technical Communication Principles and Practice. Oxford University Press: New Delhi,2014.
2. Kumar, Suresh. E. Engineering English. Orient Blackswan: Hyderabad,2015.
3. Booth-L. Diana, Project Work, Oxford University Press, Oxford: 2014.
4. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford: 2007
5. Means, L. Thomas and Elaine Langlois, English & Communication For Colleges. Cengage Learning, USA: 2007.

Students can be asked to read Tagore and Chetan Bhagat

| | Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Co1 | Read technical texts and write area- specific texts effortlessly. | | | | 2 | | | | 1 | 1 | 3 | 1 | | 1 | 1 | |
| Co2 | Listen and comprehend lectures and talks in their area of specialization successfully. | | | | 1 | 1 | | | | 2 | 3 | 1 | | 1 | | |
| Co3 | Speak appropriately and effectively in varied formal and informal contexts. | | | | | | | | | 2 | 3 | | | | | |
| Co4 | Understand the basic grammatical structures and its applications. | | | | | | | | | | 2 | | | | | |
| Co5 | Write reports and winning job applications. | | | | 2 | | | | | 1 | 2 | 1 | | 1 | 1 | 1 |

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**118MAT02**                    **ENGINEERING MATHEMATICS - I**              L  T  P  C
                                                                           3  0  0  3

**COURSE OBJECTIVES:**
- To understand the eigenvalue problems.
- To understand the concepts of curvatures, evolutes and envelopes.
- To learn the total derivatives and apply the same to find maxima and minima.
- To solve differential equations of certain types, including systems of differential equations that they might encounter in engineering subjects.
- To solve certain linear differential equations using the Laplace transform technique which has applications in control theory and circuit theory.

**UNIT I          MATRICES                                                            9**
Eigenvalues and eigenvectors of a real symmetric matrix –Properties – Cayley - Hamilton theorem (Statement and applications only) – Orthogonal transformation of a symmetric matrix to diagonal form – Quadratic form –Reduction of quadratic form to canonical form by orthogonal transformation.

**UNIT II         DIFFERENTIAL CALCULUS                                               9**
Curvature in Cartesian co-ordinates – Centre and radius of curvature – Circle of curvature – Evolutes – Envelopes – Evolutes as envelope of normals.

**UNIT III        FUNCTIONS OF SEVERAL VARIABLES                                      9**
Partial derivatives – Euler's theorem for homogenous functions – Total derivatives –  Jacobians – Taylor's expansion– Maxima and Minima – Method of  Lagrangian multipliers.

**UNIT IV         ORDINARY DIFFERENTIAL EQUATIONS                                     9**
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-Applications to Engineering problems-Electric Circuits, Simple Harmonic Motions and bending of beams.

**UNIT V          LAPLACE TRANSFORM                                                   9**
Laplace transforms – Conditions for existence –Basic properties (Statement and applications only) – Laplace Transform of elementary functions, derivatives and integrals, unit step function and impulse functions, periodic functions. Definition of Inverse Laplace transform – Convolution theorem (Statement and applications only) – Initial and final value theorems (Statement and applications only) – Solution of linear ordinary differential equations of second order with constant coefficients using Laplace transform techniques.

**TOTAL HOURS: 45 PERIODS**

**COURSE OUTCOMES:**
After completing this course, the student will be able to
CO1:  Develop the knowledge of linear algebraic concepts.
CO2:  Use the differential calculus tools application to seek solutions for many problems in engineering subjects.
CO3:  Acquire the knowledge of partial differential concepts and apply to find maxima and minima of a function.
CO4:  Determine the solutions of ordinary differential equations by various methods which have an application in their core subjects.
CO5:  Apply Laplace transform techniques to solve ordinary differential equations which have an application in many engineering fields.

**TEXT BOOKS**

1. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India, 10th edition New Delhi 2016.
2. Grewal. B.S, "Higher Engineering Mathematics", 44th Edition, Khanna Publications, Delhi, 2017.

**REFERENCE BOOKS**

1. T.Veerarajan, "Engineering Mathematics " Tata McGraw-Hill Publishing company, New Delhi, 2014.
2. Kandasamy.P, Thilagavathy,K., & Gunavathi.K., "Engineering Mathematics for first year "., S.Chand & Company Ltd., New Delhi,2014.
3. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Co. Ltd., New Delhi, 11th Reprint, 2010.
4. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3rd Edition, 2007.
5. V.Prameelakaladharan and G.Balaji, "Engineering Mathematics - I", 3rd Edition, Amrutha marketing, Chennai, 2017.

| | Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Co1 | Develop the knowledge of linear algebraic concepts. | 3 | 2 | | | | | | | | | | | 3 | | |
| Co2 | Use the differential calculus tools application to seek solutions for many problems in engineering subjects. | 3 | 3 | | | | | | | | | | | 3 | | |
| Co3 | Acquire the knowledge of partial differential concepts and apply to find maxima and minima of a function. | 3 | 3 | | | | | | | | | | | 3 | | |
| Co4 | Determine the solutions of ordinary differential equations by various methods which have an application in their core subjects. | 3 | 3 | | | | | | | | | | | 3 | | |
| Co5 | Apply Laplace transform techniques to solve ordinary differential equations which have an application in many engineering fields. | 3 | 3 | | | | | | | | | | | 3 | | |

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| 118EGT05 | ENGINEERING GRAPHICS | L | T | P | C |
|----------|---------------------|---|---|---|---|
|          |                     | 2 | 0 | 4 | 4 |

**COURSE OBJECTIVES:**

- To understand the graphical skills for drawing the object and the principle of free-hand sketching techniques.
- To understand the principle of orthographic projection of points, lines and plane surfaces.
- To study the principle of simple solids.
- To understand the principle of section and development of solids.
- To understand the principle of Isometric and Perspective projections.

**Concepts and conventions (Not for Examination)** 3

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** 15

**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** 15

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** 15

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

**UNIT IV       SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES** 15

Sectioning of simple solids like prisms, pyramids, cylinders and cones 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** 12

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.

**TOTAL HOURS: 75 PERIODS**

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**COURSE OUTCOMES**

The student will be able to

CO1: Recognize the conventions and apply dimensioning concepts while drafting simple objects.
CO2: Draw the orthographic projection of points, line, and plane surfaces.
CO3: Draw the orthographic projection of simple solids.
CO4: Draw the section of solid drawings and development of surfaces of the given objects.
CO5: Apply the concepts of isometric and perspective projection in engineering practice.

**TEXT BOOKS**

1. Ranganath G, Channankaiah and Halesh Koti, "Engineering Graphics", Second Edition, Sahana Publishers, 2015.
2. Bhatt. N.D., "Engineering Drawing" Charotar Publishing House, 53th Edition, 2014.

**REFERENCE BOOKS**

1. Dhananjay A.Jolhe, "Engineering Drawing with an introduction to AutoCAD" Tata McGraw Hill Publishing Company Limited, 2017.
2. Gopalakrishnana. K. R, "Engineering Drawing" (Vol. I & II), Subhas Publications, 2014.
3. Basant Agarwal and C.M.Agarwal, "Engineering Drawing", Tata McGraw Hill, 2013.
4. Natrajan K. V, "A Text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2012.
5. M.B.Shaw and B.C.Rana, "Engineering Drawing", Pearson Education India, 2011.

| | Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Co1 | Recognize the conventions and apply dimensioning concepts while drafting simple objects. | | 2 | | 1 | | | | | | | | 1 | 1 | | 1 |
| Co2 | Draw the orthographic projection of points, line, and plane surfaces. | 2 | 1 | | 1 | | | | | | | | 1 | | 2 | |
| Co3 | Draw the orthographic projection of simple solids. | 2 | 2 | | 2 | | | | | | | | 1 | | 3 | |
| Co4 | Draw the section of solid drawings and development of surfaces of the given objects. | | 1 | | 2 | | | | | | | | 2 | | | 2 |
| Co5 | Apply the concepts of isometric and perspective projection in engineering practice. | 1 | 1 | 1 | | | | | | | 2 | | | | | 1 |

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**118ESE02**    **BASIC CIVIL, ELECTRICAL, AND ELECTRONICS ENGINEERING**    L  T  P  C
                                                                          3  0  0  3

**COURSE OBJECTIVES:**
- To gain knowledge about Civil Engineering Materials.
- To learn about Structural Components of Building.
- To learn the basics of electrical elements.
- To introduce the fundamental concepts of DC and AC circuits.
- To interpret the principle and characteristics of semiconductor devices.

## PART-A (CIVIL)

**UNIT I        CIVIL ENGINEERING MATERIALS                                    9**

Civil Engineering Materials: Bricks, Stones, Sand, Cement, Concrete & Steel sections.
M-Sand and their types, Admixtures-Fibers and Fabrics, Superplasticizers - Selection of Materials.

**UNIT II        COMPONENTS OF BUILDING                                    9**

Component parts of the Building -Substructure (Foundation) Types, Bearing capacity, Requirement of Good Foundations.
Superstructure: Brick Masonry, Stone Masonry, Lintels, Roofing, Flooring, Plastering
Typical cross-section showing the Buildings in a Structure, Standard Legends and Insignia

## PART-B (ELECTRICAL & ELECTRONICS)

**UNIT III        INTRODUCTION TO BASIC ELECTRICAL ELEMENTS                9**

Electrical circuit : passive elements - Resistor, Inductor and Capacitor; active elements- Current, Voltage, Power and Energy – Ohm's Law and limitations - Kirchhoff's Laws – relationship between current, voltage and power – Resistors in series, parallel and series -parallel circuits

**UNIT IV        FUNDAMENTALS OF DC AND AC CIRCUITS                        9**

DC Circuits: Sources of Electrical Energy - Independent and Dependent Source, Source Conversion - Star –Delta conversion- Mesh and Nodal Analysis.
AC Circuits: Generation of sinusoidal - voltage, average - RMS value, form factor and peak factor- Phasor diagrams of R, L, C, combination of R-L, R-C and R-L-C circuits

**UNIT V        SEMICONDUCTOR DEVICES AND SWITCHING THEORY                9**

Semiconductor Devices - Overview of Semiconductors - basic principle, operation and characteristics of PN diode, zener diode, BJT, JFET -Number systems – binary codes - logic gates - Boolean algebra, laws & theorems - simplification of Boolean expression - implementation of Boolean expressions using logic gates.

**TOTAL HOURS: 45 PERIODS**

**COURSE OUTCOMES**
Upon Completion of this course, students will be able to:
CO1:  Know the usage of surveying and properties of construction materials.
CO2:  Understand the stress strain of various building and material such as substructure, road transport and bridge.
CO3:  Recognize the different combinations of circuit elements and solving the circuit by applying basic circuital laws.
CO4:  Acquire a good understanding of DC and AC circuits.
CO5:  Demonstrate the characteristics of semiconductor devices.

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## TEXT BOOKS

1. Ranganath G and Channankaiah, "Basic Engineering Civil & Mechanical", S.S.Publishers, 2014.
2. Ramamrutham. S, "Basic Civil Engineering", Dhanpat Rai Publishing Co. (P) Ltd, 3rd Edition reprint, 2013.
3. Muthusubramanian R, Salivahanan S, "Basic Electrical and Electronics Engineering", Tata McGraw Hill Education Private Limited, 2010.
4. M. Morris Mano, Digital Design, 3$^{rd}$ Edition, Prentice Hall of India Pvt. Ltd., 2003 / Pearson Education (Singapore) Pvt. Ltd., New Delhi, 2003.

## REFERENCE BOOKS

1. Shanmugasundaram. S and Mylsamy. K, "Basics of Civil and Mechanical Engineering", Cenage Learning India Pvt.Ltd, New Delhi, 2012.
2. Shanmugam G and Palanichamy M S, "Basic Civil and Mechanical Engineering", Tata McGraw Hill Publishing Co., New Delhi, 3rd Edition, 2012.
3. B.L.Theraja, A.K.Theraja, "A Text Book of Electrical Technology, Volume I ", S.Chand and company Ltd., 2006.
4. Robert L. Boylestad and Louis Nashelsky, Electronic Devices and Circuit Theory, 9$^{th}$ Edition, Pearson Education / PHI, 2007.

| | Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Co1 | Know the usage of surveying and properties of construction materials. | 3 | 1 | 2 | 2 | | | | | | | | | 3 | | 1 |
| Co2 | Understand the stress strain of various building and material such as substructure, road transport and bridge. | 1 | | 1 | | | 2 | | | | | | | 3 | | 1 |
| Co3 | Recognize the different combinations of circuit elements and solving the circuit by applying basic circuital laws. | 3 | 1 | | 2 | | | | | | | | | 3 | | 1 |
| Co4 | Acquire a good understanding of DC and AC circuits. | 2 | 1 | 2 | | | | | | | | | | 3 | | |
| Co5 | Demonstrate the characteristics of semiconductor devices. | 2 | 1 | 2 | | | | | | | | | | 3 | | 1 |

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**118CYP07**           **ENGINEERING CHEMISTRY LABORATORY**           L  T  P  C
                                                                      0  0  2  1

**COURSE OBJECTIVE:**
- Students will be conversant with the estimation of various compounds using volumetric and instrumental analysis.

**LIST OF EXPERIMENTS**
1. Estimation of Total hardness by EDTA
2. Determination of percentage of calcium in Lime Stone by EDTA
3. Estimation of chloride in water sample
4. Estimation of alkalinity of Water sample
5. Determination of DO in Water (Winkler's Method)
6. Determination of Rate of Corrosion of the given steel specimen by weight loss method (Without inhibitor)
7. Determination of Rate of Corrosion of the given steel specimen by weight loss method (With inhibitor)
8. Conduct metric titration (Simple acid base)
9. Conduct metric titration (Mixture of weak and strong acids)
10. Conduct metric titration using $BaCl_2$ vs $Na_2SO_4$
11. Potentiometric Titration ($Fe^{2+}$ / $KMnO_4$ or $K_2Cr_2O_7$)
12. PH titration (acid & base)
13. Determination of water of crystallization of a crystalline salt -Copper sulphate
14. Preparation of Bio-Diesel by Trans etherification method.

A minimum of TEN experiments shall be offered.

                                                       **TOTAL HOURS: 45 PERIODS**

**COURSE OUTCOMES:**
CO1:  Carry out the volumetric experiments and improve the analytical skills.
CO2:  Understand the maintenance and usage of analytical instruments and thereby develop their skills in the field of engineering.
CO3:  Understand the principle and handling of electrochemical instruments and Spectrophotometer
CO4:  Apply their knowledge for protection of different metals from corrosion by using different inhibitors
CO5:  Demonstrate the characteristics of PH Titration.

**REFERENCE BOOKS:**
1. Arthur I. Vogel's, "Quantitative Inorganic Analysis including Elementary Instrumental Analysis", ELBS, Group, 7th Edition, 2000.
2. Dr. K .Sivakumar, "Engineering Chemistry lab manual", S.S publishers, 2016.

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| Course Outcome | | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Co1 | Carry out the volumetric experiments and improve the analytical skills. | 3 | 3 | | | | | | | | 2 | | | 3 | | 1 |
| Co2 | Understand the maintenance and usage of analytical instruments and thereby develop their skills in the field of engineering. | 3 | 3 | | 2 | | | | | | | | | 3 | | 1 |
| Co3 | Understand the principle and handling of electrochemical instruments and Spectrophotometer | 3 | 3 | | 2 | 3 | | 2 | | | 3 | | | 3 | | 1 |
| Co4 | Apply their knowledge for protection of different metals from corrosion by using different inhibitors | 3 | 3 | | 3 | 2 | | | | | | | | 3 | | 1 |
| Co5 | Demonstrate the characteristics of PH Titration. | 3 | 3 | | | | | | | | 1 | | | 3 | | 1 |

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**118EPP07**          **ENGINEERING PRACTICE LABORATORY**          **L  T  P  C**
                                                                   **0  0  2  1**

## COURSE OBJECTIVES:

- To get the knowledge on welding techniques and its types.
- To do the fitting operation on a given material. (Specimen)
- To carry out sheet metal operation.
- To know the principle involved in plumbing work.
- To do the carpentry work on a given work piece.

## LIST OF EXPERIMENTS

**WELDING:**
Study of Electric Arc welding and Gas welding tools and equipment's.
**Preparation of Arc welding and Gas welding models:**
**i) Butt joint    ii) Lap joint    iii) T - joint.**

**FITTING:**
   Study of fitting tools and operations.
**Preparation of fitting models:          i) V-fitting    ii) Square fitting**

**SHEET METAL WORK:**
   Study of sheet metal tools and operations
   **Preparation of sheet metal models:   i) Rectangular Tray          ii)  Funnel**

**PLUMBING WORKS:**
   Study of pipeline joints and house hold fittings.
**Preparation of plumbing models:     Basic pipe connections with PVC and GI pipe fittings.**

**CARPENTRY:**
   Study of wooden joints and tools used in roofs, doors, windows, furniture.

**Preparation of carpentry models:**
**i ) Lap joint      ii) Dovetail joint          iii) T-Joint**

**DEMONSTRATION ON:**

**ELECTRICAL ENGINEERING PRACTICE**
Study of Electrical components and equipments
Residential house wiring using switches, fuse, indicator, lamp and energy meter.

**ELECTRONICS ENGINEERING PRACTICE**
Study of Electronic components –Resistor, color coding, capacitors etc
Soldering practice –components soldering in simple electric circuit & testing continuity

**COMPUTER HARDWARE AND SOFTWARE PRACTICE**
Study of PC Hardware, Internet & World Wide Web and Productivity tools including Word, Excel,
Power Point and Publisher.

                                                              **TOTAL HOURS: 45 PERIODS**

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**COURSE OUTCOMES**

The students will be able to

CO1:    Prepare simple Lap, Butt and T- joints using arc welding equipments.
CO2:    Prepare the rectangular trays and funnels by conducting sheet metal operation.
CO3:    Prepare the pipe connections and identify the various components used in plumbing.
CO4:    Prepare simple wooden joints using wood working tools.
CO5:    Demonstrate basic electrical, electronic and computer components based on their physical parameters and dimensions.

**TEXT BOOKS**

1.  Ranganath. G & Channankaiah, "Engineering Practices Laboratory Manual", S.S. Publishers, 2014.
2.  Jeyapoovan.T & Gowri S "Engineering Practice Lab Manual", Vikas publishing house pvt.ltd, 2016.

**REFERENCE BOOKS**

1.  Kannaiah.P & Narayana.K.L, "Manual on Workshop Practice", Scitech Publications, 2015.
2.  Ramesh BabuV, "Engineering Practices Laboratory Manual", VRB Publishers Private Limited, Chennai, Revised Edition, 2014.
3.  Peter Norton, "Introduction to Computers", 7th Edition, Mc Graw Hill, 2010.
4.  Bawa. H.S, "Workshop Practice", Tata McGraw – Hill Publishing Company Limited, 2009.
5.  David Anfinson and Ken Quamme, "IT Essentials PC Hardware and Software Companion Guide", CISCO Press, Pearson Education, Third Edition, 2008.

| | Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Co1 | Prepare simple Lap, Butt and T- joints using arc welding equipments. | 1 | | 2 | 2 | 1 | | | 1 | 1 | | 1 | 1 | 1 | | 2 |
| Co2 | Prepare the rectangular trays and funnels by conducting sheet metal operation. | 2 | | 2 | 2 | 1 | | | | 1 | | 1 | 1 | 1 | | 2 |
| Co3 | Prepare the pipe connections and identify the various components used in plumbing. | 1 | | 1 | 2 | 1 | | | | 1 | | 1 | 1 | 1 | | 2 |
| Co4 | Prepare simple wooden joints using wood working tools. | 1 | | 1 | 2 | 1 | | | | 1 | | 1 | 1 | 1 | | 2 |
| Co5 | Demonstrate basic electrical, electronic and computer components based on their physical parameters and dimensions. | 1 | | 1 | 1 | 2 | | | | 1 | | 1 | 1 | 1 | | 2 |

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| 218ENT01 | COMMUNICATIVE ENGLISH | L | T | P | C |
|----------|----------------------|---|---|---|---|
|          |                      | 2 | 0 | 2 | 3 |

**COURSE OBJECTIVES:**

The Course prepares first semester Engineering and Technology students:

- To help learners develop their listening skills which will enable them listen to lectures and comprehend them by asking questions; seeking clarifications.
- To help learners develop their speaking skills and speak fluently in real contexts.
- To develop the basic reading and writing skills of first year engineering and technology students.
- To help learners develop grammar and vocabulary of a general kind by developing their reading skills

**UNIT I** 9

Listening - conversation - Speaking – introducing oneself - exchanging personal information - Reading – comprehension - Writing - paragraph - Vocabulary Development - synonyms and antonyms - Language Development – consonants & vowels - phonetic transcription.

**UNIT II** 9

Listening - telephonic conversation - Speaking – sharing information of a personal kind – greeting - taking leave - Reading – short stories – The Gift of the Magi, A Service of Love and The Last Leaf by O. Henry – Writing – developing hints - Vocabulary Development – everyday vocabulary - Language Development – British and American English - infinitive and gerund.

**UNIT III** 9

Listening – class memory quiz - Speaking – impromptu - Reading – magazines – Writing – agenda - proposals - Vocabulary Development - important words used in speaking and writing - Language Development – types of sentences - information and emphasis.

**UNIT IV** 9

Listening – interviews of famous persons - Speaking – story narration - Reading – case study – Writing – invitation letter - quotation letter - Vocabulary Development – listening and reading vocabulary - Language Development – cause and effect – purpose and function.

**UNIT V** 9

Listening - a scene from a film - Speaking - role play - Reading – jigsaw – Writing – essay writing - Vocabulary Development- business vocabulary - Language Development - degrees of comparison – real English phrases.

**TOTAL HOURS: 45 PERIODS**

**COURSE OUTCOMES**

At the end of the course learners will be able to:

CO1: Comprehend conversations and talks delivered in English.

CO2: Participate effectively in formal and informal conversations; introduce themselves and their friends and express opinions in English.

CO3: Read short stories, magazines, novels and other printed texts of a general kind.

CO4: Write short paragraphs, essays, letters and develop hints in English.

CO5: Write reports and winning job applications.

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## TEXT BOOKS

1. Board of Editors. Using English A Coursebook for Undergarduate Engineers and Technologists. Orient BlackSwan Limited, Hyderabad: 2015.
2. Richards, C. Jack. Interchange Students' Book-2, New Delhi: CUP, 2015.
3. Uttham Kumar, N. Communicative English (with work book). Sahana Publications, Coimbatore, 2019.

## REFERENCE BOOKS

1. Bailey, Stephen. Academic Writing: A Practical Guide for Students. New York: Rutledge, 2011.
2. Comfort, Jeremy, et al. Speaking Effectively: Developing Speaking Skills for Business English. Cambridge University Press, Cambridge: Reprint 2011.
3. Dutt P. Kiranmai and Rajeevan Geeta. Basic Communication Skills, Foundation Books: 2013.
4. Means, L. Thomas and Elaine Langlois. English & Communication for Colleges. Cengage Learning, USA: 2007.
5. Redston, Chris & Gillies Cunningham. Face2Face (Pre-intermediate Student's Book & Workbook). Cambridge University Press, New Delhi: 2005.

| | Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Co1 | Comprehend conversations and talks delivered in English. | | | | 1 | | | | | 2 | 3 | 1 | | 1 | | |
| Co2 | Participate effectively in formal and informal conversations; introduce themselves and their friends and express opinions in English. | | | | | | | | | 1 | 3 | 1 | | | | |
| Co3 | Read short stories, magazines, novels and other printed texts of a general kind. | | | | | | | | | 1 | 1 | 1 | | | | |
| Co4 | Write short paragraphs, essays, letters and develop hints in English. | | | | | | | | | 1 | 3 | | | | | 1 |
| Co5 | Write reports and winning job applications. | | | 3 | | | | | 2 | | | | 1 | | | |

**218MAT02**                          **ENGINEERING MATHEMATICS-II**                   **L   T   P   C**
                                                                                      **3   1   0   4**

**COURSE OBJECTIVES:**
- To revise the concept of integral calculus and introduce Beta and Gamma functions.
- To understand double and triple integration concepts.
- To study vector calculus comprising of surface and volume integrals along with the classical theorems involving them.
- To learn analytic functions and their properties and also conformal mappings with few standard examples   those have direct applications.
- To grasp the basics of complex integration and application to contour integration which is important for evaluation of certain integrals encountered in engineering problems.

**UNIT I          INTEGRAL CALCULUS                                                        12**
Definite and indefinite integrals - Substitution rule – Techniques of integration –Integration by parts – Trignometric integrals -  Trigonometric substitutions -  Integration of rational functions by partial fractions – Integration irrational functions - Beta and Gamma functions.

**UNIT II         MULTIPLE INTEGRALS                                                       12**
Double integration – Cartesian and polar co-ordinates – 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.

**UNIT III        VECTOR CALCULUS                                                          12**
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 (Statement and applications only) – Simple applications involving cubes and rectangular parallelopipeds.

**UNIT IV         ANALYTIC FUNCTIONS                                                       12**
Functions of a complex variable – Analytic functions – Necessary conditions, Cauchy– Riemann equation and Sufficient conditions (Statement and applications only) – Harmonic and orthogonal properties of analytic function (Statement and applications only) – Harmonic conjugate – Construction of analytic functions – Conformal mapping: w= z+c, cz, 1/z, and bilinear transformation.

**UNIT V          COMPLEX INTEGRATION                                                      12**
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).

                                                                  **TOTAL HOURS: 60 PERIODS**

**COURSE OUTCOMES:**
At the end of the course the student will be able to
CO1:  Apply the basic integration concepts and solve problems.
CO2:  Determine the area and volume in 2-dimension and 3-dimension respectively using multiple integrals.
CO3:  Expertise the concept of vector calculus and apply in core subjects.
CO4:  Construct the analytic functions and conformal transformations of complex functions.
CO5:  Evaluate the integrals using complex integration.

**TEXT BOOK**
   1.  Grewal. B.S., "Higher Engineering Mathematics", 44th Edition, Khanna Publications, Delhi, 2017.

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**REFERENCE BOOKS**

1.  James Stewart, "Stewart Calculus", 8th edition, 2015, ISBN: 9781285741550 /1285741552.
2.  Erwin Kreyszig, "Advanced Engineering Mathematics", tenth edition, Wiley India, 2011.
3.  P.Kandasamy, K.Thilagavathy, K.Gunavathy, "Engineering Mathematics for first year", S.Chand & Company Ltd., 9th Edition, New Delhi, 2014.
4.  V.Prameelakaladharan and G.Balaji, "Engineering Mathematics - II", Amrutha marketing, Chennai, 2017.

| | Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Co1** | Apply the basic integration concepts and solve problems. | 3 | 2 | | | | | | | | | | | 3 | 3 | 2 |
| **Co2** | Determine the area and volume in 2-dimension and 3-dimension respectively using multiple integrals. | 3 | 3 | | | | | | | | | | | 3 | 3 | 3 |
| **Co3** | Expertise the concept of vector calculus and apply in core subjects. | 3 | 3 | | | | | | | | | | | 3 | 3 | 3 |
| **Co4** | Construct the analytic functions and conformal transformations of complex functions. | 3 | 2 | | | | | | | | | | | 3 | 3 | 2 |
| **Co5** | Evaluate the integrals using complex integration. | 3 | 3 | | | | | | | | | | | 3 | 3 | 3 |

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**218EMT04**                     **ENGINEERING MECHANICS**                  **L   T   P   C**
                                                                            **3   0   0   3**

**COURSE OBJECTIVES:**
- To understand the vectorial and scalar representation of forces and moments.
- To understand the static equilibrium of particles and rigid bodies both in two dimensions.
- To understand the concepts of centroids and moment of inertia of composite sections.
- To understand the principle of work and energy.
- To enable the students to comprehend the effect of friction on equilibrium.

**UNIT I          BASICS & STATICS OF PARTICLES                                    12**
Introduction-Units and Dimensions-Laws of mechanics - Lame's theorem, Parallelogram and Triangular law of forces, Polygon force, 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                                      12**
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 couples-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                               12**
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.

**UNIT IV         DYNAMICS OF PARTICLES                                           12**
Displacement, Velocity and Acceleration, their relationship, Relative motion- Rectilinear motion-Curvilinear motion, Newton's law-Work Energy Equation of particles-Impulse and Momentum-Impact of elastic bodies.

**UNIT V          FRICTION                                                        12**
Frictional force - Laws of Coloumb friction - Simple contact friction - Rolling resistance - Belt friction - Ladder friction - wedge friction.

                                                            **TOTAL HOURS: 60 PERIODS**
**COURSE OUTCOMES**
The students will be able to
CO1:  Explain the differential principle applies to solve engineering problems dealing with force, displacement, velocity and acceleration.
CO2:  Find solution for problems related to equilibrium of particles.
CO3:  Solve the Moment of inertia for different 2-D plane figures.
CO4:  Analyze the forces in any structures.
CO5:  Solve rigid body subjected to frictional forces.

**TEXT BOOKS**
1.  Ramamrutham S, "Engineering Mechanics (S.I Units)", Dhanpat Rai Publications, 10th Edition, Reprint 2015.
2.  Dr. Gujral I S, "Engineering Mechanics", Lakmi Publications, Second Edition, 2011.

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**REFERENCE BOOKS**
1. Bhavikatti S, "Engineering Mechanics", New Age International Publisher, 4th Edition, 2014.
2. Khurmi R S, "Engineering Mechanics", S Chand Publisher, 20th Edition, 2012.
3. Dr. Bansal R K and Sanjay Bansal, "Engineering Mechanics", Lakshmi Publication, 7th Edition, 2011.
4. Rajput R K, "Engineering Mechanics", Dhanpat Rai Publications, 3rd Edition, 2005.

| | Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Co1** | Explain the differential principle applies to solve engineering problems dealing with force, displacement, velocity and acceleration. | | 2 | | | | | | | | | | | 1 | | 1 |
| **Co2** | Find solution for problems related to equilibrium of particles. | 1 | 1 | | | | | | | | | | | 2 | | |
| **Co3** | Solve the Moment of inertia for different 2-D plane figures. | 1 | 2 | | | 1 | | | | | | | 1 | 1 | | 1 |
| **Co4** | Analyze the forces in any structures. | 1 | 2 | 1 | 1 | 1 | | | | | | | 2 | 1 | | 1 |
| **Co5** | Solve rigid body subjected to frictional forces. | 1 | 2 | 1 | | | | | | | | | | 1 | | 1 |

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**218PPT05**       **PROBLEM SOLVING AND PYTHON PROGRAMMING**     **L   T   P   C**
                                                                             **3   0   0   3**

**COURSE OBJECTIVES:**
- To know the basics of algorithmic problem solving
- To read and write simple Python programs.
- To develop Python programs with conditionals and loops.
- To define Python functions and call them.
- To use Python data structures –- lists, tuples, dictionaries.
- To do input/output with files in Python.

**UNIT I        ALGORITHMIC PROBLEM SOLVING                             9**
Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.

**UNIT II        DATA, EXPRESSIONS, STATEMENTS                             9**
Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

**UNIT III        CONTROL FLOW, FUNCTIONS                                     9**
Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

**UNIT IV        LISTS, TUPLES, DICTIONARIES                                  9**
Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: selection sort, insertion sort, merge sort, histogram.

**UNIT V        FILES, MODULES, PACKAGES                                      9**
Files and exception: text files, reading and writing files, format operator; command line arguments, date and time, errors and exceptions, handling exceptions, debugging, modules, packages; Illustrative programs: word count, copy file.

                                                     **TOTAL HOURS: 45 PERIODS**

**COURSE OUTCOMES**
Upon completion of the course, students will be able to
CO1: Develop algorithmic solutions to simple computational problems
CO2: Read, write, execute by hand simple Python programs.
CO3: Structure simple Python programs for solving problems.
CO4: Decompose a Python program into functions.
CO5: Represent compound data using Python lists, tuples, dictionaries.

**TEXT BOOKS**

1. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist'', 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/think-python/)
2. Guido van Rossum and Fred L. Drake Jr, ―An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.

**REFERENCE BOOKS**

1. John V Guttag, ―Introduction to Computation and Programming Using Python'', Revised and expanded Edition, MIT Press, 2013
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, ―Introduction to Programming in Python: An Inter-Disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
3. Timothy A. Budd, ―Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd., 2015.
4. Kenneth A. Lambert, ―Fundamentals of Python: First Programs‖, CENGAGE Learning, 2012.
5. Charles Dierbach, ―Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.
6. Paul Gries, Jennifer Campbell and Jason Montojo, ―Practical Programming: An Introduction to Computer Science using Python 3‖, Second edition, Pragmatic Programmers, LLC, 2013.

| | Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Co1** | Develop algorithmic solutions to simple computational problems | 3 | 3 | 3 | | | | | | | | | | | | |
| **Co2** | Read, write, execute by hand simple Python programs. | 3 | 3 | 3 | | | | | | | 1 | | | 1 | | |
| **Co3** | Structure simple Python programs for solving problems. | 3 | 3 | 3 | 1 | | | | 1 | | | 1 | | | | |
| **Co4** | Decompose a Python program into functions. | 3 | 3 | 3 | | | | | | | | | | | | |
| **Co5** | Represent compound data using Python lists, tuples, dictionaries. | 3 | 3 | 3 | | | | | | | | | | | | |

**218BSE01**                    **MATERIAL SCIENCE**                    **L  T  P  C**
                                                                        **2  0  0  2**

**COURSE OBJECTIVES:**
- To study the basic theory of structure of crystalline materials.
- To understand the essential principles of electrical properties of materials.
- To get the better knowledge of Physics of semiconductor materials.
- Become proficient in dielectric and nano materials.
- To understand the essential concepts of modern engineering materials.

**UNIT I          CRYSTAL PHYSICS                                                        9**
Introduction and structure of atoms – Crystal structure: The space lattice and Unit Cell - Crystal Systems and Bravais lattice – Calculation of number of atoms per unit cell – Atomic radius – Coordination number – Packing factor for SC, BCC, FCC, HCP and Diamond cubic structure – NaCl, ZnS structures (qualitative).

**UNIT II          CONDUCTING MATERIALS                                                  9**
Conductors - Classical free electron theory of metals - Expression for electrical conductivity - Expression for Thermal conductivity - Wiedemann-Franz law - Lorentz number - Draw backs of classical theory - Quantum theory - Fermi distribution function - Effect of temperature on Fermi distribution function - Density of energy states - carrier concentration in metals.

**UNIT III         SEMICONDUCTING MATERIALS                                              9**
Intrinsic Semiconductors - direct and indirect band gap semiconductors - Carrier concentration in intrinsic semiconductors - Fermi level - Variation of Fermi level with temperature – Electrical conductivity of intrinsic semiconductors – band gap determination - Extrinsic semiconductors - Carrier concentration in N-type & P-type semiconductors (qualitative)  - Variation of carrier concentration with temperature – variation of Fermi level with temperature and impurity concentration - Electrical conductivity of extrinsic semiconductors.

**UNIT IV          DIELECTRIC MATERIALS AND NANOMATERIALS                                9**
**Dielectric materials**: Dielectric constant – Dielectric loss - Electrical susceptibility- Electronic, ionic – orientational and space charge polarization – Frequency and temperature dependence of polarization – internal field – Claussius – Mosotti relation (derivation)
Nano materials: Synthesis-Plasma arcing- – Chemical vapour deposition – Electro deposition – Ball Milling – Properties of nanoparticles and their applications.

**UNIT V          NUCLEAR PHYSICS AND HEAT TRANSMISSION                                   9**
Nuclear fission-Nuclear fusion-nuclear reactors-classification-general features-efficiency-coolants moderators thermal reactors.
Heat conduction-Expression for thermal conductivity-Amount of heat flow through a plane wall in one direction–Determine the thermal conductivity –Lee's disc method for bad conductors.
                                                                        **TOTAL HOURS: 45 PERIODS**

**COURSE OUTCOMES**
At the end of the course, the students will able to
CO1:  Have the necessary understanding on the functioning of crystalline in solids of materials
CO2:  Gain knowledge on classical and quantum electron theories, and energy band structures.
CO3:  Acquire knowledge on basics of semiconductor physics and its applications in various devices.
CO4:  Get knowledge on dielectric and nano materials and their applications.
CO5:  Understand the basics of modern engineering materials.

**TEXT BOOKS**

1. Jasprit Singh, - Semiconductor Devices: Basic Principles, Wiley 2012.
2. Kasap, S.O. - Principles of Electronic Materials and Devices, McGraw-Hill Education, 2007.
3. Jayaprakash R.N,-Physics for engineers, Dhanam publications, 2018.
4. Kittel, C. - Introduction to Solid State Physics. Wiley, 2005.
5. Theraja B.L - Basic Electronics Solid State, S. Chand & Company Ltd, 2004.

**REFERENCE BOOK**

1. Garcia, N. & Damask, A. —Physics for Computer Science Students. Springer-Verlag, 2012.

| | Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Co1 | Have the necessary understanding on the functioning of crystalline in solids of materials | 3 | 3 | 2 | 1 | | | | | | | | | 2 | | 1 |
| Co2 | Gain knowledge on classical and quantum electron theories, and energy band structures. | 3 | 3 | 1 | 1 | | | | | | | | | 3 | | 1 |
| Co3 | Acquire knowledge on basics of semiconductor physics and its applications in various devices. | 3 | 3 | 1 | 1 | | | | | | | | | 3 | | 1 |
| Co4 | Get knowledge on dielectric and nano materials and their applications. | 3 | 3 | 1 | 1 | | | | | | | | | 3 | | 1 |
| Co5 | Understand the basics of modern engineering materials. | 3 | 2 | 1 | 1 | | | | | | | | | 3 | | 1 |

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**218PHP07**  **ENGINEERING PHYSICS LABORATORY**  **L  T  P  C**
                                                                       **0  0  2  1**

**COURSE OBJECTIVES:**
- To understand the practical concepts of Interference and diffraction.
- To understand the concept of velocities of sound in different liquids.
- To get better knowledge of modulus of elasticity.
- To understand the concepts of thermal conductivity.
- To understand the concepts of viscosities of liquid

**LIST OF EXPERIMENTS**
1. (a) Determination of laser parameters – Wavelength.
   (b) Particle size determination using Diode Laser.
2. Determination of thickness of a thin wire-Air wedge method.
3. Determination of velocity of sound and compressibility of liquid- Ultrasonic interferometer.
4. Determination of wavelength of mercury spectrum-Spectrometer grating.
5. Determination of thermal conductivity of a bad conductor-Lee's disc method.
6. Determination of Young's modulus of the material –Non uniform bending.
7. Determination of viscosity of liquid – Poiseuille's method.
8. Spectrometer- Dispersive power of prism.
9. Determination of Young's modulus of the material - Uniform bending.
10. Tensional pendulum- Determination of Rigidity modulus.

**TOTAL HOURS: 45 PERIODS**

**COURSE OUTCOMES**
At the end of the course, the student will be able to
CO1: Understanding the moduli of elasticity by determining Young's modulus and Rigidity modulus of a beam and cylinder respectively.
CO2: Understanding the phenomenon of diffraction, dispersion and interference of light using optical component
CO3: Acquiring knowledge of viscosity by determining coefficient of viscosity of a liquid and measuring the parameters of ultrasound propagating through a liquid
CO4: Understanding the phenomenon of heat transfer through conductors and bad conductors by determining thermal conductivity.

| | Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Co1 | Understanding the moduli of elasticity by determining Young's modulus and Rigidity modulus of a beam and cylinder respectively. | 3 | 3 | 3 | 3 | 3 | | | | | | | | 3 | | 3 |
| Co2 | Understanding the phenomenon of diffraction, dispersion and interference of light using optical component | 3 | 3 | 3 | 3 | 3 | | | | | | | | 3 | | 3 |
| Co3 | Acquiring knowledge of viscosity by determining coefficient of viscosity of a liquid and measuring the parameters of ultrasound propagating through a liquid | 3 | 3 | 3 | 3 | 3 | | | | | | | | 3 | | 3 |
| Co4 | Understanding the phenomenon of heat transfer through conductors and bad conductors by determining thermal conductivity. | 3 | 3 | 3 | 3 | 3 | | | | | | | | 3 | | 3 |

**218EPP08      PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY      L  T  P  C**
                                                                      0  0  2  1

**COURSE OBJECTIVES:**
- To write, test, and debug simple Python programs.
- To implement Python programs with conditionals and loops.
- Use functions for structuring Python programs.
- Represent compound data using Python lists, tuples, dictionaries.
- Read and write data from/to files in Python.

**LIST OF PROGRAMS**
1. To Implement python scripts using Variables and operators
2. To Demonstrate Operator precedence to evaluate an expression
3. Display grade of a student using elif statement
4. Implement Floyd triangle using for loop
5. Checks the given number is prime or not using while loop
6. Compute the GCD of Numbers using functions
7. Finding factorial of a given number using recursive function.
8. Takes a list of words and returns the length of longest one using strings
9. To perform linear and binary search using strings
10. To implement list as arrays (multiply 2 matrices)
11. To demonstrate use of list & related functions
12. To demonstrate use of tuple, set& related functions
13. To demonstrate use of Dictionary& related functions
14. Finding most frequent words in a text read from a file
15. Programs that take command line arguments (word count)

**PLATFORM NEEDED**
 Python 3 interpreter for Windows/Linux

                                                    **TOTAL HOURS: 45 PERIODS**

**COURSE OUTCOMES**
Upon completion of the course, students will be able to:
CO1:  Write, test, and debug simple Python programs.
CO2:  Implement Python programs with conditionals and loops.
CO3:  Develop Python programs step-wise by defining functions and calling them.
CO4:  Use Python lists, tuples, dictionaries for representing compound data.
CO5:  Read and write data from/to files in Python.

| | Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Co1 | Write, test, and debug simple Python programs. | 3 | 3 | 3 | | | | | | | | | | | | |
| Co2 | Implement Python programs with conditionals and loops. | 3 | 3 | 3 | | | | 1 | | | | 1 | | | | |
| Co3 | Develop Python programs step-wise by defining functions and calling them. | 3 | 3 | 3 | | | | | | 1 | | | | 1 | | |
| Co4 | Use Python lists, tuples, dictionaries for representing compound data. | 3 | 3 | 3 | 1 | | | | | | | | | | | |
| Co5 | Read and write data from/to files in Python. | 3 | 3 | 3 | | | | | | | | | | | | |

**318MAT01**                    **ENGINEERING MATHEMATICS III**                    **L T P C**
                                                                                   **3 1 0 4**

**COURSE OBJECTIVES:**
- To learn various methods to solve the partial differential equations.
- To introduce Fourier series analysis which plays a vital role in many applications in engineering.
- To understand the boundary value problems and to obtain the solution using partial differential equations.
- To acquaint the Fourier transform techniques used in wide variety of situations.
- To develop z-transform techniques which analyze the discrete time signals.

**PRE-REQUISITES:** Knowledge of Engineering Mathematics I and II are required.

**UNIT I          PARTIAL DIFFERENTIAL EQUATIONS                                        12**
Solutions of first order partial differential equations-Standard types-Singular solutions-Lagrange's Linear equation- Method of grouping and Method of multipliers-Solution of homogeneous and non-homogenous linear equations of second and higher order with constant coefficients.

**UNIT II          FOURIER SERIES                                                       12**
Dirichlet's conditions – General Fourier series –Change of scale - Odd and even functions – Half -range Sine and Cosine series – Parseval's identify applications – Harmonic Analysis

**UNIT III          BOUNDARY VALUE PROBLEMS                                             12**
Classification of Partial Differential Equations – Method of separation of Variables – Solutions of one dimensional wave equations and One-dimensional heat equations –Applications using Fourier series solutions in Cartesian coordinates - Steady state solution of two-dimensional heat equation.

**UNIT IV          FOURIER TRANSFORMS                                                   12**
Fourier integral theorem – Fourier transform pair - Sine and Cosine transforms – Properties – Fourier Transform of simple functions – Convolution theorem (statement and applications only ) –  Parseval's identity (statement and applications only).

**UNIT V          Z – TRANSFORMS                                                        12**
Z-Transform - Elementary properties and applications – Initial and final value theorems (statement and applications only) - Inverse Z-Transform – Partial fractions method, Residue theorem method and Convolution theorem (statement and applications only) - Solution of difference equations by applying Z-transforms.

                                                                        **TOTAL HOURS: 60 PERIODS**

**COURSE OUTCOMES**
After completing this course, the student will be able to
CO1:   Know the methods to solve partial differential equations occurring in various physical and engineering problems.
CO2:   Describe an oscillating function which appears in a variety of physical problems by Fourier series which helps them to understand its basic nature deeply.
CO3:   Acquire the knowledge to construct partial differential equations with initial and boundary conditions for various physical and engineering real time problems and obtaining solution using Fourier series methods.
CO4:   Apply the Fourier transform techniques in engineering field.
CO5:   Gain the concept of analysis of linear discrete system using Z-transform approach.

**TEXT BOOKS**

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publications, 44th edition, 2017.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition Wiley India, 2016.

**REFERENCES BOOKS**

1. Andrews L.C and Shivamoggi. B.K., "Integral Transforms for Engineers", SPIE Press Book, 1999
2. Wylie C R and Barrett L C, "Advanced Engineering Mathematics", 6<sup>th</sup> Edition, McGraw-Hill Co., New Delhi, 1995.
3. T.Veerarajan,"Engineering Mathematics-III", Tata McGraw-Hill Publishing company, New Delhi,2015.
4. P.Kandasamy, K.Thilagavathy, K.Gunavathy, " Engineering Mathematics-III", S.Chand Publishers,2015.
5. V.Prameelakaladharan and G.Balaji ,"Engineering Mathematics-III", Amrutha marketing, Chennai,2016.

| | Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Co1 | Know the methods to solve partial differential equations occurring in various physical and engineering problems. | 3 | 3 | | | | | | | | | | | 3 | | |
| Co2 | Describe an oscillating function which appears in a variety of physical problems by Fourier series which helps them to understand its basic nature deeply. | 3 | 3 | | | | | | | | | | | 3 | | |
| Co3 | Acquire the knowledge to construct partial differential equations with initial and boundary conditions for various physical and engineering real time problems and obtaining solution using Fourier series methods. | 3 | 3 | | | | | | | | | | | 3 | | |
| Co4 | Apply the Fourier transform techniques in engineering field. | 3 | 3 | | | | | | | | | | | 3 | | |
| Co5 | Gain the concept of analysis of linear discrete system using Z-transform approach. | 3 | 3 | | | | | | | | | | | 3 | | |

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**318MET02**                    **ENGINEERING THERMODYNAMICS**                    **L  T  P  C**
                                                                                 **3  0  0  3**

**COURSE OBJECTIVES:**
- To study about the basic laws of thermodynamics.
- To know the concept of second law, entropy and availability.
- To analyze the performance of various thermodynamic cycles.
- To know the properties of ideal and real gases.
- To perform the calculations of air vapour mixtures using psychometric charts.

**UNIT I          BASIC CONCEPTS AND FIRST LAW OF THERMODYNAMICS                    12**

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 – applied to closed and open systems, Internal energy, Specific heat capacities, Enthalpy, Steady Flow Energy Equation applied to various thermal equipments.

**UNIT II          SECOND LAW  OF THERMODYNAMICS                    12**

Second law of thermodynamics – Kelvin's – Planck and Clausius statement. Reversibility and Irreversibility. Carnot theorem, Carnot cycle, Reversed carnot cycle, Efficiency, Coefficient of Performance (COP). Thermodynamic temperature scale, Entropy, Clausius Inequality, Principles of Entropy Increase, Entropy change in different processes, Availability & Irreversibility: Availability of a flow and non-flow process, Effectiveness & Irreversibility, Second law of Efficiencies of processes and cycles.

**UNIT III          PROPERTIES OF PURE SUBSTANCE AND STEAM POWER CYCLE                    12**

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, p-v-T 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                    12**

Gas mixtures – properties ideal and real gases, Equation of state, Avagadro's Law, Vander Waal's equation of state, Compressability factor, Compressability chart – Dalton's law of partial pressure, Exact differentials, Tds relations, Maxwell's relations, Clausius Clapeyron equations, Joule –Thomson coefficient.

**UNIT V          PSYCHROMETRY                    12**

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

                                                                 **TOTAL HOURS: 60 PERIODS**

(Use of standard steam tables, Mollier diagram, Psychometric chart and compressibility chart are permitted)

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**COURSE OUTCOMES**

The students will be able to

CO1: Describe the thermodynamic systems and apply first law of thermodynamics to analyze the systems.

CO2: Comprehend the second law of thermodynamics and determine the efficiencies of engines.

CO3: Acquire the knowledge to calculate specified parameters of various thermodynamic cycles.

CO4: Estimate thermodynamic properties of substances in gas or liquid state of ideal and real mixture.

CO5: Analyze the performance of various gas power cycles and to study the psychometric process.

**TEXT BOOKS**

1. Nag.P.K., "Engineering Thermodynamics", Fifth Edition, Tata McGraw-Hill Education, New Delhi, 6th Edition, 2017.
2. Yunus A Cengel and Michael A Boles, "Thermodynamics – An Engineering Approach", 8th Edition, Tata McGraw Hill Education, 2017.
3. Er.R.K.Rajput, "Engineering Thermodynamics", Fifth Edition, Lakshmi Publications, 2016.

**REFERENCE BOOKS**

1. Moran, Shapiro, Boether, Bailey, "Principles of Engineering Thermodynamics", Si version, Wiley Student, 8th Edition, 2015.
2. Merala C, Pother, Craig W, Somerton, "Thermodynamics for Engineers", Schaum Outline Series, Tata McGraw-Hill, New Delhi, 2004.
3. Rogers and Mayhew, "Engineering Thermodynamics", Longman Scientific, 4th Edition, 1996.
4. Holman.J.P., "Thermodynamics", 4th Edition, McGraw-Hill, 1988.

| | Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Co1 | Describe the thermodynamic systems and apply first law of thermodynamics to analyze the systems. | 3 | 2 | 1 | | | | | | | 1 | 1 | | 2 | | |
| Co2 | Comprehend the second law of thermodynamics and determine the efficiencies of engines. | 2 | 1 | 2 | 1 | | | | | | 1 | 1 | | 2 | | |
| Co3 | Acquire the knowledge to calculate specified parameters of various thermodynamic cycles. | 2 | 1 | 1 | | | | | | | 1 | 1 | | 2 | | |
| Co4 | Estimate thermodynamic properties of substances in gas or liquid state of ideal and real mixture. | 2 | 2 | 1 | | | | | | | 1 | 1 | | 2 | | |
| Co5 | Analyze the performance of various gas power cycles and to study the psychometric process. | 3 | 2 | 1 | | | | | | | 1 | 1 | | 3 | | |

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**318MET03**        **FLUID MECHANICS AND MACHINERY**        **L  T  P  C**
                                                                                **3  0  0  3**

**COURSE OBJECTIVES:**
- To familiarize with the properties of fluids and the applications of fluid mechanics.
- To derive and analyze the problems related to laminar and turbulent flow.
- To analyze the dimensional parameters and importance of dimensional analysis in various flow problems.
- To interpret the importance of various types of turbines and draw the velocity vector triangle.
- To learn the concepts of reciprocating and rotary pump.

**UNIT I**        **INTRODUCTION**        **9**

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**        **9**

Laminar flow though 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 though pipes in series and in parallel.

**UNIT III**        **DIMENSIONAL ANALYSIS**        **9**

Dimensions and units: Buckingham's Π theorem. Discussion on dimensionless parameters. Models and similitude. Applications of dimensionless parameters to the various flow problems.

**UNIT IV**        **ROTODYNAMIC MACHINES**        **10**

Elementary cascade theory, theory of turbomachines, Euler's equation, Classification of turbines – Heads and efficiencies – velocity triangles, Axial, Radial and Mixed flow turbines. Pelton wheel turbine, Francis turbine and Kaplan turbine – working principles, Centrifugal pump, Specific speed – unit quantities – performance curves for pumps and turbines.

**UNIT V**        **POSITIVE DISPLACEMENT MACHINES**        **8**

Classification of positive displacement machines - Reciprocating pumps - Indicator diagrams, Work saved by air vessels. Rotary pumps - Working Principle and performance curves.

                                                                     **TOTAL HOURS: 45 PERIODS**

**COURSE OUTCOMES**

The students will be able to

CO1:  Acquire the knowledge regarding basic concepts in fluid mechanics.

CO2:  Determine flow rates, pressure changes, minor and major head losses for laminar and turbulent flows through pipes.

CO3:  Determine the significance of dimensional parameters that influence the flow in fluid mechanics.

CO4:  Acquire knowledge and concepts of various turbine and centrifugal pump with drawing velocity vector triangle.

CO5:  Apply principles of fluid mechanics to the operation, design and selection of pumps.

**TEXT BOOKS**

1. Streeter. V. L., and Wylie, E.B., "Fluid Mechanics", McGraw Hill, 9th Edition, 2017.
2. Modi.P.N and Seth.S.M., "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi, 2017.
3. Bansal, R.K., "Fluid Mechanics and Hydraulics Machines", 21st Edition, Laxmi Publications (P) Ltd., New Delhi, 2017.
4. Rathakrishnan. E, "Fluid Mechanics", Prentice Hall of India, 3rd Edition, 2012.

**REFERENCE BOOKS**

1. Robert W Fox, Alan T. Mc Donald, Philip J Pritchard, "Introduction to Fluid Mechanics", Wiley, 6th Edition, 2013.
2. Munson B.R., Young D.F. and Okiisi.T.H., "Fundamentals of Fluid Mechanics", John Wiley and Sons Inc., New York, 6th Edition, 2009.
3. Kumar. K.L., "Engineering Fluid Mechanics", (7th Ed.) Eurasia Publishing House (P) Ltd., New Delhi, 2002.

| | **Course Outcome** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Co1** | Acquire the knowledge regarding basic concepts in fluid mechanics. | 2 | 2 | 1 | 3 | 1 | | | | | 1 | | | 3 | | |
| **Co2** | Determine flow rates, pressure changes, minor and major head losses for laminar and turbulent flows through pipes. | 2 | 2 | 1 | 3 | 1 | | | | | 1 | | | 3 | | |
| **Co3** | Determine the significance of dimensional parameters that influence the flow in fluid mechanics. | 3 | 2 | 1 | 3 | 1 | | | | | 1 | | | 3 | | |
| **Co4** | Acquire knowledge and concepts of various turbine and centrifugal pump with drawing velocity vector triangle. | 2 | 2 | 1 | 3 | 1 | | | | | 1 | | | 3 | | |
| **Co5** | Apply principles of fluid mechanics to the operation, design and selection of pumps. | 2 | 2 | 1 | 3 | 1 | | | | | 1 | | | 3 | | |

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**318MET04**                    **COMPOSITE MATERIALS**              **L  T  P  C**
                                                                      **3  0  0  3**

**COURSE OBJECTIVES:**
- To interpret the basic concepts of modern composite materials and their applications.
- To gain the knowledge on processing and applications of PMC.
- To identify the properties, advantages and disadvantages of the metal matrix composites.
- To analyze the different processing/ fabrication techniques of composite materials.
- To analyze the mechanics of laminated composites.

**UNIT I        INTRODUCTION TO COMPOSITES                                    9**
Fundamentals of composites - need for composites – enhancement of properties - classification of composites – Matrix-Polymer matrix composites (PMC), Metal matrix composites (MMC), Ceramic matrix composites (CMC) – Reinforcement – particle reinforced composites, Fibre reinforced composites, Hybrid composites. Applications of various types of composites.

**UNIT II       POLYMER MATRIX COMPOSITES                                     9**
Polymer resin – thermosetting resin, thermoplastic resin – reinforcement fibres – rovings – woven fabrics – nonwoven random mats – various types of fibres. PMC processes - Hand layup- Pre Pregs Process- Vacuum bag molding processes, Auto Clave Method – spray-up processes – compression molding –injection molding–Blow molding– Pultrusion – Filament winding. Fibre reinforced plastics (FRP), Glass Fibre Reinforced Plastics (GFRP), Recycling of PMCs.

**UNIT III      METAL MATRIX COMPOSITES                                       9**
Characteristics of MMC, various types of metal matrix composites alloy vs. MMC, Advantages of MMC, limitations of MMC, Reinforcements – particles – fibres. Effect of reinforcement - Processing of MMC – stir casting - powder metallurgy process–squeeze casting, a spray process, Liquid infiltration In-situ reactions- applications of MMC in automotive industries

**UNIT IV       CERAMIC MATRIX COMPOSITES                                     9**
Engineering ceramic materials – properties – advantages – limitations – monolithic ceramics - need for CMC – ceramic matrix - various types of ceramic matrix composites- oxide ceramics – non oxide ceramics – aluminium oxide – silicon nitride – reinforcements – particles- fibres whiskers, Carbon Carbon Composites (CCC). Sintering - Hot pressing – Cold isostatic pressing (CIPing) – Hot isostatic pressing (HIPing). Applications of CMC in automotive industries.

**UNIT V        MECHANICS OF LAMINATED COMPOSITES                             9**
Stress-strain relationship for anisotropic and orthotropic materials, Unidirectional laminas – Rule of mixtures, Volume fraction and weight fraction, Fibre length and fibre orientation distribution, voids, Strength of orthotropic lamina, Failure criteria of the orthotropic lamina, Macro mechanical behaviour of laminates – Interfacing Bonding Mechanics.

                                                **TOTAL HOURS: 45 PERIODS**

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**COURSE OUTCOMES**
CO1: The students become aware of different composite materials, reinforcement materials, matrix materials and their usages.
CO2: The students will have knowledge about different fabrication techniques for polymer matrix composites.
CO3: The students will have skills to evaluate properties and applications of metal matrix composite materials.
CO4: The students are able to develop their skills about fabrication techniques for ceramic matrix composites.
CO5: The students will have a thorough knowledge of micro & macro-structural analysis of orthotropic materials, derivation of equations and application to problem-solving.

**TEXT BOOKS**
1. Chawla K.K., "Composite Materials Science and Engineering", Springer, Third Edition, 2013.
2. Mallick P.K., "Fibre Reinforced Composites", CRC Press, Third Edition, 2008.

**REFERENCE BOOKS**
1. Mallick, P.K. and Newman. S., "Composite Materials Technology", Hanser Publishers, 2003.
2. Harold Belofsky, "Plastics, Product Design and Process Engineering", Hanser Publishers, 2002.
3. Matthews F.L. and Rawlings R.D, "Composite Materials: Engineering and Science", CRC Press and wood head Publish Limited, 2002.
4. Derek Hull, "An Introduction to Composite Materials", Second Edition, Cambridge University Press, 1996.

| | Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Co1 | The students become aware of different composite materials, reinforcement materials, matrix materials and their usages. | 3 | 1 | 1 | | 1 | | 1 | | 1 | | | | 1 | | 1 |
| Co2 | The students will have knowledge about different fabrication techniques for polymer matrix composites. | 1 | | 1 | | 1 | | | | 1 | | | | 2 | | 1 |
| Co3 | The students will have skills to evaluate properties and applications of metal matrix composite materials. | 1 | | 1 | | 1 | | | | 1 | | | | 2 | | 1 |
| Co4 | The students are able to develop their skills about fabrication techniques for ceramic matrix composites. | 1 | | 1 | | 1 | | | | 1 | | | | 2 | | 1 |
| Co5 | The students will have a thorough knowledge of micro & macro-structural analysis of orthotropic materials, derivation of equations and application to problem-solving. | 1 | | 1 | | 1 | | | | 1 | | | | 2 | | 1 |

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**318MET05**  **MANUFACTURING TECHNOLOGY – I**  **L T P C**
**3 0 0 3**

**COURSE OBJECTIVES:**
- To comprehend the basic concepts of sand casting technique and special casting techniques.
- To know about the working principles, equipment's of different welding techniques.
- To know the various operations and equipments required for hot and cold metal forming processes.
- To understand the working principle and applications of different types of sheet metal processes.
- To understand the working principles of different types of thermo plastic manufacturing methods.

**UNIT I**  **METAL CASTING PROCESSES**  **9**

Introduction to casting - Type of patterns – Pattern materials – Pattern allowances – Types of Green sand Moulding –Moulding sand – Properties – Core making - Melting furnaces –Electric Arc Furnace – Induction furnace - Special casting processes – Investment casting – Pressure die casting – Centrifugal casting – $CO_2$ process – Sand Casting defects – Inspection methods.

**UNIT II**  **JOINING PROCESSES**  **9**

Welding processes and its classifications –Gas welding – Flame characteristics –Arc welding types - Electrodes – Coating and specifications – Principles of Resistance welding – Spot/butt, Seam welding - Gas metal arc welding –Submerged arc welding – TIG welding – Principle and application of special welding processes - Plasma arc welding – Thermit welding – Electron beam welding – Friction welding – Friction Stir Welding – Weld defects – Brazing and soldering process.

**UNIT III**  **BULK DEFORMATION PROCESSES**  **9**

Hot working and cold working of metals – Forging processes – Open and closed die forging –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.

**UNIT IV**  **SHEET METAL PROCESSES**  **9**

Sheet metal characteristics - Typical shearing operations, bending and drawing operations – Stretch forming operations – 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**  **9**

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

**TOTAL HOURS: 45 PERIODS**

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## COURSE OUTCOMES

The students will have ability to

CO1: Explain the requirements, process, applications and defects of sand casting and special casting processes.

CO2: Explain the working principles and applications of different arc welding processes, special welding processes and defects associated with it.

CO3: Select the suitable process for manufacturing of components among forging, rolling, drawing, extrusion and its types.

CO4: Explain the principles and working of shearing, bending, drawing and forming in sheet metal.

CO5: Judge the suitability of a plastic manufacturing process based on application requirements.

## TEXT BOOKS

1. Rao P.N, "Manufacturing Technology", Tata McGraw-Hill Publishing Limited, 5th Edition, 2018.
2. Hajra Choudhury, "Elements of Workshop Technology Vol. I", Media Promotors Pvt Ltd., Mumbai, 15th Edition, 2013.
3. Gowri S, P.Hariharan, and A.Suresh Babu, "Manufacturing Technology I", Pearson Education, 2008.

## REFERENCE BOOKS

1. Serope Kalpakjian, Steven R.Schmid, "Manufacturing Engineering and Technology", Pearson Education, 7th Edition, 2018.
2. Jain R.K, "Production Technology", Khanna Publishers, 17th Edition, 2012.
3. Khanna O.P, "Foundry technology", Dhanpat Rai Publications, 2011.
4. Sharma P.C, "A Text Book of Production Technology", S. Chand and Company, IV Edition, 2009.
5. Rajput R.K, "A Text Book of Manufacturing Technology", Lakshmi Publications, 2007.
6. Beddoes.J and Bibby M.J, "Principles of Metal Manufacturing Processes", Elsevier, 2006.
7. Begeman, "Manufacturing Process", John Wiley & Sons, VIII Edition, 2005.
8. Nagendra Parashar B.S & R.K. Mittal, "Elements of Manufacturing Processes", Prentice Hall of India, 2005.
9. Parmer R. S, "Welding processes and Technology", Khanna Publishers, 3rd Edition, 2003.

| Course Outcome | | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Co1 | Explain the requirements, process, applications and defects of sand casting and special casting processes. | 3 | | | | | | | | | | | | 2 | | |
| Co2 | Explain the working principles and applications of different arc welding processes, special welding processes and defects associated with it. | 3 | 2 | 1 | 3 | 3 | | | | | | | | 3 | | |
| Co3 | Select the suitable process for manufacturing of components among forging, rolling, drawing, extrusion and its types. | 3 | 3 | 2 | 3 | 3 | | | | | | | | 3 | | 1 |
| Co4 | Explain the principles and working of shearing, bending, drawing and forming in sheet metal. | 3 | 1 | 2 | 3 | 3 | | | | | | | | 3 | | 2 |
| Co5 | Judge the suitability of a plastic manufacturing process based on application requirements. | 3 | 2 | 1 | 2 | | | | | | | | | 2 | 2 | |

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**318MEP07**          **FLUID MECHANICS AND MACHINERY LABORATORY**          **L T P C**
                                                                              **0 0 2 1**

**COURSE OBJECTIVES:**
- To gain the knowledge in flow measuring devices such as venturimeter, orificemeter and rotameter.
- To gain knowledge about flow through different pipes.
- To provide practice in estimating friction losses.
- To study the performance characteristics for centrifugal, reciprocating, gear oil and submersible pump.
- To study the performance characteristics for Pelton wheel, Francis and Kaplan turbine.

**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.

**TOTAL HOURS: 45 PERIODS**

**COURSE OUTCOMES**
The students will be able to
CO1:  Measure flow through the venturimeter, orifice meter and rotometer.
CO2:  Acquire knowledge in flow through different pipes.
CO3:  Determine the friction factor for a given set of pipes.
CO4:  Draw the characteristics curve for centrifugal, reciprocating, gear oil and submersible pump.
CO5:  Draw the characteristics curve for Pelton wheel, Francis and Kaplan turbine.

| | Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Co1 | Measure flow through the venturimeter, orifice meter and rotometer. | 2 | 1 | | 2 | | | | | | 1 | | | 2 | | |
| Co2 | Acquire knowledge in flow through different pipes. | 2 | 1 | | 2 | | | | | | 1 | | | 2 | | |
| Co3 | Determine the friction factor for a given set of pipes. | 2 | 1 | | 2 | | | | | | 1 | | | 2 | | |
| Co4 | Draw the characteristics curve for centrifugal, reciprocating, gear oil and submersible pump. | 2 | 1 | | 2 | | | | | | 1 | | | 2 | | |
| Co5 | Draw the characteristics curve for Pelton wheel, Francis and Kaplan turbine. | 2 | 1 | | 2 | | | | | | 1 | | | 2 | | |

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**318MEP08**          **MANUFACTURING TECHNOLOGY LABORATORY – I**          **L  T  P  C**
                                                                                            **0  0  2  1**

**COURSE OBJECTIVES:**
- To know about basic machining processes.
- To get practical knowledge on Lathe machine operations.
- To gain the knowledge on foundry concepts.
- To perform production of contour shapes on the given component.
- To learn about injection moulding.

**LIST OF EXPERIMENTS**
1. Facing, plain turning and step turning.
2. Taper turning using compound rest, Tailstock set over, etc.
3. Single and Multi-start V- thread cutting and knurling.
4. Drilling, Boring and internal thread cutting.
5. Mould with solid, split patterns.
6. Mould with loose-piece pattern.
7. Mould with Core.
8. Cold Forging.
9. Injection Moulding- for demonstration purpose.
10. Spot Welding.

                                                              **TOTAL HOURS: 45 PERIODS**

**COURSE OUTCOMES**
CO1:   The students are capable to perform plain turning, taper turning, thread cutting, knurling, drilling, reaming and tapping etc.
CO2:   Ability to know about the basic concepts of cold forging operations.
CO3:   Ability to know the concepts of foundry technology and to develop skills on sand casting.
CO4:   Students can get the knowledge on applications on welding operation.
CO5:   Students can demonstrate and fabricate different types of components using the machine tools.

| | Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Co1** | The students are capable to perform plain turning, taper turning, thread cutting, knurling, drilling, reaming and tapping etc. | 1 | 1 | 2 | 3 | | | | | | | | | 2 | | |
| **Co2** | Ability to know about the basic concepts of cold forging operations. | 1 | 2 | 3 | 2 | 1 | | | | | | | | 2 | | 1 |
| **Co3** | Ability to know the concepts of foundry technology and to develop skills on sand casting. | 1 | 1 | 3 | 2 | 1 | | | | | | | | 2 | | 2 |
| **Co4** | Students can get the knowledge on applications on welding operation. | 1 | 1 | 2 | 3 | 1 | | | | | | | | 1 | | 1 |
| **Co5** | Students can demonstrate and fabricate different types of components using the machine tools. | 1 | 1 | 2 | 3 | 1 | | 2 | | | | | | 2 | | 1 |

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**418SNT01**  **STATISTICS AND NUMERICAL METHODS**   **L  T  P  C**
                                                                      **3  0  0  3**

**COURSE OBJECTIVES:**
- To solve equations using direct and iterative methods.
- To introduce interpolation techniques and to study the principle of numerical differentiation and integration.
- To learn some of the methods of numerical solutions of ordinary differential equations with initial conditions.
- To introduce the notion of sampling distributions and acquire the knowledge of statistical techniques useful in decision making.
- To expose the statistical methods for analysis of variance and control limits.

**UNIT I       SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS           12**
Newton-Raphson method- Direct Methods-Gauss Elimination method-Gauss-Jordan methods – Iterative methods of Gauss-Jacobi and Gauss-Seidel – Eigenvalues of a matrix by Power method.

**UNIT II       INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION      12**
Newton's forward and backward difference interpolation - Lagrange's and Newton's divided difference interpolation - Approximation of derivatives using interpolation polynomials - Numerical integration using Trapezoidal and Simpson's $1/3^{rd}$ and $3/8^{th}$ rules.

**UNIT III       NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS         12**
Taylor's series method - Euler's method - Modified Euler's method - Fourth order Runge-Kutta method for solving first order equations - Predictor-Corrector methods for solving first order equations: Milne's Method and Adam-Bashforth Method.

**UNIT IV       TESTING OF HYPOTHESIS                                      12**
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 V       DESIGN OF EXPERIMENTS                                      12**
Analysis of variance – Completely Randomized Design (CRD) -one way classification – Randomised Block Design (RBD) -two way classification - Latin Square Design (LSD) – Factorial Designs- $2^2$ Factorial designs- Control charts for measurements - $\overline{x}$ chart, R-chart, $p$ - chart and $np$ – chart.
*Note: Use of approved statistical table is permitted in the examination.*

**TOTAL HOURS: 60 PERIODS**

**COURSE OUTCOMES**
At the end of the course the student will be able to
CO1:  Apply numerical methods such as direct, iterative and interpolation to solve algebraic or transcendental equations and system of equations.
CO2:  Appreciate numerical solutions for differential and integral calculus as a handy tool to solve problems.
CO3:  Implement numerical algorithms to find solutions for intial value problems for ordinary differential equations
CO4:  Draw inference and decision making through hypothesis testing.
CO5:  Acquaint the knowledge of analysis of variance and control limits.

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## TEXT BOOKS

1. Grewal, B.S. and Grewal,J.S., " Numerical methods in Engineering and Science", 6th Edition, Khanna Publishers, New Delhi, 2004.
2. Miller and Freund., "Probability and Statistics for Engineers", Pearson Education, Asia, 7th edition, 2012.

## REFERENCE BOOKS

1. Richard L.Burden and J.Dougles Faires, "Numerical Analysis", Ninth Edition, BROOKS/COLE, Cengage.com.,2012. Visit www.cengage.com/international.
2. R.E. Walpole, R.H. Myers, S.L. Myers, and K Ye, "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia , 8th edition, 2007.
3. Veerarajan.T., "Probability, Statistics and Random Processes", Tata McGraw-Hill publishing company Limited, New Delhi, 2014.
4. S.S.Sastry, "Introductory Methods of Numerical Analysis", 5th Edition, Prentice Hall of India Private Ltd., New Delhi, 2012.
5. Gupta.S.C., & Kapoor,V.K., "Fundamentals of mathematical statistics", 11th edition, Sultan Chand & Sons publishers, New Delhi, 2013.

| Course Outcome | | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Co1 | Apply numerical methods such as direct, iterative and interpolation to solve algebraic or transcendental equations and system of equations. | 3 | 3 | | 1 | | | | | | | | | 3 | | |
| Co2 | Appreciate numerical solutions for differential and integral calculus as a handy tool to solve problems. | 3 | 3 | | 1 | | | | | | | | | 3 | | |
| Co3 | Implement numerical algorithms to find solutions for intial value problems for ordinary differential equations | 3 | 3 | | 1 | | | | | | | | | 3 | | |
| Co4 | Draw inference and decision making through hypothesis testing. | 3 | 3 | | 1 | | | | | | | | 1 | 3 | | |
| Co5 | Acquaint the knowledge of analysis of variance and control limits. | 3 | 3 | | 1 | | | | | | | | 1 | 3 | | |

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**418MET02**                     **KINEMATICS OF MACHINERY**              L  T  P  C
                                                                        3  0  0  3

**COURSE OBJECTIVES:**
- To differentiate between machine, mechanism and structure.
- To draw velocity and acceleration diagrams for different linkages.
- To design cam profile for the desired follower motion.
- To determine gear parameters and check for interference.
- To synthesis linkages for different mechanisms.

**PRE-REQUISITES:** Knowledge of Engineering Mechanics is required

**UNIT I          BASICS OF MECHANISMS                                        9**
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, Quick return mechanisms, Pantograph, Exact and Approximate straight line generators, Steering gear for automobile, Hooke's joint, Toggle mechanism, Ratchets and escapements, Indexing Mechanisms.

**UNIT II          KINEMATIC ANALYSIS                                          9**
Displacement, velocity and acceleration analysis of simple mechanisms using graphical method, graphical velocity analysis using instantaneous centers, Coincident points, Coriolis acceleration, Analytical method of analysis - slider crank mechanism, and four bar mechanism.

**UNIT III         KINEMATICS OF CAMS                                          9**
Classifications of Cams and followers -Displacement diagrams – Uniform Velocity, Parabolic, Simple harmonic and Cycloidal motions, derivatives of follower motions, Graphical construction of displacement diagrams and layout of plate cam profiles - circular arc and tangent cams, Pressure angle and undercutting, sizing of cam.

**UNIT IV          GEARS & GEAR TRAINS                                         9**
Classification of gears, Spur gear - terminology, involute and cycloidal gear profiles - Fundamental Law of toothed gearing, Length of path of contact and contact ratio, Interference and undercutting. Gear trains – Simple, compound, Epicyclic gear trains and Differentials.

**UNIT V           SYNTHESIS OF LINKAGES                                       9**
Numbers and Dimensional synthesis- Functional generation, path generation and motion generation-Graphical methods-Two and three position synthesis of slider crank and four bar mechanism using function generation method– Frudenstein Equation.

                                                            **TOTAL HOURS: 45 PERIODS**

**COURSE OUTCOMES**
The students will be able to
CO1: Demonstrate the simple mechanisms with suitable examples.
CO2: Determine displacement, velocity and acceleration of any point on a link in simple mechanism.
CO3: Construct cam profile for various follower motions
CO4: Describe law of gearing, types of gears, terminologies of spur gears and gear trains.
CO5: Analyze and synthesis position, velocity and acceleration for various mechanisms

**TEXT BOOKS**
1. Rattan S.S, "Theory of Machines", Tata McGraw Hill Education Pvt. Ltd., 5th Edition, 2020.
2. Robert L. Norton, "Design of Machinery", Tata Mc Graw Hill, 2012.

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**REFERENCE BOOKS**
1. Ambekar A. G., "Mechanism and Machine Theory", Prentice Hall of India, New Delhi, 2015.
2. UickerJ.J., Pennock G.R., Shigley J.E., "Theory of Machines and Mechanisms" (Indian Edition), Oxford University Press, 2017.
3. Rao J.S and Dukkipati R.V, "Mechanism and Machine Theory", Wiley-Eastern Ltd., New Delhi, 2007.
4. Thomas Bevan, "Theory of Machines", CBS Publishers and Distributors, 2005.
5. Khurmi R.S, "Theory of Machines", S. Chand & Co. Ltd., New Delhi, 14th Edition, 2005.
6. Ramamurti,V., "Mechanism and Machine Theory", Second Edition, Narosa Publishing House, 2005.
7. John Hannah and Stephens R.C, "Mechanics of Machines", Viva Low-Price Student Edition, 1999.
8. Ghosh A and A.K.Mallick, "Theory of Mechanisms and Machines", Affiliated East-West Pvt. Ltd., New Delhi, 2020.

| | Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Co1 | Demonstrate the simple mechanisms with suitable examples. | 1 | 2 | 1 | | | | | | | | | | 1 | | |
| Co2 | Determine displacement, velocity and acceleration of any point on a link in simple mechanism. | 1 | 2 | 1 | | | | | | | 1 | | | 1 | | 1 |
| Co3 | Construct cam profile for various follower motions | 1 | 2 | 2 | | | | | | | 1 | | | 1 | | 1 |
| Co4 | Describe law of gearing, types of gears, terminologies of spur gears and gear trains. | 1 | 2 | 1 | | | | | | | 1 | | | | | |
| Co5 | Analyze and synthesis position, velocity and acceleration for various mechanisms | 1 | 2 | 2 | | 1 | | 1 | | | | | | 2 | | 2 |

**418MET03**                    **THERMAL ENGINEERING**                    L  T  P  C
                                                                           3  0  0  3

**COURSE OBJECTIVES:**
- To understand various process in air standard cycles.
- To understand the basic concepts in air compressors
- To familiarize with the principles, working of internal combustion engines and combustion.
- To learn the performance of Internal combustion engines
- To study the basic principles of refrigeration systems.

**PRE-REQUISITES:** Knowledge of Engineering Thermodynamics is required.

**UNIT I        AIR STANDARD CYCLES                                              10**
Air standard cycles – Assumptions - Otto, Diesel, Dual, Brayton cycles, Calculation of mean effective pressure and air standard efficiency – Comparison of cycles -Actual and Theoretical P-V diagram of two stroke and four stroke engines.

**UNIT II        AIR COMPRESSOR                                                    9**
Classification and working principle of reciprocating air compressor, work of compression with and without clearance, Volumetric efficiency, Isothermal efficiency - Isentropic efficiency of reciprocating air compressors, Multi stage air compressor and Inter cooling -Work of multi stage air compressor.

**UNIT III        INTERNAL COMBUSTION ENGINES AND COMBUSTION                      9**
IC engine – Classification, working, components and their functions. Ideal and actual: Valve and port timing diagrams, SI and CI engines – comparison. Chemical reactions, fuel properties, flue gas analysis, Heating values –HCF and LCF analysis. Minimum air flow requirement for combustion. Fuel ratings: Octane and Cetane numbers, knocking / detonation, adiabatic flame temperature.

**UNIT IV        INTERNAL COMBUSTION ENGINE PERFORMANCE AND SYSTEMS              9**
Performance parameters and calculations, Morse and Heat Balance tests, Multipoint fuel injection system and Common Rail Direct injection systems, Ignition systems – Magneto, battery and electronic, Lubrication and Cooling systems, Concepts of supercharging and turbo charging – Emission measurement, emission reduction techniques.

**UNIT V        REFRIGERATION SYSTEMS                                             8**
Refrigerants –Working principle of vapour compression systems - use of T-s and p-h diagrams, Effect of sub cooling and super heating – Performance calculations – working principle of vapour absorption system - Comparison between vapour compression and absorption systems, Construction and working of Ammonia – Water, Lithium bromide – water systems (Description only)
**(Use of standard Refrigerant property data book are permitted.)**
                                                          **TOTAL HOURS: 45 PERIODS**

**COURSE OUTCOMES**
Students will able to
CO1:  Calculate the mean effective pressure and air standard efficiency of different gas power cycles.
CO2:  Calculate the efficiency of reciprocating air compressor
CO3:  Acquire the basic concepts of Internal combustion engines and combustion
CO4:  Evaluate the performance test on IC engine.
CO5:  Evaluate COP of vapour compression refrigeration systems.

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**TEXT BOOKS**

1. Rajput. R. K., "Thermal Engineering", Laxmi Publications (P) Ltd., 10<sup>th</sup> Edition, 2017.
2. Kothandaraman.C.P., Domkundwar.S, Domkundwar. A.V., "A Course in Thermal Engineering", Dhanpat Rai & sons, 9<sup>th</sup> Edition, 2016.

**REFERENCE BOOKS**

1. Ganesan V., "Internal Combustion Engines", Fourth Edition, Tata McGraw-Hill Publishers, 2017.
2. Sarkar, B.K, "Thermal Engineering" Tata McGraw-Hill Publishers, 2017.
3. Rudramoorthy, R, "Thermal Engineering ", Tata McGraw-Hill Publishers, New Delhi, 2017.
4. Arora.C.P, "Refrigeration and Air Conditioning", Tata McGraw-Hill Publishers, 3<sup>rd</sup> Edition, 2013.

| | Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Co1 | Calculate the mean effective pressure and air standard efficiency of different gas power cycles. | 3 | 2 | 1 | | | | | | 1 | 1 | 1 | | 2 | | 1 |
| Co2 | Calculate the efficiency of reciprocating air compressor | 3 | 2 | 1 | | | | | | 1 | 1 | 1 | | 2 | | 1 |
| Co3 | Acquire the basic concepts of Internal combustion engines and combustion | 3 | 2 | 1 | | | | | | 1 | 1 | 1 | 1 | 2 | | 1 |
| Co4 | Evaluate the performance test on IC engine. | 3 | 2 | 1 | | | | | | 1 | 1 | 1 | | 2 | | 1 |
| Co5 | Evaluate COP of vapour compression refrigeration systems. | 3 | 2 | 1 | | | | | | 1 | 1 | 1 | | 2 | | 1 |

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**418MET04**                     **STRENGTH OF MATERIALS**                     L  T  P  C
                                                                              3  0  0  3

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

**PRE-REQUISITES:** Knowledge of Engineering Mechanics is required.

**UNIT I          STRESS, STRAIN AND DEFORMATION OF SOLIDS                     9**
Rigid bodies and deformable solids – Simple stresses and strains in tension, compression and shear– Stress strain diagrams- Factor of safety-Poisson's ratio-Deformation of simple, compound and composite bars– Hooke's law– Elastic constants and their relation – Volumetric strains, Thermal stresses, State of stress in two dimensions - Stresses on inclined planes – Principal stresses - Principal planes – Maximum shear stress- Mohr's circle of stresses.

**UNIT II          TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAM           9**
Beam - Types of beams– Types of transverse loading on beams – Shear force and bending moment in beams – Cantilevers – Simply supported beams - Over hanging beams. Theory of simple bending– Bending stress distribution for beam sections – Section modulus for beam sections – Flitched beams – Shear stress distribution for beam sections.

**UNIT III          TORSION                                                    9**
Torsion formulation stresses and deformation in solid and hollow circular shafts – Power transmitted to shaft – Shaft in series and parallel, Stresses in helical springs – Deflection of helical springs – Springs in series and parallel-Various spring applications.

**UNIT IV          DEFLECTION OF BEAMS AND COLUMNS                             9**
Computation of slopes and deflections in beams using Double Integration method, Macaulay's method and Area moment method.
Columns – End conditions, equivalent length of a column, Euler's equation, Slenderness ratio, Rankine's formula for columns.

**UNIT V          SPHERES, THIN AND THICK CYLINDERS                            9**
Stresses in thin and thick cylindrical shell due to internal pressure in circumferential and longitudinal - Deformation in thin and thick cylinders – Lame's theorem for thick cylinders-    Spherical shells subjected to internal pressure –Deformation in spherical shells.
                                                              **TOTAL HOURS: 45 PERIODS**

**COURSE OUTCOMES**
Students will be able to
CO1:  Understand the concepts of stress and strain in simple and compound bars, the importance of principal stresses and principal planes.
CO2:  Understand the load transferring mechanism in beams and stress distribution due to shearing force and bending moment.
CO3:  Apply basic equation of simple torsion in designing of shafts and helical spring
CO4:  Calculate the slope and deflection in beams and columns using different methods.
CO5:  Analyze and design thin and thick shells for the applied internal and external pressures.

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**TEXT BOOKS**

1. Dr R. K. Bansal, "Strength of Materials" 4th Edition, Laxmi Publications (P) Ltd., 2018
2. R. K. Rajput, "Strength of Materials", Laxmi Publications (P) Ltd., 2018

**REFERENCE BOOKS**

1. Jindal U.C., "Strength of Materials", Asian Books Pvt. Ltd., New Delhi, 2016
2. Egor. P.Popov "Engineering Mechanics of Solids" Prentice Hall of India, New Delhi, 2015
3. Ferdinand P. Been, Russell Johnson, J.r. and John J. Dewole, "Mechanics of Materials", Tata McGraw Hill Publishing 'co. Ltd., New Delhi, 2005.
4. Hibbeler, R.C., "Mechanics of Materials", Pearson Education, Low Price Edition, 2013
5. Subramanian R., "Strength of Materials", Oxford University Press, Oxford Higher Education Series, 2010.

| | Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Co1 | Understand the concepts of stress and strain in simple and compound bars, the importance of principal stresses and principal planes. | 2 | 2 | 3 | 1 | | | | | | | | | 2 | | |
| Co2 | Understand the load transferring mechanism in beams and stress distribution due to shearing force and bending moment. | 2 | 1 | 2 | 1 | | | | | 2 | | | | 2 | 1 | |
| Co3 | Apply basic equation of simple torsion in designing of shafts and helical spring | 2 | 2 | 3 | 2 | | | | | | | | | 2 | | |
| Co4 | Calculate the slope and deflection in beams and columns using different methods. | 2 | 2 | 3 | 2 | | | | | | | | | 2 | | |
| Co5 | Analyze and design thin and thick shells for the applied internal and external pressures. | 2 | 2 | 3 | | | | | | | | | | 2 | | |

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**418MET05**　　　　　**MANUFACTURING TECHNOLOGY – II**　　　　**L　T　P　C**
　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　**3　0　0　3**

**COURSE OBJECTIVES:**
- To know the fundamentals of metal cutting like cutting forces, tool materials, tool life, surface finish (machinability).
- To learn the parts and working principle of centre lathe and special purpose lathes.
- To gain the knowledge about special purpose machines used in industrial application.
- To study the abrasive processes and gear cutting.
- Able to know about basic usage of CNC machines, its construction and learning about program.

**PRE-REQUISITES:** Knowledge of Manufacturing Technology I and Engineering Materials and Metallurgy is required.

**UNIT I　　　THEORY OF METAL CUTTING　　　　　　　　　　　　　9**
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　　　　9**
Centre lathe, constructional features, cutting tool geometry, various operations, 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　　　SPECIAL PURPOSE MACHINES　　　　　　　　　　　9**
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　　　　　　9**
Abrasive processes: grinding wheel – specification and selection, types of grinding process – cylindrical grinding, surface grinding, Centreless grinding – Honing, Lapping, Super finishing, Polishing and Buffing, Gear cutting, Forming, Generation, Shaping, Hobbing.

**UNIT V　　　CNC MACHINE TOOLS AND PART PROGRAMMING　　　　9**
Numerical control (NC) machine tools – CNC: types, constructional details, special features – Structural members – Slide ways –Linear bearings – Ball screws – Spindle drives and feed drives, Part Programming fundamentals – Manual programming – Computer Assisted Part Programming**.**

　　　　　　　　　　　　　　　　　　　　　　　　　　**TOTAL HOURS: 45 PERIODS**

**COURSE OUTCOMES**
　The students will be able to
CO1:　Gain the knowledge on the fundamentals of metal cutting, merchant circle diagram, to solve tool life problems, types of wear, tool-tip temperature.
CO2:　Learn various types of centre lathe and special purpose lathes.
CO3:　Learn various types and operations of drilling machine, boring and reaming, broaching, shaping and planning, grinding, honing, lapping and super finishing operations.
CO4:　Learn the manufacturing processes of abrasive processes and gear cutting.
CO5:　Know the concepts of Part programming and about CNC machine tools.

**TEXT BOOKS**

1. Narang J.S., "CNC Machines and Automation", Dhanpat Rai & Co., 2016.
2. P.N. Rao, "Manufacturing Technology - Metal Cutting and Machine Tools (Vol-2)", Tata McGraw–Hill, New Delhi, 3rd Edition, 2013.
3. Hajra Choudry, "Elements of Work Shop Technology – Vol. II", Media Promoters, 2010.

**REFERENCE BOOKS**

1. Chapman. W. A. J, "Workshop Technology", Volume 3, CBS Publishers, 2018.
2. Serope KalpakJian, Steven R Schmid, "Manufacturing Engineering and Technology", Pearson, 7th Edition, 2013.
3. Milton C.Shaw, "Metal Cutting Principles", Oxford University Press, Second Edition, 2011.
4. P.N. Rao, "CAD/CAM Principles and Applications", Tata McGraw Hill, 3rd Edition 2011.
5. P.C. Sharma, "A Text Book of Production Engineering", S. Chand and Co. Ltd, 2010.
6. Rajput R.K, "A Text Book of Manufacturing Technology", Lakshmi Publications, 2010.
7. M.P.Groover and Zimers Jr., "CAD/CAM", Prentice Hall of India Ltd., 1st Edition, 2006.
8. HMT – "Production Technology", Tata McGraw-Hill, 23rd Edition, 2005.

| | Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Co1 | Gain the knowledge on the fundamentals of metal cutting, merchant circle diagram, to solve tool life problems, types of wear, tool-tip temperature. | 3 | | | | | | | | | | | | 2 | | |
| Co2 | Learn various types of centre lathe and special purpose lathes. | 3 | 2 | 1 | 3 | 3 | | | | | | | | 3 | | |
| Co3 | Learn various types and operations of drilling machine, boring and reaming, broaching, shaping and planning, grinding, honing, lapping and super finishing operations. | 3 | 3 | 2 | 3 | 3 | | | | | | | | 3 | | 1 |
| Co4 | Learn the manufacturing processes of abrasive processes and gear cutting. | 3 | 1 | 2 | 3 | 3 | | | | | | | | 3 | | 2 |
| Co5 | Know the concepts of Part programming and about CNC machine tools. | 3 | 2 | 1 | 2 | | | | | | | | | 2 | 2 | |

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| 418MET06 | PROCESS PLANNING AND COST ESTIMATION | L | T | P | C |
|----------|--------------------------------------|---|---|---|---|
|          |                                      | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

- To know the use of work study leads to high productivity in a manufacturing unit.
- To study the steps involved in conducting a method study and apply the principles of motion economics.
- To know the importance of process planning in manufacturing environment.
- To get knowledge on step by step procedures in the cost estimation of any product.
- To learn the concept of pricing of material.

**UNIT I          WORK STUDY AND ERGONOMICS                                                 10**

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                                                          10**

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 AND BREAK EVEN ANALYSIS                  7**

Objective of cost estimation- costing - Cost accounting- classification of cost- Elements of cost – Break Even Analysis – Basic assumptions – Problems on Break Even Analysis – Break Even chart – Managerial use of Break Even Analysis.

**UNIT IV          COST ESTIMATION AND PRICING                                               8**

Types of estimates - Methods of estimates - Data requirements and sources- Collection of cost- Allowances in estimation. Pricing practice – Full cost pricing – Marginal cost pricing – Going rate pricing – Bid pricing – Pricing for a rate of return.

**UNIT V          PRODUCTION COST ESTIMATION                                                10**

Estimation of material cost, Labour cost and over heads, Allocation of overheads - Estimation for different types of jobs. Internal rate of return – Payback period – Net present value – Calculations on Cost benefit analysis.

**TOTAL HOURS: 45 PERIODS**

**COURSE OUTCOMES**

CO1: The students can make analyze on the techniques of work study and principles of ergonomics.
CO2: The students will know the concept of process planning and cost estimation for various product and process of industry.
CO3: The students will be familiar with types of estimation, pricing methods and production cost estimation.
CO4: The student will have an ability to know about the calculations of finding internal rate of return, net present value and payback period.
CO5: The students will have knowledge about estimation of production costs.

**TEXT BOOKS**

1. T.R. Banga and S.C.Sharma, "Mechanical Estimating and Costing", Khanna Publishers, 16th Edition, 2011.
2. Sinha.B.P., "Mechanical Estimating and Costing", Tata McGraw-Hill, Publishing Co., 2000.

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**REFERENCE BOOKS**
1. Varshney R.L and Maheshwari K.L., "Managerial Economics", S.Chand & Co., 2014.
2. Russell.R.S and Tailor, B.W, "Operations Management", Prentice Hall of India, 7th Edition, 2011.
3. Khan M.Y. and Jain P.K., "Financial Management", McGraw-Hill Publishing Co. Ltd, 6th Edition, 2011.
4. Kesavan R K, "Process Planning and Cost Estimation", New Age International (P) Ltd, 2009.
5. Dewett K.K and Jain J.D., "Elementary Economic Theory", S.Chand & Co., 2006.
6. Adithan M and Pabla B S, "Production Engineering Estimating and Costing", Konark Publishers, 1990

| | Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Co1 | The students can make analyze on the techniques of work study and principles of ergonomics. | | 2 | | 1 | | | | | | | | 1 | 1 | | 1 |
| Co2 | The students will know the concept of process planning and cost estimation for various product and process of industry. | 3 | 2 | | | | | | | | 1 | | | 3 | | 2 |
| Co3 | The students will be familiar with types of estimation, pricing methods and production cost estimation. | 3 | 2 | | 2 | 2 | | | | | 1 | | | 3 | | |
| Co4 | The student will have an ability to know about the calculations of finding internal rate of return, net present value and payback period. | | 1 | | 2 | | | | | | | | 2 | | | 2 |
| Co5 | The students will have knowledge about estimation of production costs. | | | | | | | | 2 | | 3 | 2 | | 2 | | |

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**418MEP07**        **THERMAL ENGINEERING LABORATORY – I**        **L  T  P  C**
                                                                  **0  0  3  1**

**COURSE OBJECTIVES:**
- To expertise in the various thermodynamic concepts and principles.
- To conduct performance tests on a petrol engine and diesel engine, heat balance test, energy balance test on 4 stroke diesel engine.
- To expertise in the computerized VCR and emission measurement in S.I engine.
- To expertise in the computerized VCR and emission measurement in C.I engine.
- To compare justification on conventional fuel with alternative fuel.

**PRE-REQUISITES:** Knowledge of Engineering Thermodynamics and Thermal Engineering are required.

**LIST OF EXPERIMENTS**
**CYCLE – 1**
1. Valve Timing Diagram and Port Timing Diagram.
2. Performance Test on 4-stroke S.I Engine.
3. Performance Test on 4-stroke C.I Engine.
4. Heat Balance Test on 4-stroke Diesel Engine.
5. Morse Test on Multi - cylinder Petrol Engine.
6. Retardation Test to find Frictional Power of a Diesel Engine.

**CYCLE – 2**
7. Performance Test on Computerised VCR Engine.
8. Emission measurement in VCR Engine.
9. Determination of Viscosity of fuel oils.
10. Determination of Flash Point and Fire Point of fuel.
11. Boiler efficiency and energy balance sheet.
12. Performance Test on two stage Reciprocating Air Compressor.

                                                        **TOTAL HOURS: 45 PERIODS**
**COURSE OUTCOMES**
Students will able to
CO1:   Draw the valve and port timing diagram.
CO2:   Perform experiments on the engine and draw the characteristics curve.
CO3:   Perform experiments on computerised VCR S.I and C.I Engine.
CO4:   Perform experiments on two stage Reciprocating Air Compressor and draw the characteristics curve.
CO5:   Perform experiments to determine the properties of fuels and oils.

| | Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Co1 | Draw the valve and port timing diagram. | | 2 | | 1 | | | | | | | | 1 | 1 | | 1 |
| Co2 | Perform experiments on the engine and draw the characteristics curve. | 2 | 1 | | 1 | | | | | | | | 1 | | 2 | 1 |
| Co3 | Perform experiments on computerised VCR S.I and C.I Engine. | 2 | 2 | | 2 | | | | | | | | 2 | 1 | 3 | 2 |
| Co4 | Perform experiments on two stage Reciprocating Air Compressor and draw the characteristics curve. | 1 | 1 | | 2 | | | | | | | | 1 | | | |
| Co5 | Perform experiments to determine the properties of fuels and oils. | | 1 | | 1 | | | | | | | | 1 | | | |

**418MEP08**  **MATERIAL TESTING AND METALLURGY LABORATORY**  **L T P C**
                                                                        **0 0 3 1**

**COURSE OBJECTIVES:**
- To understand the basic principles of strength of materials to the undergraduate students through a series of experiments.
- To evaluate the mechanical properties of materials.
- To learn the concept of testing of materials under untreated and heat treated conditions.
- To understand the various microstructure of engineering materials by metallographic examination.
- To study about various non – destructive testing methods.

**PRE-REQUISITES:** Knowledge of Strength of Materials is required.

**LIST OF EXPERIMENTS**
**PART – A**
1. Tension test on a different specimen.
2. Shear test on metal specimen.
3. Torsion test on metal specimen.
4. Impact test on metal specimen.
5. Hardness test on metals - Brinell and Rockwell Hardness Number.
6. Deflection test on beams.
7. Compression test on springs.

**PART – B**
8. Preparation of specimen for Metallographic examination of different engineering materials. Identification of microstructures of plain carbon steel, tool steel, gray CI, SG iron, Brass, Bronze & composites.
9. Heat treatment: Annealing, normalizing, hardening and tempering of steel. Hardness studies of heat – treated samples.
10. Non – destructive test experiments like,
    (a) Ultrasonic flaw detection
    (b) Magnetic crack detection
    (c) Dye penetration testing, to study the defects of Casted and Welded specimens.

                                                              **TOTAL HOURS: 45 PERIODS**

**COURSE OUTCOMES**
CO1:    The student will have the knowledge to perform various mechanical testing.
CO2:    The student will have the knowledge to prepare the specimens as per standard for mechanical testing.
CO3:    The student will be able to analyze the microstructure of various engineering materials.
CO4:    The students will have an ability to conduct experiment of materials under untreated and heat treated conditions.
CO5:    The student will have the knowledge of performing various non – destructive tests.

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| | Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Co1 | The student will have the knowledge to perform various mechanical testing. | 1 | 2 | | 3 | 2 | | | | | | | | 2 | | |
| Co2 | The student will have the knowledge to prepare the specimens as per standard for mechanical testing. | 1 | 2 | 1 | 3 | 2 | | | | | | | | 2 | | 1 |
| Co3 | The student will be able to analyze the microstructure of various engineering materials. | 1 | 2 | | 3 | 2 | | | | | | | | 2 | | 1 |
| Co4 | The students will have an ability to conduct experiment of materials under untreated and heat treated conditions. | 1 | 2 | | 3 | 2 | | | | | | | | 2 | | 1 |
| Co5 | The student will have the knowledge of performing various non – destructive tests. | 1 | 2 | | 3 | 2 | | | | | | | | 2 | | 1 |

**418MEP09**      **MANUFACTURING TECHNOLOGY LABORATORY II**      L  T  P  C
                                                                  0  0  3  1

**COURSE OBJECTIVES:**
- To know the machining operations on Shaper, Lathe, Milling, Drilling and Slotting.
- To know about Milling Machine: Indexing methods, Cutting of gear tooth (Spur gear, Helical gear), face milling, grooving and cylindrical grinding operation.
- To understand the Surface Grinding operations and cylindrical grinding machine.
- To understand the working principles of Capstan and Turret lathes.
- To understand the working principles of gear hobbing operation.

**PRE-REQUISITES:** Knowledge of Manufacturing Technology I and II are required.

**LIST OF EXPERIMENTS**
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.)

**TOTAL HOURS: 45 PERIODS**

**COURSE OUTCOMES**
The students will be able to
CO1:  Calculate machining time, metal removal rate for all machining operation.
CO2:  Prepare the models with dimensional accuracy and tolerance using the special purpose machineries.
CO3:  Find suitable machining process for various applications.
CO4:  Perform Lathe, Milling and Drilling operations
CO5:  Perform Grinding, Milling and Drilling operations.

| | Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Co1 | Calculate machining time, metal removal rate for all machining operation. | 1 | 1 | 2 | 3 | 1 | | 1 | | | | | | 2 | | 1 |
| Co2 | Prepare the models with dimensional accuracy and tolerance using the special purpose machineries. | 1 | 2 | 2 | 3 | 1 | | | | | | | | 2 | | 2 |
| Co3 | Find suitable machining process for various applications. | 2 | 2 | 2 | 3 | 1 | | | | | | | | 2 | | 1 |
| Co4 | Perform Lathe, Milling and Drilling operations | 1 | 2 | 3 | 3 | 1 | | | | | | | | 2 | | 1 |
| Co5 | Perform Grinding, Milling and Drilling operations. | 1 | 1 | 2 | 3 | 1 | | | | | | | | 2 | | 2 |

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**518MET01**          **METROLOGY AND INSTRUMENTATION**          **L  T  P  C**
                                                                **3  0  0  3**

**COURSE OBJECTIVES:**
- To comprehend the concept of measurement system and understanding the geometric dimensioning and tolerancing.
- To know about linear and angular measurement.
- To impart knowledge about screw thread measurement, gear measurement and surface finish.
- To know about the laser and advances in metrology.
- To know about measurement of mechanical parameter by using different instrument and devices in practical applications.

**PRE-REQUISITES:** Knowledge of Engineering Physics is required.

**UNIT I          CONCEPT OF MEASUREMENT                                    9**
General concept - Generalised measurement system-Units and standards-measuring instruments: Definitions of sensitivity, stability, range, accuracy and precision-static and dynamic response-repeatability-systematic and random errors-correction, calibration - Introduction to Dimensional and Geometric Toleranceing – interchangeability, Transducers-Types-L.V.D.T.

**UNIT II          LINEAR AND ANGULAR MEASUREMENT                          9**
Definition of metrology-Linear measuring instruments: Vernier, Micrometer, Slip gauges and classification, Tool Makers Microscope - interferometery, 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                                        9**
Measurement of screw threads: Thread gauges, floating carriage micrometer- measurement of gear tooth thickness: constant chord and base tangent method- Parkinson gear testing machine - radius measurements-surface finish: equipment and parameters, straightness, flatness and roundness measurements.

**UNIT IV          LASER AND ADVANCES IN METROLOGY                         9**
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                     9**
Force, torque, power: mechanical, pneumatic, hydraulic and electrical type-Pressure measurement - Flow: Venturi, Orifice meter, Rotameter, Pitot tube-Temperature: bimetallic strip, thermocouples, pyrometer, electrical resistance thermistor.

**TOTAL HOURS: 45 PERIODS**

**COURSE OUTCOMES**
The students will be able to
CO1:  Know about the working principle of generalized measurement system, the knowledge on calibration and definitions of various measurement terms.
CO2:  Know about the concepts of linear and angular measuring instruments.
CO3:  Know the concepts of screw thread, gear measurement and surface finish.
CO4:  Gain knowledge on working principle of Laser devices and Coordinate measuring machine.
CO5:  Gain knowledge on how to measure the instrumentation parameters like force, power, torque, flow and temperature.

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## TEXT BOOKS

1. Jain R.K., "Engineering Metrology", Khanna Publishers, 21$^{st}$ Edition, 2012.
2. Alan S. Morris, "The Essence of Measurement", Prentice Hall of India, 1997.
3. D.S.Kumar, "Mechanical Measurements and Control", Metropolian Publisher, New Delhi, Revised and Enlarged, 2002.

## REFERENCE BOOKS

1. Gupta S.C, "Engineering Metrology", Dhanpat rai Publications, 2018.
2. Thomas G.Beckwith, Roy D.Marangoni, John H.Lienhard V, "Mechanical Measurements", Pearson Education, 6$^{th}$ Edition, 2006.
3. Donald P Eckman, "Industrial Instrumentation", CBS, 2004.
4. Tayal A.K, "Instrumentation and Mechanical Measurements", Galgotia Publications 2000.

| | Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Co1 | Know about the working principle of generalized measurement system, the knowledge on calibration and definitions of various measurement terms. | 2 | | 2 | | | | | | | 2 | | | | 1 | |
| Co2 | Know about the concepts of linear and angular measuring instruments. | 2 | | 1 | | | | | | | 2 | | | | | |
| Co3 | Know the concepts of screw thread, gear measurement and surface finish. | 2 | 1 | | | 2 | | | | | 2 | | | | | 1 |
| Co4 | Gain knowledge on working principle of Laser devices and Coordinate measuring machine. | 2 | 2 | | | | | | | 2 | 2 | 2 | 2 | 1 | 1 | |
| Co5 | Gain knowledge on how to measure the instrumentation parameters like force, power, torque, flow and temperature. | 2 | 2 | | | 2 | | | | | 2 | 2 | 3 | | | 1 |

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**518MET02**                    **HEAT AND MASS TRANSFER**                    L  T  P  C
                                                                              3  0  0  3

**COURSE OBJECTIVES:**
- To study about the basic concepts of heat transfer modes.
- To analyze the relationship between fluid flow and convection heat transfer.
- To study about the fundamental concepts of radiation heat transfer to include both black body radiation and gray body radiation.
- To learn the thermal analysis and sizing of heat exchangers.
- To study about the basic concepts of mass transfer and its applications.

**PRE-REQUISITES:** Knowledge of Engineering Thermodynamics and Fluid mechanics is required.

**UNIT I          CONDUCTION                                                           9**
Introduction and basics of heat transfer– Modes of Heat Transfer – Conduction, Convection and Radiation – Effect of temperature on thermal conductivity of different solids, liquids and gases – Fourier's law of Conduction – Newton's Law of cooling– Derivation of generalized heat conduction equation in Cartesian and Polar coordinates and its reduction to specific cases – OneDimensionalSteady State Heat Conduction – Conduction through Plane Wall, Cylinders and Spherical Systems – Composite Systems – Conduction with Internal Heat Generation– Critical radius of insulation – Extended Surfaces – Unsteady state Heat Conduction – Lumped system Analysis –Semi-Infinite and Infinite solids –Use of Heisler's Charts.

**UNIT II          CONVECTION                                                           9**
Introduction to Convection Fundamentals – Velocity and Thermal boundary layer – Types of Convection –Dimensional analysis applied to forced and free convection– Dimensionless numbers and their physical significance–Forced Convection – 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 – Flow over Vertical Plate, Horizontal Plate, Inclined Plate, Cylinders and Spheres.

**UNIT III          PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS                      9**
Boiling heat transfer – Pool boiling–Pool boiling curve–Flow boiling – Nusselt's theory of condensation– Condensation heat transfer, film condensation – Heat transfer correlations in boiling and condensation. Types of Heat Exchangers – Overall Heat Transfer Coefficient – Fouling Factors – Analysis of heat exchangers – LMTD Method and ε-NTU method.

**UNIT IV          RADIATION                                                           9**
Introduction to Radiation – Absorptivity, Reflectivity and Transmissivity– black, white and grey body, emissive power and emissivity– Laws of radiation – Planck, Stefan-Boltzmann, Wein's displacement, Kirchhoff's law, Lambert's cosine law – Radiation heat exchange between black bodies – Shape factor– Heat exchange between non-black bodies– Infinite parallel planes and infinite long concentric cylinders– Radiation shield– Heat exchange between two grey surfaces– electrical analogy – Introduction to Gas Radiation.

**UNIT V          MASS TRANSFER                                                        9**
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.

                                                            **TOTAL HOURS: 45 PERIODS**

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## COURSE OUTCOMES

The student will be able to

CO1: Intrepret conduction, convection and radiation heat transfer.

CO2: Solve problems involving steady-state and transient heat conduction in simple geometries.

CO3: Determine values of the convection heat transfer co-efficient by applying empirical correlations.

CO4: Analyze heat transfer performance by using the method of log mean temperature difference and heat exchanger effectiveness.

CO5: Evaluate radiation heat transfer between black body and gray body surfaces.

## TEXT BOOKS

1. Sachdeva R C, "Fundamentals of Engineering Heat and Mass Transfer" New Age International Publishers, 5th Edition, 2017.

2. Yunus A Cengel and Afshin J Ghajar, "Heat and Mass transfer" Tata McGraw-Hill, New Delhi, 5th Edition, 2015.

## REFERENCE BOOKS

1. Frank P. Incropera, David P. Dewitt, Theodore L. Bergman and Adrienne S Lavine, "Fundamentals of Heat and Mass Transfer", Wiley, 7th Edition, 2013.

2. Kothandaraman C.P "Fundamentals of Heat and Mass Transfer" New Age International Publishers, New Delhi, 4th Edition, 2012.

3. Nag P.K, "Heat and Mass Transfer", Tata McGraw-Hill Education, New Delhi, 3rd Edition, 2011.

4. Holman J.P and Souvik Bhattacharyya, "Heat Transfer", McGraw-Hill Education, 10th Edition, 2010.

5. Rudramoorthy R and Mayilsamy K, "Heat and Mass Transfer", Pearson Education, 2nd Edition, 2010.

6. Yadav R, "Heat and Mass Transfer", Central Publishing House, 4th Edition, 2004.

| | Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Co1 | Intrepret conduction, convection and radiation heat transfer. | 2 | 2 | | 2 | 2 | | | | | 1 | | | 3 | | 3 |
| Co2 | Solve problems involving steady-state and transient heat conduction in simple geometries. | 2 | 2 | | 2 | 2 | | | | | 1 | | | 3 | | 1 |
| Co3 | Determine values of the convection heat transfer co-efficient by applying empirical correlations. | 2 | 2 | | 2 | 2 | | | | | 1 | | | 3 | | 2 |
| Co4 | Analyze heat transfer performance by using the method of log mean temperature difference and heat exchanger effectiveness. | 2 | 2 | | 2 | 2 | | | | | 1 | | | 3 | | 2 |
| Co5 | Evaluate radiation heat transfer between black body and gray body surfaces. | 1 | | | | | | | | | | | | 1 | | 1 |

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**518MET03**                    **DYNAMICS OF MACHINERY**                    L  T  P  C
                                                                            3  0  0  3

**COURSE OBJECTIVES:**
- To understand the method of static force analysis and dynamic force analysis of mechanism and machines.
- To study the undesirable effects of unbalance in rotors and engines.
- To study the free vibration and degree of freedom.
- To understand the functions of forced vibration.
- To understand the principles of governors and gyroscopes.

**PRE-REQUISITES:** Knowledge of Kinematics of Machinery is required.

**UNIT I          FORCE ANALYSIS AND FLYWHEELS                                    9**
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, Crankshaft Torque-Engine shaking Forces, Turning moment diagrams, Flywheels of engines and punch press.

**UNIT II          BALANCING                                                       9**
Static and dynamic balancing, Balancing of rotating masses, Balancing of a single-cylinder Engine - Primary and secondary unbalanced forces, Balancing of Multi-cylinder Engines - Firing order.

**UNIT III          FREE VIBRATION                                                9**
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                                              9**
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                                         9**
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, ships & Aeroplanes.

**TOTAL HOURS: 45 PERIODS**

**COURSE OUTCOMES**
The student will be able to
CO1:  Predict the force analysis in the mechanical system.
CO2:  Balance the static and dynamic balancing of rotating and reciprocating masses.
CO3:  Analyse the free vibration in a single degree of freedom.
CO4:  Analyse force vibration caused by unbalancing, vibration transmissibility and isolation.
CO5:  Find the role of governors and gyroscopes used for speed control and stability control.

**TEXT BOOKS**
1. Rattan.S.S, "Theory of Machines", Tata McGraw Hill Inc, 5th Edition, 2019.
2. Shigley J.E., Uicker J.J., & Pennock G.R., "Theory of Machines and Mechanisms", Oxford University Press, 5th Edition, 2017.

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## REFERENCES BOOKS

1. Dr.R.K.Bansal and Dr.J.S. Brar, "Theory of Machines", Lakshmi Publications, New Delhi, 2011.
2. Thomas Bevan, "Theory of Machines", CBS Publishers and Distributors, 3rd Edition2011.
3. Gupta B.V.R, "Theory of Machines: Kinematics and Dynamics", I K International PublishingHouse (P) Ltd, New Delhi,2010.
4. Ambekar A. G., "Mechanism and Machine Theory", Prentice-Hall of India Private Limited, New Delhi, 2007.
5. Rao J.S. and Dukkipati R.V., "Mechanism and Machine Theory", Wiley-Eastern Limited, New Delhi, 2007.
6. P.L.Ballaney, "Theory of Machines and Mechanisms", 23rd Edition, Khanna Publications, New Delhi, 2003.
7. Sadhu Singh,"Theory of Machines", 2nd Edition, Pearson Education India, South Asia, 2006.

| | Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Co1 | Predict the force analysis in the mechanical system. | 2 | 2 | 1 | 1 | | 1 | 1 | | | | | | 2 | | 1 |
| Co2 | Balance the static and dynamic balancing of rotating and reciprocating masses. | 2 | 2 | 1 | 2 | | | | | | | | | 1 | | 1 |
| Co3 | Analyse the free vibration in a single degree of freedom. | 2 | 2 | 1 | 2 | | | | | | | | 1 | 1 | | |
| Co4 | Analyse force vibration caused by unbalancing, vibration transmissibility and isolation. | 2 | 3 | 1 | 2 | | | | | | | | 1 | 1 | | 2 |
| Co5 | Find the role of governors and gyroscopes used for speed control and stability control. | 2 | 2 | 1 | 3 | 1 | 1 | 1 | | | | | | 1 | | 2 |

| 518MET04 | DESIGN OF MACHINE ELEMENTS | L T P C |
|---|---|---|
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**COURSE OBJECTIVES:**
- To familiarize the various steps involved in the Design Process.
- To acquire knowledge on standards and procedure for designing shaft and coupling.
- To interpret the design of bolt, welded and riveted joint so as to meet desired needs within the realistic constraints.
- To analyse the design of energy storing elements in order to perform safely with their intended functions
- To impart the design principles to evaluate the bearings in order to satisfy the strength and functional requirements.

**PRE-REQUISITES:** Knowledge of Strength of Materials is required.

**UNIT I**      **STEADY STRESSES AND VARIABLE STRESSES IN MACHINE MEMBERS**      **9**
Introduction to the design process - factor influencing machine design, Selection of materials based on mechanical properties, Direct, Bending and torsional stress equations, Impact and shock loading, Calculation of principal stresses for various load combinations, Eccentric loading, Factor of safety, Theories of failure, Stress concentration, Design for variable loading - Soderberg, Goodman and Gerber relations.

**UNIT II**      **DESIGN OF SHAFTS AND COUPLINGS**      **9**
Design of solid and hollow shafts based on strength, rigidity and critical speed, Design of keys, key ways and splines, Design of rigid couplings – Muff, Split muff and flange coupling, Design of flexible couplings - Bushed pin and Oldham coupling.

**UNIT III**      **DESIGN OF TEMPORARY AND PERMANENT JOINTS**      **9**
Threaded fasteners, Design of bolted joints including eccentric loading, Knuckle joint, Cotter joints, Design of welded joints including eccentric loading, Riveted joints for structures including eccentric loading.

**UNIT IV**      **DESIGN OF ENERGY STORING ELEMENTS**      **9**
Various types of springs, Design of helical springs under compression and tension, Design of leaf springs, Design of flywheels considering stresses in rims and arms for engines and punching machines.

**UNIT V**      **DESIGN OF BEARINGS**      **9**
Theory of lubrications, Sliding contact and rolling contact bearings, Design of hydrodynamic journal bearings, McKee's equations, Sommerfield number, Raimondi & Boyd graphs, Selection of rolling contact bearings.

                                                       **TOTAL HOURS: 45 PERIODS**

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

**COURSE OUTCOMES**
The students will be able to
CO1: Apply the concept of steady stresses in design of machine elements.
CO2: Design shafts and couplings for various applications.
CO3: Design temporary and permanent joints.
CO4: Design various energy storing elements.
CO5: Select bearings for specific applications.

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**TEXT BOOKS**

1. Shigley J.E and Mischke C. R., "Mechanical Engineering Design", 10<sup>th</sup> Edition, Tata McGraw-Hill, 2015.
2. Bhandari V.B, "Design of Machine Elements", Third Edition, Tata McGraw-Hill Book Co, 2010.

**REFERENCE BOOKS**

1. Orthwein W, "Machine Component Design", Jaico Publishing Co, digitized 2010.
2. Ugural A.C, "Mechanical Design - An Integrated Approach", McGraw-Hill Book Co, 2004.
3. Spotts M.F., Shoup T.E., "Design and Machine Elements", Pearson Education, 2004.
4. Sundararajamoorthy T. V, Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2003.

| | Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Co1 | Apply the concept of steady stresses in design of machine elements. | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 2 | 2 |
| Co2 | Design shafts and couplings for various applications. | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 2 | 2 |
| Co3 | Design temporary and permanent joints. | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 2 | 2 |
| Co4 | Design various energy storing elements. | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 2 | 2 |
| Co5 | Select bearings for specific applications. | 2 | 2 | 3 | 2 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 2 | 2 |

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**518MET05**          **APPLIED HYDRAULICS AND PNEUMATICS**                    **L  T  P  C**
                                                                               **3  0  0  3**

**COURSE OBJECTIVES:**

- To familiar with applications, advantages of the fluid power engineering and transmission systems.
- To learn the function of fluid power system in hydraulic system and components.
- To know the function of fluid power system with control components, accessories of hydraulic systems.
- To learn the function of fluid power system for pneumatic system and components.
- To draw the invention of circuits for hydraulic and pneumatic power systems in the industrial applications.

**PRE-REQUISITES:** Knowledge of Engineering Physics I, Basics of Civil and Mechanical Engineering and Fluid Mechanics and Machinery are required.

**UNIT I          FLUID POWER PRINCIPLES AND FUNDAMENTALS                              6**
Introduction to Fluid power- Advantages and Applications- Types of fluid power systems – Fluid power symbols-Types of fluids- Properties of hydraulics fluids – Applications of Pascal's Law- Principles of flow –Work, Power and Torque-Darcy–Weisbach equation, Losses in pipe, valves and fittings.

**UNIT II          HYDRAULIC SYSTEMS AND COMPONENTS                              9**
Sources of Hydraulic power: Pumping theory – Pump classification- Variable displacement pumps for Gear pump, Vane pump and Piston pump Construction, working principle, advantages, disadvantages and Performance-Types of hydraulic cylinders- Linear cylinders, Rotary cylinders, construction, working principle, advantages, disadvantages and applications- Cushioning Mechanism in cylinder.

**UNIT III          CONTROL COMPONENTS, ACCESSORIES OF HYDRAULIC SYSTEMS          9**
Control Components: Direction control, Flow control and Pressure control valves- Types, Construction and Operation, Applications – Types of actuation- Accessories: Reservoirs, Accumulators, Intensifiers and Pressure Switches- Applications.

**UNIT IV          PNEUMATIC SYSTEMS AND COMPONENTS                              9**
Properties of air-Compressors- (FRL)Filter, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust valves, Pneumatic actuators, Servo systems and Proportional valves -Introduction the fluidics devices -Pneumatic logic circuits.

**UNIT V          HYDRAULIC AND PNEUMATIC CIRCUITS AND TROUBLESHOOTING          12**
Hydraulic circuits: Regenerative (with accumulator devices), Fail-safe, Speed control, Sequence, Electro hydraulic circuits-Case studies of to draw the circuits of hydraulic system for the Shaping and Punching operation (with intensifier device).
Pneumatic circuits: Sequential circuit design for simple application (of two or three cylinders) using cascade method-Electro pneumatic circuits- Fluid power circuits failures and troubleshooting.
                                                            **TOTAL HOURS: 45 PERIODS**

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## COURSE OUTCOMES

CO1: The students are able to comprehend the concept of fluid power systems and applications in industries.

CO2: The students are able to select appropriate fluid power driving system and actuators for any given applications.

CO3: The students are able to know about the use of control components, accessories of hydraulic systems.

CO4: The students are able to gain knowledge on pneumatic system and components.

CO5: An ability to design the hydraulic and pneumatic circuits and exposure of diagnose or troubleshoot the power systems.

## TEXT BOOKS

1. Majumdar, S.R., "Oil Hydraulics Systems- Principles and Maintenance", McGraw Hill, 2017.
2. Anthony Esposito," Fluid Power with Applications", Pearson Education, 2013.

## REFERENCES BOOKS

1. Shanmugasundaram.K, "Hydraulic and Pneumatic controls", S. Chand & Co, 2013.
2. Srinivasan .R, "Hydraulic and Pneumatic controls", McGraw Hill, 2008.
3. Micheal J, Pinches and Ashby, J.G., "Power Hydraulics", Longman Higher Education, 1988.
4. Dudley, A Pease and John J Pippenger, "Basic Fluid Power", Prentice Hall, 1987.
5. Anthony Lal, "Oil hydraulic in the service of industry", Allied publishers, 1982.

## WEB REFERENCE:

www.nptel.ac.in

| | Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Co1 | The students are able to comprehend the concept of fluid power systems and applications in industries. | 3 | 1 | | | 1 | | | 1 | 1 | | | 2 | | | |
| Co2 | The students are able to select appropriate fluid power driving system and actuators for any given applications. | 2 | 1 | | | | | | | | 2 | | | 1 | | |
| Co3 | The students are able to know about the use of control components, accessories of hydraulic systems. | 2 | 1 | 2 | | | | | 1 | 1 | | | 1 | | 1 | 1 |
| Co4 | The students are able to gain knowledge on pneumatic system and components. | 2 | 3 | 1 | 1 | 1 | | | | | 1 | | 2 | 1 | | |
| Co5 | An ability to design the hydraulic and pneumatic circuits and exposure of diagnose or troubleshoot the power systems. | 2 | 1 | 2 | 1 | 1 | 1 | | | | 2 | | 2 | 1 | | 1 |

**518MEP07**    **METROLOGY AND INSTRUMENTATION LABORATORY**    L  T  P  C
                                                                0  0  2  1

**COURSE OBJECTIVES:**
- To gain knowledge on 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.
- To calculate least count of measuring equipments.
- To know about the procedure of calibration for various measuring devices.

**PRE-REQUISITES:** Knowledge of Metrology and Instrumentation is required.

**LIST OF EXERCISES**
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 using Autocollimator.
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.
13. Measurement of Dimensional attributes like Cylindricity, Circularity, Flatness, Straightness by using Coordinate Measuring Machine.

**TOTAL HOURS: 45 PERIODS**

**COURSE OUTCOMES**
The students will be able to
CO1:   Perform calibration process for micrometer, dial gauge, vernier caliper.
CO2:   Perform experiments by using sine bar, gear tooth vernier caliper and tool makers microscope.
CO3:   Use autocollimator for straightness and flatness measurement and thermocouple for temperature measurement.
CO4:   Learn about coordinate measuring machine for linear and angular measurements.
CO5:   Identify sources of variability, error and uncertainties.

| | Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Co1 | Perform calibration process for micrometer, dial gauge, vernier caliper. | | | | | 3 | | | | 2 | | | | 1 | | |
| Co2 | Perform experiments by using sine bar, gear tooth vernier caliper and tool makers microscope. | 2 | | | 2 | | | | | 2 | 1 | | | | 1 | |
| Co3 | Use autocollimator for straightness and flatness measurement and thermocouple for temperature measurement. | | | | 2 | | | | | | | | 3 | | | 1 |
| Co4 | Learn about coordinate measuring machine for linear and angular measurements. | | | | | | | | | | | | 3 | | 1 | |
| Co5 | Identify sources of variability, error and uncertainties. | | | | 2 | | | | | 2 | | | | | | 1 |

**518MEP08**　　　　　　　**HEAT TRANSFER LABORATORY**　　　　　**L  T  P  C**
　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　**0  0  2  1**

**COURSE OBJECTIVES:**
- To demonstrate the concepts discussed in the heat transfer course.
- To experimentally determine thermal conductivity and heat transfer coefficient through various materials.
- To experimentally measure effectiveness of heat exchangers.
- To conduct performance tests on refrigeration systems.
- To determine emissivity of radiation surface with different surfaces namely polished, gray and metal black.

**PRE-REQUISITES:** Knowledge of Thermal Engineering is required.

**LIST OF EXPERIMENTS**
**Conduction Mode Experiments**
1. Heat transfer through composite wall.
2. Thermal Conductivity of insulating powder.
3. Thermal Conductivity measurement by guarded plate method.
4. Thermal Conductivity of pipe insulation using lagged pipe apparatus.
5. Thermal Conductivity of metal rod.

**Convection Mode Experiments**
6. Heat transfer from a pin-fin apparatus (Natural Convection).
7. Heat transfer from a pin-fin apparatus (Forced Convection).
8. Heat transfer in natural convection (Vertical cylinder).
9. Heat transfer in forced convection (Inside tube).

**Radiation Mode Experiments**
10. Emissivity measurement apparatus.
11. Stefan Boltzmann apparatus.

**Experiments on applications of heat transfer**
12. Effectiveness of parallel flow heat exchanger.
13. Effectiveness of counter flow heat exchanger.
14. Determination of heat transfer coefficient in shell and tube heat exchanger.
15. Determination of COP of a refrigeration system.

　　　　　　　　　　　　　　　　　　　　　**TOTAL HOURS: 45 PERIODS**

**COURSE OUTCOMES**
The students will be able to
CO1:　Practically relate to concepts discussed in the heat transfer course.
CO2:　Conduct various experiments to determine thermal conductivity of various materials.
CO3:　Conduct performance tests and thereby improve effectiveness of heat exchangers.
CO4:　Conduct performance tests and improve COP of refrigeration systems.
CO5:　To determine the overall heat transfer coefficient for a composite wall.

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| | Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Co1 | Practically relate to concepts discussed in the heat transfer course. | | 2 | | 1 | | | | | | | | 1 | 1 | | 1 |
| Co2 | Conduct various experiments to determine thermal conductivity of various materials. | 2 | 1 | | 1 | | | | | | | | 1 | | 2 | |
| Co3 | Conduct performance tests and thereby improve effectiveness of heat exchangers. | 2 | 2 | | 2 | | | | | | | | 1 | | 3 | 2 |
| Co4 | Conduct performance tests and improve COP of refrigeration systems. | | 1 | | 2 | | | | | | | | 2 | | 2 | 2 |
| Co5 | To determine the overall heat transfer coefficient for a composite wall. | 1 | 1 | | 1 | | | | | | | | 1 | | | 1 |

**518MEP09**                    **DYNAMICS LABORATORY**                    **L  T  P  C**
                                                                         **0  0  2  1**

**COURSE OBJECTIVES:**
- To study the kinematics of different mechanisms.
- To study the mass moment of inertia of body by experimentally.
- To study the cam and its applications.
- To study the natural frequency of vibratory systems.
- To study the principles of governors and gyroscopic.

**PRE-REQUISITES:** Knowledge of Kinematics and Dynamics of Machinery is required.

**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 Flywheel 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 of Spring Mass System - Determination of Natural Frequency and verification of Laws of springs - Damping coefficient determination.
   b) Multi degree of freedom of 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. The Vibration of the 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 a vibrating table.

                                            **TOTAL HOURS: 45 PERIODS**

**COURSE OUTCOMES**

The students will have the ability to
- CO1: Demonstrate the principles of kinematics and dynamics of machinery.
- CO2: Determine mass-moment of inertia for simple bodies experimentally.
- CO3: Design the cam and follower for different applications.
- CO4: Analyze natural frequency of vibratory systems.
- CO5: Analyze governors and gyroscopes.

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| | Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Co1** | Demonstrate the principles of kinematics and dynamics of machinery. | | 2 | | 1 | | | | | | | | 1 | 1 | | 1 |
| **Co2** | Determine mass-moment of inertia for simple bodies experimentally. | 2 | 1 | | 1 | | | | | | | | 1 | | 2 | |
| **Co3** | Design the cam and follower for different applications. | 2 | 2 | | 2 | | | | | | | | 1 | | 3 | |
| **Co4** | Analyze natural frequency of vibratory systems. | | 1 | | 3 | | | | | | | | 2 | | | 2 |
| **Co5** | Analyze governors and gyroscopes. | | | | 2 | | | 1 | | | | | 1 | | | 2 |

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| 518MEE01 | ADVANCED MANUFACTURING PROCESSES | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**
- To gain knowledge on advanced manufacturing processes and their applications.
- To learn about mechanical energy based processes and its process parameters.
- To know the electrical energy based processes and its process parameters.
- To be familiar with chemical and electro-chemical energy based processes and its process parameters.
- To identify the thermal energy based processes and its process parameters.

**PRE-REQUISITES:** Knowledge of Manufacturing Technology II is required.

**UNIT I        INTRODUCTION                                                                        5**
Introduction of Unconventional machining Processes - Need for Unconventional machining Processes - Classification – Design Considerations, Process economics – Introduction to Abrasives and Bond abrasives.

**UNIT II        MECHANICAL ENERGY BASED PROCESSES                                              10**
Abrasive Jet Machining (AJM) - Water Jet Machining (WJM) - Abrasive Water Jet Machining (AWJM) - Ultrasonic Machining. (USM). Working Principles - Equipments - Process parameters – Material Removal Rate - Applications.

**UNIT III        ELECTRICAL ENERGY BASED PROCESSES                                              8**
Electro 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 Process - Applications.

**UNIT IV        CHEMICAL AND ELECTRO-CHEMICAL ENERGY BASED PROCESSES                    12**
Chemical machining (CHM) and Electro-Chemical machining (ECM)-Etchants- Maskants-Techniques of applying maskants-Process Parameters - Surface finish and MRR-Applications. Principles of ECM-Equipments-Surface Roughness and MRR- Electrical circuits-Process Parameters-ECG and ECH - Applications.

**UNIT V        THERMAL ENERGY BASED PROCESSES                                                  10**
Laser Beam Machining and Drilling (LBM), Plasma Arc Machining (PAM) and Electron Beam Machining (EBM) - Principles - Equipment -Types - Beam control techniques – Applications, Introduction to 3D printing.

**TOTAL HOURS: 45 PERIODS**

**COURSE OUTCOMES**
The students will be able to
CO1: Demonstrate the basic operation of various unconventional manufacturing processes.
CO2: Apply the knowledge of mechanical energy based processes in their projects and interpret the importance of different processes for various applications.
CO3: Apply the knowledge of electrical energy based processes in their projects and to identify the various parameters and their influence on the performance of the processes.
CO4: Explain the various chemical machining processes and its effects on environment.
CO5: Explain thermal energy based processes like laser beam machining, electron beam machining and plasma arc machining, cutting and spraying.

**TEXT BOOKS**
1. Vijay.K. Jain, "Advanced Machining Processes", Allied Publishers Pvt. Ltd., New Delhi, 2009.
2. Pandey P.C. and Shan H.S. "Modern Machining Processes" Tata McGraw-Hill, New Delhi, 1980.

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**REFERENCE BOOKS**

1. M Adithan, "Unconventional Machining Processes", Atlantic Publishers, 2009.
2. Serope KalpakJian, Steven R Schmid, "Manufacturing Processes for Engineering Materials", Pearson Education, 5th Edition, 2007.
3. Mc Geough, "Advanced Methods of Machining", Chapman and Hall, Springer, 1988.
4. Benedict. G.F., "Non traditional Manufacturing Processes", Marcel Dekker Inc., New York, 1987.

| | Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Co1 | Demonstrate the basic operation of various unconventional manufacturing processes. | 2 | | 2 | | | | 2 | | | 2 | | | | | 1 |
| Co2 | Apply the knowledge of mechanical energy based processes in their projects and interpret the importance of different processes for various applications. | 2 | | | 2 | | | | | | 2 | | | | 1 | |
| Co3 | Apply the knowledge of electrical energy based processes in their projects and to identify the various parameters and their influence on the performance of the processes. | 2 | | | | 2 | | | 1 | | 2 | 1 | | 1 | | |
| Co4 | Explain the various chemical machining processes and its effects on environment. | 2 | | | | | | 2 | | | 2 | | | | | 1 |
| Co5 | Explain thermal energy based processes like laser beam machining, electron beam machining and plasma arc machining, cutting and spraying. | 3 | 2 | | 1 | 2 | | | 1 | | 2 | | | | | 2 |

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**518MEE04**  NON DESTRUCTIVE TESTING AND MATERIALS  L  T  P  C
3  0  0  3

**COURSE OBJECTIVES:**
- To understand principle behind various NDT techniques.
- To study about NDT equipments and accessories.
- To learn working procedures of various NDT techniques.
- To know the applications and recent trends in NDT.
- To know about the NDT techniques for flaw detection.

**PRE-REQUISITES:** Knowledge of Manufacturing technology and Material science are required.

**UNIT I  INTRODUCTION AND VISUAL INSPECTION TECHNIQUE  6**
Introduction to various Non-destructive methods – Comparison of Destructive and Non destructive Tests, Visual Inspection, Optical aids used for Visual inspection - Applications.

**UNIT II  LIQUID PENETRANT TESTING AND MAGNETIC PARTICLE TESTING  10**
Physical principles, procedure for liquid penetrant testing, Characteristics of penetrants – Developers, Penetrant testing methods – Applications, Principle of MPT, Magnetising procedure used for testing a component, Equipment used for MPT, Applications

**UNIT III  EDDY CURRENT TESTING AND ACOUSTIC EMISSION TESTING  10**
Principles, Instrumentation for ECT, Various Techniques – High sensitivity Techniques, Single, Multi and high frequency ECT, Applications - Principle of AET, AE signal parameters, Applications.

**UNIT IV  ULTRASONIC TESTING  10**
Introduction, Principle of operation, Types of Ultrasonic propagation – Ultrasonic probes. Types of Ultrasonic Transducers – Testing Techniques and Inspection methods – Pulse Echo, ABC scans, Transmission angle beam, Testing procedures and its applications.

**UNIT V RADIOGRAPHY, COMPARISON AND SELECTION OF NDT METHODS  9**
Basic principle, Effect of radiation of Film, Radiographic Imaging – Inspection Techniques – Single wall single image, Double wall Penetration & Multiwall Penetration technique – Comparison and selection of various NDT techniques.

**TOTAL HOURS: 45 PERIODS**

**COURSE OUTCOMES**
The students will be able to
CO1:  Apply scientific and technical knowledge to the field of non-destructive testing.
CO2:  Use the relevant non-destructive testing methods for various engineering practice.
CO3:  Analyse and interpret the defects to improve the overall quality of products.
CO4:  Develop their skills in inspection of the components.
CO5:  Increase overall reliability of the products by selection of suitable inspection techniques.

**TEXT BOOKS**
1. J Prasad, and CGK Nair, "Non Destructive Test and Evaluation of Materials", Tata McGraw Hill, 2017.
2. Ravi Prakash, "Non Destructive Testing Techniques", New Age International, 1st Edition revised, 2010.

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**REFERENCE BOOKS**
1. Baldev Raj and B.Venkataraman, "Practical Radiography", Narosa Publishing House, 2004.
2. Baldev raj, T Jeyakumar, M. Thavasimuthu "Practical Non-Destructive Tesitng" Narosa Publishing house, New Delhi, 2002.
3. Krautkramer.J, "Ultra Sonic Testing of Materials", 1$^{st}$ Edition, Springer – Verlag Publication, New York, 1996.
4. Birchan.B, "Non-Destructive Testing", Oxford University Press, London, 1975.

| | Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Co1 | Apply scientific and technical knowledge to the field of non-destructive testing. | 3 | | 2 | 1 | 2 | | | | | 1 | | 1 | | 2 | 1 |
| Co2 | Use the relevant non-destructive testing methods for various engineering practice. | 3 | 2 | 2 | 1 | 2 | | 1 | | | 1 | | 1 | 1 | | |
| Co3 | Analyse and interpret the defects to improve the overall quality of products. | 3 | | 1 | 1 | 2 | | | | | 1 | | 1 | | 2 | |
| Co4 | Develop their skills in inspection of the components. | 2 | 1 | 2 | 1 | 2 | | 1 | | | 1 | | 1 | | | 1 |
| Co5 | Increase overall reliability of the products by selection of suitable inspection techniques. | 1 | | 1 | | | 2 | | | | | 2 | 2 | 1 | | |

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**618MET01**          **PRINCIPLES OF MANAGEMENT AND BUSINESS CONCEPTS**          L  T  P  C
                                                                                 3  0  0  3

**COURSE OBJECTIVES:**

- To gain knowledge on organization structure.
- To understand the various types of business organizations.
- To know the modern techniques in controlling.
- To gain knowledge on various types of business activities.
- To know about the marketing concepts.

**UNIT I          OVERVIEW OF MANAGEMENT AND PLANNING          10**

Definition of Management – Role of managers – Evolution of Management thoughts. Contribution of Taylor and Fayol, Functions of management – Types of business organizations.
Nature and purpose of planning – Planning process – Types of plans – Objectives – Management By Objective (MBO) Strategies – Types of strategies – Policies – Decision Making – Decision Making Process – Forecasting techniques.

**UNIT II          ORGANIZING AND DIRECTING          10**

Nature and purpose of organizing – Organization structure – Organisation Chart – Formal and informal groups of organization – Line and Staff authority – Departmentation – Span of control – Centralization and Decentralization – Delegation of authority – Selection and Recruitment – Orientation – Career Development – Career stages – Training – Performance Appraisal.
Creativity and Innovation – Management and Human facts – Motivation – Motivation Theories – Leadership Styles – Leadership theories – Communication – Barriers to effective communication – Electronic Media in Communication.

**UNIT III          CONTROLLING          7**

Process of controlling – Types of control – Budgetary and non-budgetary control techniques – Managing Productivity – Cost Control – Purchase Control – Maintenance Control – Quality Control – Planning operations, Modern Techniques in Controlling.

**UNIT IV          BUSINESS ENVIRONMENT          10**

Nature and purpose of business, Classification of business activities: Industry, Commerce and Trade – Objectives of business and essentials of successful business – Economic environment – Basic problems of scarcity and choice – Allocation of resources – Opportunity cost – Business growth and measurement of size – International Environment – Balance of trade, the trade gap and balance of payments – Role and methods of trade protectionism – Business Ethics.

**UNIT V          ELEMENTS OF BUSINESS ACTIVITY          8**

Purchasing – Choosing of suppliers – Overview of stock control – Production – Scale of production, Main features of job – Mass and Batch production systems – Marketing – Concept and Role of marketing – Marketing mix – Channels of distribution – Finance – Sources of Finance – Assessing business performance.

**TOTAL HOURS: 45 PERIODS**

**COURSE OUTCOMES**
The students will be able to
CO1:  Understand the elements of effective management.
CO2:  Know about motivation theories.
CO3:  Gain the knowledge on managerial skills and business activities.
CO4:  Understand business concepts and its applications.
CO5:  Organize, plan and control the process of business activity.

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**TEXT BOOKS**

1. P C Tripathi and P N Reddy, "Principles of Management", Tata Mc Graw Hill Pvt Ltd, 6th Edition, 2017.
2. Stephen P. Robbins and Mary Coulter, "Management", Pearson Education, 13rd Edition, 2016.

**REFERENCE BOOKS**

1. Philip Kotler, "Marketing Management", Pearson Education, 15th Edition, 2015.
2. Charles W L Hill, Steven L McShane, "Principles of Management", McGraw Hill Education, Special Indian Edition, 2012.
3. Harold Koontz, Heinz Weihrich and Mark V Cannice, "Essentials of Management", Tata McGraw Hill, 9th Edition, 2012.
4. Andrew J.Dubrin, "Essentials of Management", Thomson Southwestern, 7th Edition, 2007.
5. Hellriegel, Slocum & Jackson, "Management - A Competency Based Approach", Thomson South Western, 10th Edition, 2002.
6. Gary Dessler, "Human Resource Management", 7th Edition, Prentice-Hall of India P.Ltd., Pearson, 1999.
7. Joel Dean, "Managerial Economics", Prentice Hall Pearson Education, 1992.
8. Rangarajan, "Principles of Macro Economics", Tata McGraw Hill, 1979.

| | Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Co1 | Understand the elements of effective management. | | 3 | | | 1 | 2 | | | | 2 | 2 | 3 | | | 2 |
| Co2 | Know about motivation theories. | | 3 | 2 | | | | | | | | | 3 | | 1 | |
| Co3 | Gain the knowledge on managerial skills and business activities. | | | 1 | | 1 | 1 | | 1 | | 1 | 2 | | | | 1 |
| Co4 | Understand business concepts and its applications. | | | 1 | | | 2 | 2 | | 1 | | | | | | |
| Co5 | Organize, plan and control the process of business activity. | | 3 | 2 | | 1 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 1 | | |

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**618MET02**         **GAS DYNAMICS AND JET PROPULSION**         L  T  P  C
                                                                3  0  0  3

**COURSE OBJECTIVES:**
- To understand the basic concepts of isentropic flows.
- To understand the phenomenon of heat transfer and friction for flow through ducts.
- To study the phenomenon of shock waves and its effects on flow.
- Analyse the performance of aircraft propulsion.
- Analyse the performance of rocket propulsion.

**PRE-REQUISITES:** Knowledge of Engineering Thermodynamics, Fluid Mechanics and Machinery, Thermal Engineering are required.

**UNIT I         BASIC CONCEPTS AND ISENTROPIC FLOWS                          9**
Energy and momentum equations of compressible fluid flows – concepts of compressible flow 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                                          9**
Flows through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) - variation of flow properties – Variation of mach number with duct length-Use of tables and charts.

**UNIT III         NORMAL AND OBLIQUE SHOCKS                                  9**
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                                             9**
Theory of jet propulsion - Thrust equation - Thrust power and propulsive efficiency – Operation Principle, cycle analysis and performance of ram jet, turbojet, turbofan, turbo prop engines and pulse jet engines.

**UNIT V         SPACE PROPULSION                                           9**
Types of rocket engines - Propellants- Liquid fuel feeding systems - Theory of single stage and multistage rocket propulsion – Rocket performance calculations - Terminal and characteristic velocity - Applications - space flights.

                                                        **TOTAL HOURS: 45 PERIODS**
Note: (Use of standard gas table book is permitted in the examination)

**COURSE OUTCOMES**
CO1:  The students will become familiar with basic fundamental equations of one dimensional flow of compressible fluid and isentropic flow of an ideal gas.
CO2:  The students will be able to acquire knowledge on the effects of heat transfer and friction flow through ducts.
CO3:  An ability to acquire the knowledge on flow parameters with normal and oblique shocks.
CO4:  An ability to understand the working concepts of the gas dynamics principles in the jet propulsions.
CO5:  An ability to study the working concepts of rocket propulsion and various propellants.

**TEXT BOOKS**
1. S.M. Yahya, "Fundamentals of Compressible Flow", New Age International (P) Limited, New Delhi, 5th Edition, 2016.
2. Anderson, J.D., "Modern Compressible flow", Third Edition, McGraw Hill, 2003.

**REFERENCE BOOKS**

1. G.P. Sutton, "Rocket Propulsion Elements", John Wiley & sons, New York, 9th Edition, 2016.
2. V. Babu, "Fundamentals of Gas Dynamics", ANE Books India, 2015.
3. V.Ganesan, "Gas Turbines", Tata McGraw Hill Publishing Co., NewDelhi,2010.
4. P. Hill and C. Peterson, "Mechanics and Thermodynamics of Propulsion", Addison - Wesley Publishing Company, 2009.
5. Anderson J.D., "Modern Compressible flow", McGraw Hill, 3rd Edition, 2003.
6. S.L. Somasundaram, "Gas Dynamics and Jet Propulsions", New Age International Publishers, New Delhi, 1996.
7. A.H. Shapiro, "The Dynamics and Thermodynamics of Compressible Fluid Flow", John Wiley &sons, New York, 1983.
8. M.J.Zucrow, "Aircraft and Missile Propulsion",Vol.1&II, John Wiley & sons,1975.
9. M.J. Zucrow, "Principles of Jet Propulsion and Gas Turbines", John Wiley & sons, New York, 1970.

| Course Outcome | | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Co1 | The students will become familiar with basic fundamental equations of one dimensional flow of compressible fluid and isentropic flow of an ideal gas. | 3 | 2 | | | | | | | | 1 | | | 3 | 2 | 1 |
| Co2 | The students will be able to acquire knowledge on the effects of heat transfer and friction flow through ducts. | 3 | 1 | | | | | | | | 3 | 2 | | 2 | 3 | 1 |
| Co3 | An ability to acquire the knowledge on flow parameters with normal and oblique shocks. | 3 | 3 | | 1 | | | | | 2 | 1 | 1 | | 2 | 3 | 1 |
| Co4 | An ability to understand the working concepts of the gas dynamics principles in the jet propulsions. | 3 | 3 | | 1 | 2 | | | | 1 | 2 | 1 | | 2 | 3 | 3 |
| Co5 | An ability to study the working concepts of rocket propulsion and various propellants. | 3 | 3 | | 1 | | | | | 1 | 3 | 1 | | 3 | 1 | 3 |

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**618MET03**                  **DESIGN OF TRANSMISSION SYSTEMS**              L  T  P  C
                                                                              3  0  0  3

**COURSE OBJECTIVES:**
- To understand the standards and procedure for designing flexible elements.
- To understand the design of spur gears and parallel axis helical gears.
- To understand the design of bevel, worm and cross helical gears.
- To analyse the design of gear boxes in order to perform safely with their intended functions.
- To study the design principles to evaluate the clutches and brakes in order to satisfy the strength and functional requirements.

**PRE-REQUISITES:** Knowledge of Kinematics of Machinery and Design of Machine Elements are required.
**NOTE:** Usage of Design Data Book is permitted in the end examination.

**UNIT I          DESIGN OF TRANSMISSION SYSTEMS FOR FLEXIBLE ELEMENTS          9**
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          9**
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          9**
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 Gear – Terminology, helix angles, Estimating the size of the pair of cross helical gears.

**UNIT IV          DESIGN OF GEAR BOXES          9**
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  CLUTCHES AND BRAKES          9**
Design of plate clutches –Friction materials, Centrifugal clutch, axial clutches, Single plate clutch, multiple plate clutch, cone clutch and internal expanding rim clutch, Internal and external shoe brakes, Band brake, Disk brakes**.**

                                                                  **TOTAL HOURS: 45 PERIODS**

**COURSE OUTCOMES**
The students will be able to
CO1:   Design and select pulleys, chain drives, rope drives and belt drives.
CO2:   Design and select spur gears and parallel axis helical gears.
CO3:   Design and select bevel, worm and cross helical gears.
CO4:   Design gear boxes.
CO5:   Design brakes and clutches.

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## TEXT BOOKS

1. Bhandari, V.B., "Design of Machine Elements", 4th Edition Tata McGraw-Hill Publishing Company Ltd., 2017.
2. Shigley J.E., "Mechanical Engineering Design", 10th Edition, Tata McGraw-Hill, 2014.

## REFERENCE BOOKS

1. Hamrock B.J., Jacobson B., Schmid S.R., "Fundamentals of Machine Elements", Third Edition, CRC Press, 2013.
2. Sundararajamoorthy T. V and Shanmugam. N, "Machine Design", Anuradha Publications, Chennai, 2007.
3. R. S. Khurmi & J. K. Gupta, "A Text book of Machine Design", Eurasia Publishing House, 2005.
4. Ugural A.C, "Mechanical Design, An Integrated Approach", McGraw-Hill, 2003
5. Prabhu. T.J., "Design of Transmission Elements", Fifth Edition, Mani Offset, Chennai, 2002.
6. Maitra G.M., and Prasad L.V., "Hand book of Mechanical Design", II Edition, Tata McGraw-Hill, 1985.

## STANDARDS:

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

| | Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Co1 | Design and select pulleys, chain drives, rope drives and belt drives. | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 2 | 2 |
| Co2 | Design and select spur gears and parallel axis helical gears. | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 2 | 2 |
| Co3 | Design and select bevel, worm and cross helical gears. | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 2 | 2 |
| Co4 | Design gear boxes. | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 2 | 2 |
| Co5 | Design brakes and clutches. | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 2 | 2 |

**618MET04**                     **CAD/CAM/CIM**                              L  T  P  C
                                                                            3  0  0  3

**COURSE OBJECTIVES:**
- To study the computer aided design and drawing using popular software package.
- To study the basics of manufacturing, DNC and CNC servo system.
- To understand the components of computer integrated manufacturing.
- To study the group technology and computer aided process planning in industry.
- To understand the system of shop floor control and flexible manufacturing system in industry

**PRE-REQUISITES:** Knowledge of Manufacturing Technology II is required.

**UNIT I        INTRODUCTION OF COMPUTER AIDED DESIGN                              9**
Concept of Graphic Primitives- 2Dimensional Transformations and 3Dimensional Transformations (Concept) -Geometric Modeling, Concept and Types (Any Popular CAD Software) - Typical features of drafting package - Salient features of solid modeling- Understanding curve and Surface design.

**UNIT II        DNC AND CNC SERVO SYSTEM                                          9**
Principle and operation of a CNC servo system- Direct Numerical Control (DNC), Objectives of DNC- Types of standard controllers (Only Industrial Purpose), Programming codes- Manual part programming of turning operation and milling operation(examples of turning, facing, taper, thread and rectangular and circular packet, drilling holes )

**UNIT III        COMPONENTS OF COMPUTER INTEGRATED MANUFACTURING                 9**
Computer Integrated Manufacturing: Concept and  Technology, Role of the elements of CIM system, CASA/SME model of CIM, CIM II, Benefits – Communication matrix in CIM, Fundamentals of computer communication in CIM - CIM data transmission methods - Types of communication in CIM - Computer networking in CIM (LAN and MAP model) - OSI model seven layer -Network topologies: Types and advantages

**UNIT IV        GROUP TECHNOLOGY AND COMPUTER AIDED PROCESS PLANNING             9**
Group Technology (GT) – Part Families – Parts Classification and Coding systems (DCLASS , MICLASS and OPTIZ) -Facility design using GT - Benefits of GT- Concept of Cellular Manufacturing Process planning: Role of process planning in CAD/CAM Integration -Approaches to computer aided process planning, Structure of a process planning software, Variant approach and Generative approaches, CMPP systems

**UNIT V        SHOP FLOOR CONTROL AND INTRODUCTION TO FLEXIBLE MANUFACTURING SYSTEM                                                                     9**
Components of shop floor data collection systems, shop floor control phases-Types of data collection systems- Automatic data collection system, Flexible Manufacturing System: Scopes, Components, Types, Workstation, Benefits, Material handling and Storage system, Layouts, Computer control systems

**TOTAL HOURS: 45 PERIODS**

**COURSE OUTCOMES**
The students will be able to
 CO1:  Use computer and popular CAD software's for modelling.
 CO2:  Know the construction features of NC and CNC machines and the components.
 CO3:  Gain the knowledge of computer integrated manufacturing.
 CO4:  Develop knowledge on group technology and computer aided process planning.
 CO5:  Utilize knowledge of flexible manufacturing system on shop floor in industries.

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**TEXT BOOKS**

1. Mikell. P. Groover "Automation, Production Systems and Computer Integrated Manufacturing", Pearson Education, 4th Edition, 2016.
2. Radhakrishnan.P., Subramanyan.S. and Raju.V., "CAD/CAM/CIM", New Age International, 2012.

**REFERENCE BOOKS**

1. P N Rao, "CAD/CAM Principles and Applications", TMH Publications, 3rd Edition, 2010.
2. Chris McMahon and Jimmie Browne, "CAD CAM Principles, Practice and Manufacturing Management", Pearson Education, Second Edition, 2005.
3. Ranky, Paul G., "Computer Integrated Manufacturing", Prentice Hall of India Pvt. Ltd., 2005.
4. Mikell. P. Groover and Emory Zimmers Jr.,"CAD/CAM", Prentice Hall of India Pvt. Ltd., 2003.
5. Krar.S, and Gill.A, "CNC Technology and Programming" , McGraw Hill Publishers, 1989.

| | Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Co1 | Use computer and popular CAD software's for modelling. | 2 | | | 1 | | | | | | 2 | 2 | | | 1 | |
| Co2 | Know the construction features of NC and CNC machines and the components. | | 1 | | | 2 | | 1 | | | 1 | | | | | |
| Co3 | Gain the knowledge of computer integrated manufacturing. | 2 | 1 | 1 | | 2 | | 2 | | | 2 | 1 | | 1 | | |
| Co4 | Develop knowledge on group technology and computer aided process planning. | 2 | | | | 2 | | | | | 1 | | 1 | | | 1 |
| Co5 | Utilize knowledge of flexible manufacturing system on shop floor in industries. | 2 | 1 | | | | | | | | 2 | 1 | | | 1 | |

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**618MEP07**                  **COMPUTER AIDED MACHINE DRAWING**                  L  T  P  C
                                                                                  0  0  2  1

**COURSE OBJECTIVES:**
- To provide knowledge on reading of machine drawing with drawing standards
- To make the students understand and interpret drawings of machine components
- To familiarize the representation of various machine element drawings
- To impart the significance of sectional views and its representation in drawings
- To develop skill to handle 2D drafting, 3D modeling and assembly using standard CAD packages

**PRE-REQUISITES:** Knowledge of Engineering Graphics and Design of Machine Elements are required.

**DRAWING STANDARDS, FITS AND TOLERANCES**                                             **5**
Code of practice for Engineering Drawing, BIS specifications – Geometric constraint and symbols – Fundamentals of Limits, Tolerances, Fits, surface roughness and its indication in drawings – Elementary weld symbol – Preparation of production drawings and reading of part and assembly drawings.

**2D DRAFTING, 3D MODELLING AND ASSEMBLY**                                             **40**
Introduction to 2D drafting - Drawing, Editing, Dimensioning, Layering, Hatching, Block, Array, Detailing, Detailed drawing – Conversion of pictorial views into orthographic projections of simple machine parts.
Introduction to 3D modelling, assembly concept, sectional views and sectional views of assembled drawings, Bill of materials – Assembly drawing of Sleeve and Cotter joint, Knuckle Joint, Flanged coupling, Plummer block, Stuffing box, Safety valve, Screw jack, Machine Vice, Tail stock, Piston and connecting rod.
Use of standard CAD application packages is recommended from the point of view of requirement by industries.

**TOTAL HOURS: 45 PERIODS**

**COURSE OUTCOMES**
Student will be able to
CO1:  Follow the drawing standards, Fits and Tolerances
CO2:  Represent the machine elements in industrial drawings.
CO3:  Explain the concept of sectional views in drawings.
CO4:  Prepare bill of materials for production drawings.
CO5:  Re-create part drawings and assembly drawings of machine components as per standards

**REFERENCE BOOKS**
1. Sidheswar N, Kannaiah P and Sastry V. V. S, "Machine Drawing", Tata McGraw Hill, 2017.
2. Narayana K.L., Kannaiah P and Venkata Reddy K, "Machine Drawing ", 5th Edition, New Age International (P) Limited Publishers, 2016.
3. Bhatt N.D. and Panchal V.M., "Machine Drawing", 49th Edition, Charotar Publishing House Pvt. Ltd., 2014.
4. Gopalakrishna K.R., "Machine Drawing", 22nd Edition, Subhas Stores Books Corner, Bangalore, 2013.
5. Basudeb Bhattacharyya, "Machine Drawing", Oxford University Press, 2011.

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| | Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Co1 | Follow the drawing standards, Fits and Tolerances | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 2 | 2 |
| Co2 | Represent the machine elements in industrial drawings. | 2 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 2 | 2 |
| Co3 | Explain the concept of sectional views in drawings. | 3 | 2 | 2 | 3 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 3 | 2 |
| Co4 | Prepare bill of materials for production drawings. | 3 | 2 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 2 | 2 |
| Co5 | Re-create part drawings and assembly drawings of machine components as per standards | 2 | 2 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 2 | 2 |

**618MEP08**                    **CAM LABORATORY**                    L  T  P  C
                                                                      0  0  2  1

**COURSE OBJECTIVES:**
- The students acquire practical knowledge about fundamentals of numerical control.
- To know the types of CNC machines and the programming technique.
- To understand the concepts of G and M codes.
- To write the manual part programming to modern control systems. (Fanuc, Siemens etc)
- To know the modern application of various CNC machines.

**PRE-REQUISITES:** Knowledge of CAD/CAM/CIM and Manufacturing Technology –II are required.

**INTRODUCTION**
1. Study of CNC lathe, milling
2. Study of international standards G-Codes, M-Codes
3. Program writing – Turning simulator – Milling simulator, IS practice – commands – menus

**EXERCISE PRACTICE**
**CNC Lathe**
1. Develop a part program for plain turning and simulate
2. Develop a part program for Facing turning and simulate
3. Develop a part program for Step turning and simulate
4. Develop a part program for taper turning and simulate
5. Develop a part program for Thread cutting and simulate
6. Develop a part program for drilling and simulate

**CNC Milling**
7. Develop a part program for drilling with dwell and simulate
8. Develop a part program for drilling with dwell and PCD and simulate
9. Develop a part program for rectangular pocket and simulate
10. Develop a part program for circular pocket and simulate

**TOTAL HOURS: 45 PERIODS**

**COURSE OUTCOMES**
The students will able to know about
CO1: PC based CNC machines and windows based CAM software packages has made CNC programming.
CO2: Good aptitude for understand by the modern CNC control system in modern manufacturing system.
CO3: Knowledge to prepare the CNC Part Programming Techniques and to perform the manufacturing operation.
CO4: CAM software packages make it easy to translate CAD files into CNC programs which enable users to handle sophisticated jobs.
CO5: Knowledge of programming codes used in industry.

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| | Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Co1 | PC based CNC machines and windows based CAM software packages has made CNC programming. | | 2 | | 2 | | | 1 | | 2 | | 1 | | 2 | | |
| Co2 | Good aptitude for understand by the modern CNC control system in modern manufacturing system. | | | 2 | 1 | | | | | 1 | | | | | 2 | |
| Co3 | Knowledge to prepare the CNC Part Programming Techniques and to perform the manufacturing operation. | | | 2 | | | | 1 | | | | 1 | 2 | | | 1 |
| Co4 | CAM software packages make it easy to translate CAD files into CNC programs which enable users to handle sophisticated jobs. | | | | | 3 | | | | 2 | | 2 | | | 1 | |
| Co5 | Knowledge of programming codes used in industry | 3 | | | 2 | | | | | | | | | | | 1 |

**618MEE02**     **PROFESSIONAL ETHICS AND HUMAN VALUES**      L  T  P  C
                                                               3  0  0  3

**COURSE OBJECTIVES:**
- To understand the scope of ethics in engineering.
- To learn about research ethics, codes of ethics and industrial standards.
- To know about the concepts of engineers responsibility on safety and risk.
- To understand about the professional rights and crime.
- To gain the knowledge on multinational corporation ethics like business ethics, environmental ethics, computer ethics, etc.

**UNIT I         HUMAN VALUES AND ENGINEERING ETHICS                         9**

Objectives – Morals – Values – Ethics – Integrity – Work Ethics – Service learning – Virtues – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing Time – Co-operation – Commitment – Empathy – Self-confidence – Challenges in the Work place – Sprituality.
Sense 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                      9**

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                       9**

Safety and Risk - Assessment of Safety and Risk - Risk Benefit Analysis - Reducing Risk - The Government Regulator's Approach to Risk - Chernobyl Case Study and Bhopal gas tragedy.

**UNIT IV         RESPONSIBILITIES AND RIGHTS                                9**

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                                               9**

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.

                                                        **TOTAL HOURS: 45 PERIODS**

**COURSE OUTCOMES**

CO1:  The students will have awareness on engineering ethics and human values to instill moral and social values.
CO2:  Students will be able to know about the importance and outcomes of experimentation of ethics with a case study.
CO3:  Students will be able to know about assessment of safety and risk.
CO4:  The student will have an ability to develop the knowledge in the area of collegiality, loyalty, confidentiality and IPR.
CO5:  The students are aware of about the global issues related to engineering.

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## TEXT BOOKS

1. Charles E Harris, Michael S Pritchard and Michael J Rabins, "Engineering Ethics - Concepts and Cases", Wardsworth Publishing, 6th Edition, 2018.
2. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw Hill, New York, 4th Edition, 2017.

## REFERENCE BOOKS

1. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, 8th Edition, 2016.
2. M. Govindarajan, S.Natarajan, V.S. Senthil Kumar, "Engineering Ethics", Prentice Hall of India Pvt. Ltd., New Delhi, 2013.
3. Subramaniam R, "Professional Ethics", Oxford University Press, New Delhi, 2013.
4. Laura P Hartman and Joe Desjardins, "Business Ethics: Decision making for personal integrity and social responsibility", McGraw Hill Education India Pvt. Ltd., New Delhi, 2013.
5. Charles D Fleddermann, "Engineering Ethics", Prentice Hall, New Mexico, 4th Edition, 2011.
6. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, 2008.
7. Gail D Baura, "Engineering Ethics: An Industrial Perspective", Elsevier Academic Press, 2006.
8. Prof. (Col) P S Bajaj and Dr. Raj Agrawal, "Business Ethics - An Indian Perspective", Dreamtech Press, 2004.
9. David Ermann and Michele S Shauf, "Computers, Ethics and Society", Oxford University Press, 2003.

| | Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Co1 | The students will have awareness on engineering ethics and human values to instill moral and social values. | | | 2 | | | 2 | | 3 | | | 2 | 2 | | 2 | 1 |
| Co2 | Students will be able to know about the importance and outcomes of experimentation of ethics with a case study. | | | | | 2 | | | 2 | | 1 | | | | 1 | |
| Co3 | Students will be able to know about assessment of safety and risk. | | | 2 | | | 3 | | | | | | | | 1 | |
| Co4 | The student will have an ability to develop the knowledge in the area of collegiality, loyalty, confidentiality and IPR. | | | 2 | | | 2 | | 3 | | | 3 | 1 | | | |
| Co5 | The students are aware of about the global issues related to engineering. | | | 2 | | | 3 | | | | | | | | 2 | 2 |

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| 618MEE08 | METAL FORMING TECHNIQUES | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**
- To know about Von-mises stress, Octahedral shear stress and shear strain theory.
- To know about the forging and rolling operations.
- To study about the working principle and applications of extrusion and drawing processes.
- To gain the knowledge on sheet metal forming processes.
- To develop new component by using new techniques and analyse with CAM software.

**PRE-REQUISITES:** Knowledge of Manufacturing technology is required.

**UNIT I          FUNDAMENTALS OF METAL FORMING                                              9**
State of stress – Components of stress, symmetry of stress tensor, principle stresses – Stress deviator – von-mises, Tresca yield criteria – Octahedral shear stress and shear strain theory – Flow stress determination – Temperature in metal forming – Hot, cold and warm working – Strain rate effects – Metallurgical structures – Residual stresses – Spring back.

**UNIT II          FORGING AND ROLLING                                                               9**
Principle – Classification – Equipment – Tooling – Process parameters and calculation of forces during forging and rolling processes – Ring compression test – Post forming heat treatment – defects (causes and remedies) – Applications – Roll forming.

**UNIT III          EXTRUSION AND DRAWING PROCESSES                                         9**
Classification of extrusion processes – tool, equipment and principle of these processes – influence of friction – extrusion force calculation – defects (causes and remedies) – Rod-Wire drawing – tool, equipment and principle of processes – defects – Tube drawing and sinking processes – Mannessmann process of seamless pipe manufacturing – Tube bending.

**UNIT IV          SHEET METAL FORMING PROCESSES                                            9**
Classification – conventional and HERF processes – Presses – types and selection of presses – formability studies – FLD, Limiting Draw ratio – processes: Deep drawing, spinning, stretch forming, plate bending, Rubber pad forming, bulging and press brake forming – Explosive forming, Electro hydraulic forming, Magnetic pulse forming and Super plastic forming.

**UNIT V          POWDER FORGING AND RECENT ADVANCES                                  9**
Powdered metals and fabrication procedures, Applications, Preparation of powders, Compacting and sintering, Yield criteria and flow rules, Hot and cold pressing (HIP, CIP) –P/M forming – Electro forming – fine blanking – Hydro forming – Peen forming – Laser Forming – Micro forming – Isothermal forging – High speed forging and extrusion near net shape forming – Ultra fine grained materials by severe plastic deformation, CAD and CAM in forming.

**TOTAL HOURS: 45 PERIODS**

**COURSE OUTCOMES**
CO1: The students can understand load requirements for various bulk metal forming with or without addition of heat.
CO2: The students can understand tooling and press capacity for making sheet metal components.
CO3: Ability to know about extrusion processes and its force calculations.
CO4: The students are able to develop super plastic forming processes technique.
CO5: Student can able to analyse the new develop component by using simulation software.

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**TEXT BOOKS**

1. Dieter G.E., "Mechanical Metallurgy", McGraw Hill, Co., 3rd Edition, 2017.
2. Nagpal G.R. "Metal forming processes", Khanna Publishers, New Delhi, 2005.

**REFERENCE BOOKS**

1. Rao, P.N. "Manufacturing Technology", TMH Ltd., Vol 2, 2017
2. B.L.Juneja, "Fundamentals of Metal Forming Processes", New Age International Publishers, 2018.
3. Marciniak Z, Duncen J L and Hu S J, "Mechanics of Sheet Metal Forming", Butterworth-Heinemann, An imprint of Elsevier, 2006.
4. Serope Kalpakjian, Steven R Schmid, "Manufacturing Process for Engineering Materials" Pearson Education, 4th Edition, 2003.
5. ASM Hand book, "Forming and Forging", Ninth Edition, Vol-III, 2003.
6. Edward M.Mielink, "Metal Working Science Engineering", McGraw Hill, Inc, 2000.

| | **Course Outcome** | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Co1** | The students can understand load requirements for various bulk metal forming with or without addition of heat. | | 2 | 2 | | | | | | | | | | 2 | | |
| **Co2** | The students can understand tooling and press capacity for making sheet metal components. | 1 | | | | 3 | | | | 1 | | | | 2 | | |
| **Co3** | Ability to know about extrusion processes and its force calculations. | | 3 | 2 | | 3 | | | | 1 | | | | 1 | | |
| **Co4** | The students are able to develop super plastic forming processes technique. | | | 2 | | 3 | | | | 1 | | | | 3 | | |
| **Co5** | Student can able to analyse the new develop component by using simulation software. | | 2 | 1 | | 3 | | | | | | | 2 | 1 | | 3 |

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**618MEE10**　　　　　　　　**OPERATIONS RESEARCH**　　　　　　　　**L　T　P　C**
　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　**3　0　0　3**

**COURSE OBJECTIVES:**
The student should be made
- To know about linear programming formulation and its graphical solution.
- To know about dual simplex method.
- To get knowledge on branch and bound techniques.
- To know about classical optimization techniques.
- To understand the applications of CPM and PERT techniques.

**PRE-REQUISITES:** Knowledge of Engineering Mathematics is required.

**UNIT I**　　　　　　**LINEAR PROGRAMMING**　　　　　　　　　　　　　　　　**9**
Principal components of decision problem – Modeling phases – LP Formulation and graphic solution – Resource allocation problems – Simplex method – Sensitivity analysis.

**UNIT II**　　　　　　**DUALITY AND NETWORKS**　　　　　　　　　　　　　　**9**
Definition of dual problem – Primal – Dual relationships – Dual simplex methods – Post optimality analysis – Transportation and assignment model – Shortest route problem.

**UNIT III**　　　　　　**INTEGER PROGRAMMING**　　　　　　　　　　　　　　**9**
Cutting plan algorithm – Branch and bound methods, Multistage (Dynamic) programming.

**UNIT IV**　　　　　　**CLASSICAL OPTIMISATION THEORY**　　　　　　　　**9**
Unconstrained external problems, Newton – Raphson method – Equality constraints – Jacobean methods – Lagrangian method – Kuhn – Tucker conditions – Simple problems.

**UNIT V**　　　　　　**OBJECT SCHEDULING**　　　　　　　　　　　　　　　　**9**
Network diagram representation – Critical path method – Time charts and resource leveling – PERT.
　　　　　　　　　　　　　　　　　　　　　　　　　　　**TOTAL HOURS: 45 PERIODS**

**COURSE OUTCOMES**
The students will be able to
CO1:  Understand the mathematical tools that are needed to solve optimization problems.
CO2:  Identify and develop operational research models from the verbal description of the dual systems.
CO3:  Study the techniques of integer programming.
CO4:  Solve mathematical models like Newton Raphson method, Lagrangian method and Kuhn Tucker conditions.
CO5:  Develop a operational event and activities effectively by use of CPM and PERT for project management

**TEXT BOOKS**
1. S.D.Sharma, "Operations Research", Kedar Nath Ram Nath Publications, Chennai, 2015.
2. Panneerselvam, "Operations Research", Prentice Hall of India, 2nd Edition, 2015.

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## REFERENCE BOOKS

1. J.K.Sharma, "Operations Research Theory and Applications", Mc Millan India, 5th Edition 2013.
2. Hira and Gupta, "Problems in Operations Research", S.Chand and Co, 2013.
3. Hamdy A Taha, "Operations Research: An Introduction", Prentice Hall, 9th Edition, 2010.
4. Frederick.S.Hiller and Gerald.J.Lieberman, "Operations Research Concepts and Cases", McGraw Hill Publishers, 9th Edition, 2010.
5. G Srinivasan, "Operations Research Principles and Applications", Prentice Hall of India (EEE), 2010.
6. Wagner, "Operations Research", Prentice Hall of India, 2000.

| | Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Co1 | Understand the mathematical tools that are needed to solve optimization problems. | 3 | 3 | 1 | | 3 | | | | 1 | 2 | | | 3 | | |
| Co2 | Identify and develop operational research models from the verbal description of the dual systems. | | | | | 2 | | | | | 3 | | | 1 | | |
| Co3 | Study the techniques of integer programming. | 1 | | | | 2 | | | | | | | | 1 | | |
| Co4 | Solve mathematical models like Newton Raphson method, Lagrangian method and Kuhn Tucker conditions. | 3 | 3 | | | 2 | | | | | | | | | 3 | |
| Co5 | Develop a operational event and activities effectively by use of CPM and PERT for project management | 3 | 3 | | | 2 | | | | | | | | 3 | 3 | |

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| Course Code | Course Title | Hours/Week | | | Credits | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | C | CA | EA | Total |
| 715MET01 | MECHATRONICS AND ROBOTICS | 3 | 0 | 0 | 3 | 50 | 50 | 100 |

**OBJECTIVES:**
1. To have knowledge on various types of sensors and transducer used in mechatronics system.
2. To learn about the different system models and controllers used in mechatronics system.
3. To comprehend the concepts of electrical circuits and signal conditioning.
4. To learn the various types of grippers and selection of grippers.
5. To know about the basic concepts associated with the design and functioning and applications of Robots.

**PRE-REQUISITES:** Knowledge of Applied Hydraulic and Pneumatics and Engineering Mechanics are required.

**UNIT I MECHATRONICS SENSORS AND TRANSDUCERS                                                 9**
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 SYSTEM MODELS AND CONTROLLERS                                                 8**
Building blocks of Mechanical, Electrical, Fluid and Thermal Systems, Rotational and Translational Systems, Electromechanical Systems, Hydraulic and 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 III PROGRAMMING LOGIC CONTROLLERS AND DESIGN OF MECHATRONICS SYSTEM                                                 10**
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.
Stages in designing Mechatronics Systems, Traditional and Mechatronic Design, Possible Design Solutions, Autonomous mobile robot-Wireless surveillance balloon- Engine Management system- Automatic car park barrier.

**UNIT IV ROBOT AND END EFFECTORS                                                 9**
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.
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 V ROBOT KINEMATICS AND ROBOT PROGRAMMING                                                 9**
Forward Kinematics, Inverse Kinematics and Differences, Forward Kinematics and Inverse Kinematics of Manipulators with Two, Three Degrees of Freedom (In 2 Dimensional).
Teach Pendant Programming, Lead through programming, Robot programming Languages - VAL Programming - Motion Commands, Sensor Commands, End effector commands, and Simple programs.

**TOTAL : 45 Hours**

**COURSE OUTCOMES:**
- The students will be able to analyze mechatronics systems and different sensors used for displacement, position, velocity, motion, force, fluid pressure, temperature, etc
- The students acquire knowledge in system models of mechanical, electrical, fluid, thermal systems and continuous and discrete process controllers
- The students will be familiar with the basic structure of programmable logic controllers and in designing mechatronics systems
- The students will be able to acquire the knowledge of different types and classification of robots, end effectors and robot kinematics.
- The students will be able to gain the knowledge on robot programming languages.

**TEXT BOOKS:**
1. Bolton W, "Mechatronics- Electronic Control Systems in Mechanical and Electrical Engineering", Pearson Education, 6th Edition, Indian Reprint, 2015.
2. M.P.Groover, "Industrial Robotics - Technology, Programming and Applications", Tata McGraw-Hill, 2nd Edition, Special Indian Edition, 2012.

**REFERENCE BOOKS:**
1. Fu.K.S., Gonzalz.R.C., and Lee C.S.G., "Robotics Control, Sensing, Vision and Intelligence", McGraw-Hill Book Co., 2008.
2. Rajput. R.K, "A Textbook of Mechatronics", S. Chand & Co, 2007.
3. Michael B. Histand and David G. Alciatore, "Introduction to Mechatronics and Measurement Systems", McGraw-Hill International Editions, 2007.
4. Lawrence J. Kamm, "Understanding Electro - Mechanical Engineering, An Introduction to Mechatronics", Prentice - Hall of India Pvt., Ltd., 1995.
5. Janakiraman.P.A.,"Robotics and Image Processing", Tata McGraw-Hill, 1995.
6. Yoram Koren, "Robotics for Engineers", McGraw-Hill Book Co., 1985.

| | **Course Outcome** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Co1** | The students will be able to understand mechatronics system and different sensors used for displacement, position, velocity, motion, force, fluid pressure, temperature, etc | 2 | - | - | - | 1 | - | 1 | - | - | - | - | - | 2 | - | 1 |
| **Co2** | The students acquire knowledge in system models of mechanical, electrical, fluid, thermal systems and continuous and discrete process controllers | 1 | - | 3 | - | - | - | - | - | - | - | - | - | 2 | - | 1 |
| **Co3** | The students will be familiar with the basic structure of programmable logic controllers and in designing mechatronics systems | 1 | 1 | 2 | 1 | 2 | - | - | - | - | - | - | - | 2 | - | 2 |
| **Co4** | The students will be able to acquire the knowledge of different types and classification of robots, end effectors and robot kinematics. | 2 | 1 | 2 | - | - | - | - | - | - | - | - | - | 2 | - | 2 |
| **Co5** | The students will be able to acquire the knowledge on robot programming languages. | - | 1 | 1 | - | 2 | 1 | 1 | 1 | - | - | - | - | 2 | - | 1 |

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| Course Code | Course Title | Hours/Week | | | Credits | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | C | CA | EA | Total |
| **715MET02** | **FINITE ELEMENT ANALYSIS** | **3** | **0** | **0** | **3** | **50** | **50** | **100** |

**OBJECTIVES:**

1. To interpret the mathematical and physical principles underlying the Finite Element Analysis.
2. To acquire knowledge about the characteristics of various one dimensional elements for the problems being solved.
3. To explain about the finite element equations for simple and complex elements.
4. To learn how the finite element method is implemented in vibration analysis.
5. To develop finite element formulations of engineering problems from a variety of application areas including heat transfer and fluid flow analysis.

**PRE-REQUISITES:** Knowledge of Engineering Mathematics III, Strength of Materials, Engineering Thermodynamics, Dynamics of Machinery are required.

**INTRODUCTION** (Not for examination) **4**

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** **9**

Weighted residual methods -General weighted residual statement - Weak formulation of the weighted residual statement - Piecewise continuous trial functions- Principle of stationary total potential - Rayleigh Ritz method - Piecewise continuous trial functions – Solution of equilibrium problems – Gaussian elimination method – Rayleigh Ritz method – Galerkin method.

**UNIT II ONE DIMENSIONAL FINITE ELEMENT ANALYSIS** **9**

General form of total potential for 1D applications - Generic form of finite element equations - linear bar element – Quadratic bar 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** **9**

Introduction - Approximation of geometry and field variable - 3 noded triangular elements - four noded rectangular elements - Higher order elements - 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 formule - transformations to natural coordinates - Gaussian quadrature - Example problems in plane stress, Plane strain and Axisymmetric applications.

**UNIT IV DYNAMIC ANALYSIS USING FINITE ELEMENT METHOD** **9**

Introduction - Vibrational Problems - Equations of motion based on weak form - Axial vibration of bars - Transverse vibration of beams - Consistent mass matrices and lumped mass matrices- element equations -Solution of eigen value problems - Vector iteration methods.

Basic equation of steady state heat transfer and fluid flow problems – 1D finite element formulation – 1D heat transfer and fluid flow problems - Scalar variable problems in 2Dimensions - Applications to heat transfer in 2 Dimension.

**TOTAL : 45 Hours**

## COURSE OUTCOMES:

Student will be able to

- Identify mathematical model for solution of common engineering problems
- Formulate one dimensional finite element equation for simple problems.
- Examine 2-D finite element continuum for structural applications
- Formulate and solve vibration problems using finite element techniques.
- Solve 1-D and 2-D heat transfer and fluid flow problems using finite element approach.

## TEXT BOOKS:

1. Logan D.L., "A First Course in the Finite Element Method", 6th Edition, Thomson Learning, 2016.
2. P.Seshu, "Text Book of Finite Element Analysis", Prentice-Hall of India Pvt. Ltd., New Delhi, 2012.

## REFERENCE BOOKS:

1. Rao S.S, "The Finite Element Method in Engineering", Butterworth-Heinemann (An imprint of Elsevier), 6th Edition, 2018.
2. J.N.Reddy, "An Introduction to the Finite Element Method", McGraw-Hill International, 3rd Editions, 2017.
3. David V.Hutton, "Fundamentals of Finite Element Analysis", Tata McGraw-Hill Edition 2017.
4. Chandrupatla T.R. & Belagundu A.D., "Introduction to Finite Elements in Engineering", Pearson Education, New Delhi, 4th Edition, 2014.
5. K.J. Bathe, "Finite Element Procedures", Prentice-Hall India Pvt. Ltd., New Delhi, 2nd Edition, 2014.
6. Chennakesava R Alavela, "FEM: Basic Concepts and Applications", Prentice Hall India Pvt. Ltd, New Delhi, 2012.
7. Cook R.D., Malkus D.S., Plesha M.E., and Witt R.J., "Concepts and Applications of Finite Element Analysis", Wiley India (P) Ltd., New Delhi, 4th Edition, 2007.

| | Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Co1 | Identify mathematical model for solution of common engineering problems | 3 | 3 | - | - | - | - | - | - | - | - | - | - | 2 | - | - |
| Co2 | Formulate one dimensional finite element equation for simple problems. | 2 | 3 | - | - | - | - | - | - | - | - | - | - | 2 | - | - |
| Co3 | Examine 2-D finite element continuum for structural applications | 2 | 3 | 1 | - | - | - | - | - | - | - | - | - | 2 | - | - |
| Co4 | Formulate and solve vibration problems using finite element techniques. | 2 | 3 | 1 | - | - | - | - | - | - | - | - | - | 2 | - | - |
| Co5 | Solve 1-D and 2-D heat transfer and fluid flow problems using finite element approach. | 2 | 3 | - | - | - | - | - | - | - | - | - | - | 2 | - | - |

| Course Code | Course Title | Hours/Week | | | Credits | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | C | CA | EA | Total |
| **715MET03** | **POWER PLANT AND ENERGY ENGINEERING** | 3 | 0 | 0 | 3 | 50 | 50 | 100 |

**OBJECTIVES:**
1. To penetrate the various components, operations and applications of different types of power plants.
2. To gain the knowledge on steam power plants, steam generators their analyses on fuel and fluidized bed combustion, ash handling systems,
3. To findout the requirements for a Nuclear Power Plant, from sources to consumption.
4. To describe basic working principles of gas turbine and diesel engine power plants.
5. To know various methods for the Economics of Power Generation and list factors affecting the power plants.

**PRE-REQUISITES:** Knowledge of Basic of Civil and Mechanical Engineering is required.

**UNIT I INTRODUCTION TO POWER PLANTS AND BOILERS                9**

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                9**

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                9**

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                9**

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 - Combined cycle.

**UNIT V RENEWABLE ENERGY  & ECONOMICS OF POWER PLANTS                9**

Bio Energy, Biomass, Biogas, Source, Composition, Wind Energy, Wind Data and Energy Estimation - Wind Energy Conversion Systems, Geo thermal-OTEC- Tidal energy, Solar central receiver system (Solar Power Tower Plants). Cost of electric Energy- Fixed and operating costs-Energy rates- Types of tariffs- Economics of load sharing, Comparison of various power plants.

**TOTAL : 45 Hours**

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## COURSE OUTCOMES:

The students will be able to

- Realize the importance of power requirement, generation and utilization in the present world energy scenario.
- Apply the knowledge gained by analyzing the steam power plants, steam generators and gas turbine power plants, to improve the efficiency and reduce the thermal losses.
- Analyze the processes and cycles followed in nuclear power plants and components used in the power plants and identify the losses to get better efficiency.
- Describe the working of various components of diesel power plant and Illustrate the working of gas turbine power plant and its components.
- Apply knowledge about economics of power generation and use of renewable energy.

## TEXT BOOKS:

1. Nag P.K, "Power Plant Engineering", Tata McGraw- Hill, 4th Edition, 2017.
2. Arora S.C and Domkundwar S, "A Course in Power Plant Engineering", Dhanpat Rai, 8th Edition, 2016.

## REFERENCE BOOKS:

1. R.K.Rajput, "Power Plant Engineering", Laxmi Publications, 5th Edition, 2016.
2. G.D.Rai, "An Introduction to Power Plant Technology", Khanna Publishers, 2015.
3. EI-Wakil M.M, "Power Plant Technology", Tata McGraw-Hill, 2013.
4. G.R,Nagpal , "Power Plant Engineering", Khanna Publishers, 2002.

| | Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Co1 | Realize the importance of power requirement, generation and utilization in the present world energy scenario. | 3 | 1 | - | - | - | 1 | 1 | - | 1 | 1 | - | - | 2 | - | - |
| Co2 | Apply the knowledge gained by analyzing the steam power plants, steam generators and gas turbine power plants, to improve the efficiency and reduce the thermal losses. | 3 | 1 | - | - | - | 1 | 1 | - | 1 | 1 | - | - | 2 | - | - |
| Co3 | Analyze the processes and cycles followed in nuclear power plants and components used in the power plants and identify the losses to get better efficiency. | 3 | 1 | - | - | - | 1 | 1 | - | 1 | 1 | - | - | 2 | - | - |
| Co4 | Describe the working of various components of diesel power plant and Illustrate the working of gas turbine power plant and its components. | 3 | 1 | - | - | - | 1 | 1 | - | 1 | 1 | - | - | 2 | - | - |
| Co5 | Apply knowledge about economics of power generation and use of renewable energy. | 3 | 1 | - | - | - | 1 | 1 | - | 1 | 1 | - | - | 2 | - | - |

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| Course Code | Course Title | Hours/Week | | | Credits | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | C | CA | EA | Total |
| **715MET04** | **COMPOSITE MATERIALS** | 3 | 0 | 0 | 3 | 50 | 50 | 100 |

**OBJECTIVES:**
1. To interpret the need of newer materials which are having better properties to suit with conventional materials.
2. To analyze the mechanics of laminated composites.
3. To analyze the different processing/ fabrication techniques of composite materials.
4. To identify the properties, advantages and disadvantages of the metal matrix composites.
5. To gain the knowledge of the advanced composite materials used in various applications.

**PRE-REQUISITES:** Knowledge of Engineering Chemistry is required.

**UNIT I   INTRODUCTION TO COMPOSITE MATERIALS                                      09**
Definition, Need, Classification and Characteristics of composite materials– Fibrous composites, laminated composites, Particulate composites, Hybrid composites,  Merits, demerits and applications of composite materials, Types of matrix and reinforcements, Properties of matrix and reinforcements.

**UNIT II   MECHANICS OF LAMINATED COMPOSITES                                      10**
Stress-strain relationship for anisotropic and orthotropic materials, Unidirectional laminas – Rule of mixtures, Volume fraction and weight fraction, Fibre length and fibre orientation distribution, voids, Strength of orthotropic lamina, Failure criteria of orthotropic lamina, Macro mechanical behaviour of laminates, Interfacing bonding mechanics.

**UNIT III   FABRICATION OF COMPOSITES                                      09**
Fabrication process–Open and closed mould process, Hand layup techniques, Vacuum bag molding – Auto clave method – Filament winding, Pultrusion, Pulforming, Thermo-forming, Injection molding, Blow molding, Curing, Machining, Recycling of PMC.

**UNIT IV   METAL MATRIX COMPOSITES                                      09**
Commonly used Matrices, Basic Requirements in Selection of constituents, Fabrication process – Liquid metallurgy – Liquid metal impregnation technique, Pressure infiltration, Stir-casting, Squeeze casting, Powder metallurgy technique, Mechanical properties and Machinability of MMCs.

**UNIT V   ADVANCED COMPOSITES                                      08**
Interface, Properties and Processing of Ceramic matrix composites, Carbon fibre composites, Carbon Carbon Composites, Multifilmentary super conducting composites, In-situ composites, Nano composites.

                                                                **TOTAL: 45 Hours**

## COURSE OUTCOMES:

- Students become aware of different composite materials, reinforcement materials, matrix materials and their usages.
- The students will have thorough knowledge of micro & macro structural analysis of orthotropic materials, derivation of equations and application to problem solving.
- The students will have knowledge about different fabrication techniques for polymer matrix composites.
- They will have demonstrate skill to evaluate properties and applications of metal matrix composite materials.
- The student will have knowledge on the advanced composite materials, their properties and applications.

## TEXT BOOKS:

1. Chawla K.K., "Composite Materials Science and Engineering", Third Edition, Springer, 2013.
2. Mallick P.K., "Fibre Reinforced Composites", Third Edition, CRC Press, 2008.

## REFERENCE BOOKS:

1. Mallick, P.K. and Newman. S., "Composite Materials Technology", Hanser Publishers, 2003.
2. Mathews F.L. and Rawlings R.D, "Composite Materials: Engineering and Science", CRC Press and wood head Publish Limited, 2002.
3. Harold Belofsky, "Plastics, Product Design and Process Engineering", Hanser Publishers, 2002.
4. Derek Hull, "An Introduction to Composite Materials", Second Edition, Cambridge University Press, 1996.

| | Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Co1 | Students become aware of different composite materials, reinforcement materials, matrix materials and their usages. | 2 | - | 1 | - | - | - | - | - | - | 1 | - | 1 | 1 | - | - |
| Co2 | The students will have thorough knowledge of micro & macro structural analysis of orthotropic materials, derivation of equations and application to problem solving. | 2 | 3 | 1 | - | - | - | - | - | - | - | - | 1 | 2 | - | - |
| Co3 | The students will have knowledge about different fabrication techniques for polymer matrix composites. | 1 | - | 2 | - | - | - | - | - | - | - | - | 1 | 2 | - | 2 |
| Co4 | They will have demonstrate skill to evaluate properties and applications of metal matrix composite materials. | 1 | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - |
| Co5 | The student will have knowledge on the advanced composite materials, their properties and applications. | 2 | 1 | - | - | - | - | - | - | - | - | - | - | 2 | - | - |

| 715MEP07 | **INTERNSHIP & TECHNICAL SEMINAR** | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 2 | 1 |

**OBJECTIVES:**
1. To make the students to get practical exposure and learn about various activities happening in the industries.
2. To make the students to learn about effective communication, presentation skills and report preparation.
3. To build the strength, team work spirit and self confidence in students life.
4. To develop skills in the application of theory to practical work situations.
5. To increase a student's strength of responsibility and good work habits.

**GUIDELINES**
- ☐ It is mandatory that each student should undergo internship / in-plant training in reputed industries for the duration of 2-3 weeks after second semester end examination. Then the student has to submit a hard copy of the training report not less than 10 pages. Also he / she has to give presentation on the training report for about 30 minutes.
- ☐ Students are encouraged to use various teaching aids such as over head projectors, power point presentation and demonstrative models.

**EVALUATION**
- ☐ The training report will be evaluated by the faculty in-charge.
- ☐ There is internal assessment and end examination.

**TOTAL : 30 Hours**

**COURSE OUTCOMES:**
- The students will have practical knowledge about various activities like process design, quality control that are takes place in industries.
- The students will have the skills about effective communication, presentation and report preparation.
- The students are able to improve their problem solving and critical thinking skills.
- The students are able to identify the professional standards.
- The students are able to create or modify the new technology policies.

| | **Course Outcome** | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Co1** | The students will have practical knowledge about various activities like process design, quality control that are takes place in industries. | 1 | 1 | 1 | - | 2 | - | 1 | - | - | - | - | - | 1 | 1 | - |
| **Co2** | The students will have the skills about effective communication, presentation and report preparation. | - | - | - | - | - | - | - | - | 2 | 3 | 1 | 1 | - | - | 1 |
| **Co3** | The students are able to improve their problem solving and critical thinking skills. | 1 | - | - | 1 | - | - | - | - | - | - | 2 | - | 1 | 2 | - |
| **Co4** | The students are able to identify the professional standards. | - | - | - | - | - | 3 | 1 | 2 | 1 | - | - | 2 | - | 3 | - |
| **Co5** | The students are able to create or modify the new technology policies. | - | - | - | - | 2 | - | 3 | - | - | - | - | 1 | 1 | 2 | 3 |

| Course Code | Course Title | Hours/Week | | | Credits | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | C | CA | EA | Total |
| **715MEP08** | **MECHATRONICS LABORATORY** | 0 | 0 | 4 | 2 | 50 | 50 | 100 |

**OBJECTIVES:**
1. To know the basic working principle of hydraulic and pneumatic systems.
2. To interpret system drawings and design simple systems for sequential control systems involving valves and cylinders.
3. To develop the capability of design and implementation of pneumatic circuits for industrial automation / electro - pneumatic circuits for industrial automation.
4. To learn the virtual instrumentation software and its applications for automated measurement / monitoring.
5. To familiar with interfacing of electromechanical system to micro controllers.

**PRE-REQUISITES:** Knowledge of Basic Applied Hydraulic and Pneumatics, Mechatronics and Robotics are required

**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. Design and 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 Hours**

**COURSE OUTCOMES:**
The students will be able to
- Identify the hydraulic and pneumatic systems employed in manufacturing industry.
- Apply the principles of Mechatronics and automation for the development of productive and efficient manufacturing systems.
- Use the engineering technique skills and modern engineering tools necessary for practical applications.
- Use design principles and develop conceptual, engineering design and fabrication of various components.
- Simulate the basic electrical, hydraulic and pneumatic system using simulation software.

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| | Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Co1** | The students will be able to identify the hydraulic and pneumatic systems employed in manufacturing industry. | 2 | 2 | 3 | 2 | 3 | 1 | - | - | 2 | 1 | 2 | 3 | 1 | - | 3 |
| **Co2** | The students will have an ability to learn about how to apply the principles of Mechatronics and automation for the development of productive and efficient manufacturing systems. | 3 | 2 | 2 | 1 | 2 | - | - | - | 1 | 1 | 2 | 1 | 1 | 2 | 1 |
| **Co3** | The students will be able to use the engineering technique skills and modern engineering tools necessary for practical applications. | 2 | 2 | 2 | 2 | 1 | - | - | - | 1 | -- | 2 | 1 | 1 | 3 | 1 |
| **Co4** | Students will use design principles and develop conceptual, engineering design and fabrication of various components. | 3 | 1 | 2 | 2 | 2 | - | - | - | 2 | 1 | 2 | 2 | 1 | - | 2 |
| **Co5** | The students will be able to simulate the basic electrical, hydraulic and pneumatic system using simulation software. | 3 | 2 | 2 | 1 | 2 | - | - | - | 1 | 2 | 2 | 1 | - | - | - |

| Course Code | Course Title | Hours/Week | | | Credits | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | C | CA | EA | Total |
| 715MEP09 | CAE LABORATORY | 0 | 0 | 4 | 2 | 50 | 50 | 100 |

**OBJECTIVES:**
1. To interpret design concepts to use the Finite Element Method software correctly and efficiently
2. To comprehend the types of element used, type of analysis done, interpretation of results, method of solving and analyzing a given problem.
3. To acquire the basic skills in using professional level finite element software, applied to structural and heat transfer components at various loading conditions.
4. To analyze a physical problem, develop experimental procedures for accurately investigating the problem, and effectively perform and document findings.
5. To simulate simple mechanisms using simulation software.

**PRE-REQUISITES:** Knowledge of Finite Element Analysis is required.

**LIST OF EXPERIMENTS**

**A. ANALYSIS (SIMPLE TREATMENT ONLY)**                                    **37**
1. Stress Analysis of bars (Constant cross sectional area, Tapered area &Stepped bar).
2. Two Dimensional Truss analysis.
3. Stress Analysis of Beams (Cantilever, Simply supported, Fixed ends).
4. Stress Analysis of a Plate with a Circular Hole.
5. Stress Analysis of Rectangular L Bracket.
6. Stress Analysis of an Axi-symmetric Component.
7. Mode Frequency Analysis of Beams (Cantilever, Simply supported, Fixed ends).
8. Mode Frequency Analysis of a 2-D Component.
9. Harmonic Analysis of Beams.
10. Thermal Stress Analysis of a 2D Component.
11. Conductive Heat Transfer Analysis of a 2D Component.
12. Convective Heat Transfer Analysis of a 2D Component.

**B. SIMULATION**                                                          **8**
1. Simulation of Air conditioning system with Condenser Temperature and Evaporator Temperatures as input to get COP using C /MAT Lab.
2. Simulation of Cam and Follower Mechanism using C / MAT Lab.
3. Simulation of Four Bar Mechanism using C / MAT Lab.
4. Simulation of Slider Crank Mechanism using C / MAT Lab.

**TOTAL : 45 Hours**

**COURSE OUTCOMES:**
The students will be able to
- Select the method, meshing, analysis and optimize the given problem for structural and thermal applications.
- Conduct structural analyses and selected other analysis like normal modes/natural frequency analysis, harmonic analysis, steady-state heat conduction analysis.
- Use professional level finite element software to solve engineering problems in solid mechanics and heat transfer.
- Simulate simple kinematic mechanisms and air conditioning system using simulation software.
- Recognize sources of errors in FEA.

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| Course Outcome | | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Co1 | Select the method, meshing, analysis and optimize the given problem for structural and thermal applications. | 2 | 3 | 2 | 2 | 2 | - | - | - | 1 | 2 | 2 | - | 1 | - | 1 |
| Co2 | Conduct structural analyses and selected other analysis like normal modes/natural frequency analysis, harmonic analysis, steady-state heat conduction analysis. | 2 | 3 | 1 | 2 | 2 | - | - | - | 2 | 1 | 2 | - | 1 | - | 1 |
| Co3 | Use professional level finite element software to solve engineering problems in solid mechanics and heat transfer. | 2 | 3 | 2 | 2 | 2 | - | - | - | 2 | - | 2 | - | 1 | - | 1 |
| Co4 | Simulate simple kinematic mechanisms and air conditioning system using simulation software. | 2 | 3 | 2 | 2 | 2 | - | - | - | 2 | - | 2 | - | 1 | - | 2 |
| Co5 | Recognize sources of errors in FEA. | 2 | 2 | 1 | 2 | 2 | - | - | - | - | - | 1 | - | 1 | - | 1 |

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| Course Code | Course Title | Hours/Week | | | Credits | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | C | CA | EA | Total |
| **715MEP10** | **DESIGN AND FABRICATION PROJECT** | 0 | 0 | 4 | 2 | 50 | 50 | 100 |

**OBJECTIVES:**
1. To provide opportunity for the student to recollect the fundamental knowledge acquired during the earlier semesters and apply the same to real life problems and provide solution to the problems
2. To learn concepts, models, frameworks, and tools that engineering graduate need in a world where creativity and innovation is fast becoming a pre-condition for competitive advantage.
3. Each student will choose a nagging workplace problem or socially relevant problems and prove their understanding of fundamental concepts.
4. To give an opportunity to the student to get hands on training in the fabrication of one or more components of a complete working model, which is designed by them
5. To understand the basic steps of project planning, project management, Quality assurance, process management and their relationships

**GUIDE LINES**
1. The students in convenient groups of not more than 4 members have to take one small system for design and fabrication.
2. Every project workgroup shall have a guide who is the member of the faculty of the institution and if possible with an industrial guide also.
3. The system chosen may be a machine element (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.
4. The students are required to design and fabricate the chosen system 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.

**CONTINUOUS ASSESSMENT**
1. The progress of the project is evaluated by a review committee consisting of a minimum of three members.
2. The review committee may be constituted by the Head of the Department.
3. The continuous assessment shall be made by conducting three reviews.

**TOTAL : 90 Hours**

**COURSE OUTCOMES:**
The students are able to
- Use design principles and develop conceptual design of various components
- Fabricate various components using different manufacturing tools
- Develop skills to be the effective members of team
- Have the knowledge of contemporary issues and modern practices
- Familiarize presentation, communication and team-work skills

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| Course Outcome | | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Co1 | Use design principals and develop conceptual design of various components | 2 | 3 | 2 | - | - | 1 | 1 | - | 1 | - | - | - | 3 | - | 3 |
| Co2 | Fabricate various components using different manufacturing tools | - | - | 3 | 2 | 1 | - | - | - | - | - | - | 1 | 2 | 1 | 3 |
| Co3 | Develop skills to be the effective members of team | - | - | - | - | 2 | 1 | - | 2 | 3 | 1 | 1 | - | - | 2 | - |
| Co4 | Have the knowledge of contemporary issues and modern practices | 2 | 2 | - | 1 | 3 | - | - | - | - | - | - | - | - | 1 | 1 |
| Co5 | Practice presentation, communication and team-work skills | - | - | - | - | - | - | - | 1 | 2 | 3 | 2 | - | - | 1 | - |

| Course Code | Course Title | Hours/Week | | | Credits | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | C | CA | EA | Total |
| **715MEE01** | **PROCESS PLANNING AND COST ESTIMATION** | 3 | 0 | 0 | 3 | 50 | 50 | 100 |

**OBJECTIVES:**
1. To know the use of work study leads to high productivity in a manufacturing unit.
2. To study the steps involved in conducting a method study and apply the principles of motion economics.
3. To know the importance of process planning in manufacturing environment.
4. To get knowledge on step by step procedures in the cost estimation of any product.
5. To learn the concept of pricing of material.

**PRE-REQUISITES:** Knowledge of Engineering Economics and Cost Analysis is required.

**UNIT I WORK STUDY AND ERGONOMICS** 10

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** 10

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 AND BREAK EVEN ANALYSIS** 7

Objective of cost estimation- costing - Cost accounting- classification of cost- Elements of cost – Break Even Analysis – Basic assumptions – Problems on Break Even Analysis – Break Even chart – Managerial use of Break Even Analysis.

**UNIT IV COST ESTIMATION AND PRICING** 8

Types of estimates - Methods of estimates - Data requirements and sources- Collection of cost-Allowances in estimation. Pricing practice – Full cost pricing – Marginal cost pricing – Going rate pricing – Bid pricing – Pricing for a rate of return.

**UNIT V PRODUCTION COST ESTIMATION** 10

Estimation of material cost, Labour cost and over heads, Allocation of overheads - Estimation for different types of jobs. Internal rate of return – Payback period – Net present value – Calculations on Cost benefit analysis.

**TOTAL : 45 Hours**

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## COURSE OUTCOMES:

- The students can make analyze on the techniques of work study and principles of ergonomics.
- The students will know the concept of process planning and cost estimation for various product and process of industry.
- The students will be familiar with types of estimation, pricing methods and production cost estimation.
- The student will have an ability to know about the calculations of finding internal rate of return, net present value and payback period.
- The students will have knowledge about estimation of production costs.

## TEXT BOOKS:

1. T.R. Banga and S.C.Sharma, "Mechanical Estimating and Costing", Khanna Publishers, 18th Edition, 2019.
2. Sinha.B.P., "Mechanical Estimating and Costing", Tata McGraw-Hill, Publishing Co., 2000.

## REFERENCE BOOKS:

1. Varshney R.L and Maheshwari K.L., "Managerial Economics", S.Chand & Co., 2014.
2. Russell.R.S and Tailor, B.W, "Operations Management", Prentice Hall of India, 7th Edition, 2011.
3. Khan M.Y. and Jain P.K., "Financial Management", McGraw-Hill Publishing Co. Ltd, 6th Edition, 2011.
4. Kesavan R K, "Process Planning and Cost Estimation", New Age International (P) Ltd, 2009.
5. Dewett K.K and Jain J.D., "Elementary Economic Theory", S.Chand & Co., 2006.
6. Adithan M and Pabla B S, "Production Engineering Estimating and Costing", Konark Publishers, 1990

| | Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Co1 | The students understand the techniques of work study and principles of ergonomics. | 2 | 3 | 1 | - | 1 | - | 1 | - | 1 | - | - | 1 | 2 | - | 1 |
| Co2 | The students will know the concept of process planning and cost estimation for various products and processes in industry. | 1 | 2 | 1 | - | 1 | - | - | - | 1 | - | - | 1 | 1 | - | 1 |
| Co3 | The students will be familiar with types of estimation, pricing methods and production cost estimation. | 1 | 2 | - | - | - | - | - | - | 1 | - | - | 2 | 2 | - | - |
| Co4 | The student will have an ability to know about the calculations of finding internal rate of return, net present value and payback period. | 1 | 2 | - | - | - | - | - | - | 1 | - | - | 2 | 2 | - | - |
| Co5 | The students will have knowledge about estimation of production costs. | 1 | 2 | - | - | - | - | - | - | 1 | - | - | 2 | 2 | - | - |

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| Course Code | Course Title | Hours/Week | | | Credits | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | C | CA | EA | Total |
| 715MEE02 | MAINTENANCE ENGINEERING | 3 | 0 | 0 | 3 | 50 | 50 | 100 |

**OBJECTIVES:**
1. To study about the principles, functions and practices adapted in industry for the successful management of maintenance activities.
2. To gain the knowledge about different maintenance categories like Preventive maintenance and about the methods of lubrication.
3. To know about condition monitoring systems.
4. To know about the repair methods of basic machine elements.
5. To gain knowledge on repair methods for material handling equipments.

**PRE-REQUISITES:**Knowledge of Process Planning and Cost Estimation, Production Planning and Cost Estimation are required.

**UNIT I PRINCIPLES AND PRACTICES OF MAINTENANCE PLANNING          10**

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          9**

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

**UNIT III CONDITION MONITORING          9**

Condition Monitoring - Cost comparison with and without CM - On-load testing and off- load testing - Methods and instruments for CM - Temperature sensitive tapes - Pistol thermometers - wear-debris analysis.

**UNIT IV REPAIR METHODS FOR BASIC MACHINE ELEMENTS          10**

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          7**

Repair methods for Material handling equipment - Equipment records -Job order systems -Use of computers in maintenance.

                                          **TOTAL: 45 PERIODS**

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**COURSE OUTCOMES:**
The Students will be able to

- Analyze the basic concepts of different types of maintenance and selection maintenance methods for various types of organizations like product oriented and service oriented sectors based on the understanding.
- Gain the knowledge of preventive maintenance concept and implementation of PM budget cost control techniques.
- Know about the working principle of pistol thermometers.
- Know the Concept's of repair, replacement and overhaul.
- Apply the knowledge on use of computers in maintenance.

**TEXT BOOKS:**

1. Srivastava S.K., "Industrial Maintenance Management", S. Chand and Co., 2002.
2. Bhattacharya S.N., "Installation, Servicing and Maintenance", S. Chand and Co., First Edition Reprint 2008.
3. Alakesh Manna, "A Textbook of Reliability and Maintanence Engineering", I K International Publishing ware Pvt Ltd, 2011.

**REFERENCE BOOKS:**

1. Garg M.R., "Industrial Maintenance", S. Chand & Co., 2009.
2. Davies, "Handbook of Condition Monitoring", Chapman & Hall, 1996.
3. "Advances in Plant Engineering and Management", Seminar Proceedings - IIPE, 1996.
4. Higgins L.R., "Maintenance Engineering Hand book", McGraw Hill, 5th Edition, 1995.
5. White E.N., "Maintenance Planning", I Documentation, Gower Press, 1979.

| | **Course Outcome** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Co1** | Understand the basic concepts of different types of maintenance and selection maintenance methods for various types of organizations like product oriented and service oriented sectors based on the understanding. | 1 | 2 | 1 | 2 | 1 | - | 2 | - | 2 | - | - | 1 | 2 | - | 1 |
| **Co2** | Gain the knowledge of preventive maintenance concept and implementation of PM budget cost control techniques. | 1 | 2 | 1 | 2 | 1 | - | 2 | - | 2 | - | - | 1 | 2 | - | 1 |
| **Co3** | To know about the working principle of pistol thermometers. | 2 | 1 | 1 | 2 | 1 | - | - | - | - | - | 1 | 2 | 2 | - | 1 |
| **Co4** | Know the Concept's of repair, replacement and overhaul. | 2 | 1 | 2 | 1 | 1 | - | - | - | 1 | - | 1 | 2 | 2 | - | 1 |
| **Co5** | Apply the knowledge on use of computers in maintenance. | 2 | 1 | 1 | 3 | - | - | - | - | - | - | 1 | 2 | 2 | - | 1 |

| Course Code | Course Title | Hours/Week | | | Credits | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | C | CA | EA | Total |
| **815MET01** | **AUTOMOBILE ENGINEERING** | 3 | 0 | 0 | 3 | 50 | 50 | 100 |

**OBJECTIVES:**
1. To understand the structure of vehicle chassis and engine components.
2. To understand the working of various engine auxiliary and emission system.
3. To impart knowledge about the various transmission system and their working.
4. To demonstrate the students about working principle of steering, suspension and braking systems.
5. To learn about the electrical systems and advances in automotive engineering.

**PRE-REQUISITES:** Knowledge of Basic of Civil and Mechanical Engineering is required.

**UNIT I VEHICLE STRUCTURE AND ENGINES                     9**
Types of automobiles, and need for a gearbox, components of engine-their forms, functions and materials. Vehicle construction - Chassis and body – Specifications, resistances to vehicle motion. Engine - Types - Construction - Location of engine - Cylinder arrangement - Construction details - Cylinder block - Cylinder head - Cylinder liners - Piston – piston rings - Piston pin - Connecting rod - Crankshaft - Valves. Lubrication system - Types - Oil pumps - Filters - Cooling system - Types - Water pumps - Radiators - Thermostats - Anti-freezing compounds.

**UNIT II ENGINE AUXILIARY SYSTEMS  AND EMISSION CONTROL SYSTEM     9**
Ignition system - Coil and Magneto - Spark plug - Distributor – Electronic ignition system - Fuel system - Carburetor - Fuel pumps - Fuel injection systems - Mono point and Multi point – Unit injector – Nozzle types - Electronic Fuel Injection system (EFI) – GDI, MPFI, DTSI-Automobile Emissions - Source of formation – Effects on human health and environment - Control techniques - Exhaust Gas Recirculation (EGR) - Catalytic converter - Emission tests and standards (Indian and Europe)

**UNIT III TRANSMISSION SYSTEMS                      9**
Clutches - Function - Types - Single plate, Multiple plate and Diaphragm Clutch - Fluid coupling - Gearbox - Manual - Sliding - Constant - Synchromesh - Overdrive - Automatic transmission - Torque converter - Epicylic and Hydromatic transmission - Continuously variable transmission - Universal joint - Propeller shaft - Hotchkiss drive – Final drive - Rear axle assembly - Types -Differential - Need - Construction – Non-slip differential – Differential locks - Four wheel drive.

**UNIT IV STEERING, SUSPENSION AND BRAKING SYSTEM             9**
Principle of steering - Steering Geometry and wheel alignment - Steering linkages – Steering gearboxes - Power steering - front axle - Suspension system - Independent and Solid axle – coil, leaf spring and air suspensions - torsion bar - shock absorbers - Wheels and Tires - Construction - Type and specification - Tire wear and causes - Brakes - Needs – Classification –Drum and Disc Mechanical - Hydraulic and pneumatic - Vacuum assist – Retarders – Anti-lock Braking System(ABS)

**UNIT V AUTOMOBILE ELECTRICAL SYSTEMS  AND ADVANCES IN AUTOMOBILE ENGINEERING                          9**

Battery-General electrical circuits-Dash board instrumentation - Passenger comfort - Safety and security - HVAC - Seat belts - Air bags - Automotive Electronics - Electronic Control Unit (ECU) - Variable Valve Timing (VVT) - Active Suspension System (ASS) - Electronic Brake Distribution (EBD) – Electronic Stability Program(ESP) Traction Control System (TCS) - Global Positioning System (GPS) - X-by-wire - Electric - Hybrid vehicle.

**TOTAL : 45 PERIODS**

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## COURSE OUTCOMES:

The students will able to

- Understand the structure of vehicle chassis and engine component.
- Understand the working of various engine auxiliary and emission system.
- Impart knowledge about the various transmission systems and their working.
- Demonstrate about the working principle of steering, suspension and braking systems.
- Learn about the electrical systems and advances in automotive engineering.

## TEXT BOOKS:

1. Dr. Kirpal Singh, "Automobile Engineering Vols 1 & 2 ", Standard Publishers Distributors, 13th Edition, New Delhi, 2014.
2. Srinivasan. S, "Automotive Mechanics", Tata McGraw Hill Publishers, 2nd Edition, New Delhi, 2003.

## REFERENCE BOOKS:

1. Rajput R K, "A Text book of Automobile Engineering", Laxmi Publication, 2015.
2. Ganesan V, "Internal Combustion Engines", Third Edition, Tata McGraw-Hill, 2012.
3. Richard van Basshuysen, "Modern Engine Technology from A to Z", SAE International Publications, USA, 2007.
4. Martin W. Stockel and Martin T Stockel, "Auto Fundamentals", The Goodheart -Will Cox Company Inc, USA, 10th Edition, 2005.
5. Heinz Heisler, "Advanced Vehicle Technology", SAE International Publications USA, 2nd Edition, 2002.
6. Garret.T.K, Newton.K and Steeds.W, "Motor Vehicles", Butterworth-Heinemaan Publishers, 13th Edition, 2001.

| | Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Co1** | Imparts knowledge on different types of chassis and identify suitable engine for different applications. | - | - | 2 | - | - | 1 | 1 | - | - | - | 1 | 1 | 2 | - | 1 |
| **Co2** | Develop knowledge on troubleshooting of engine auxiliary systems and emission control. | - | 3 | - | 1 | 1 | 2 | 2 | - | - | - | - | 1 | - | 3 | - |
| **Co3** | Equipped with knowledge on automatic transmission system. | - | 2 | 1 | - | 1 | - | - | - | - | - | 1 | 1 | - | 3 | - |
| **Co4** | Analyze the steering geometry, braking principle and suspension systems. | 3 | 1 | - | 2 | - | - | 1 | - | - | - | - | 2 | - | - | 2 |
| **Co5** | Identify the usage of Electrical vehicles and Hybrid vehicles. | 2 | - | - | - | 1 | - | - | - | 2 | - | 2 | - | 2 | - | 3 |

| Course Code | Course Title | Hours/Week | | | Credits | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | C | CA | EA | Total |
| 815MEP04 | PROJECT WORK | 0 | 0 | 16 | 8 | 50 | 50 | 100 |

**OBJECTIVES:**

The objectives of the project are

1. To get an opportunity to synthesize knowledge from various areas of learning, and critically and creatively apply it to real life situations.
2. To acquire skills like collaboration, communication and independent learning, prepares them for lifelong learning and the challenges ahead.
3. 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 or an analysis.
4. To use the engineering technical skills and modern engineering tools necessary for practical applications.
5. To document and present one's own work, for a given target group, with strict requirements on structure, format, and language usage.

**GUIDELINES**

1. 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.

2. Every project work shall have a guide who is the member of the faculty of the institution.

3. 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.

4. Each student shall finally produce a comprehensive report covering background information, literature survey, problem statement, project work details and conclusion. The final report shall be typewritten form as specified in the guidelines.

**EVALUATION**

1. The progress of the project is evaluated by a review committee consisting of a minimum of three members.
2. The review committee may be constituted by the Head of the Department.
3. The continuous assessment shall be made by conducting three reviews.
4. The external assessment shall be done by one internal examiner and one external examiner (from other institution) by conducting oral examination.

**TOTAL :45 PERIODS**

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## COURSE OUTCOMES:

The students will be able to

- Use the engineering technical skills and modern engineering tools necessary for practical applications.
- Use design principles and develop conceptual, engineering design and fabrication of various components.
- Take up any challenging practical problems and find solution by formulating proper methodology.
- Create the document of the project with correct format and structure.
- Gain Practical knowledge about various activities like processes, design, quality control that are taking place in industries.

| Course Outcome | | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Co1 | Use the engineering technical skills and modern engineering tools necessary for practical applications. | 2 | 3 | 1 | - | 2 | - | - | - | - | - | - | - | 3 | 2 | 3 |
| Co2 | Use design principles and develop conceptual, engineering design and fabrication of various components. | 2 | 2 | 3 | 1 | 2 | - | - | - | - | - | - | - | 2 | 1 | 3 |
| Co3 | Take up any challenging practical problems and find solution by formulating proper methodology. | 1 | 2 | 1 | 2 | - | - | 1 | - | - | - | - | - | 1 | - | 3 |
| Co4 | Create the document of the project with correct format and structure. | - | - | - | - | - | - | - | - | 2 | 3 | 1 | 1 | - | - | 1 |
| Co5 | Gain Practical knowledge about various activities like processes, design, quality control that are taking place in industries. | 2 | 1 | 2 | - | 1 | - | 1 | 1 | - | - | - | - | - | 1 | 1 |

| Course Code | Course Title | Hours/Week | | | Credits | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | C | CA | EA | Total |
| **815MEE02** | **ENGINEERING ECONOMICS AND COST ANALYSIS** | 3 | 0 | 0 | 3 | 50 | 50 | 100 |

**OBJECTIVES:**
1. To know the different engineering economic principles and strategies.
2. To know about the concept of value engineering and the various methods to calculate interest.
3. To gain the knowledge on cost calculations.
4. To study various replacement policies.
5. To know about the types of depreciation methods.

## UNIT I INTRODUCTION TO ECONOMICS 8

Introduction to Economics- Circular 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- P/V ratio, Elementary economic Analysis - Material selection for product Design selection for a product, Process planning.

## UNIT II ECONOMICS IN ENGINEERING 10

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 9

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 9

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 9

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.

**TOTAL : 45 PERIODS**

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**COURSE OUTCOMES:**

Student are able to

- Get knowledge about basics of economics.
- Know about make or buy decisions.
- Become familiar with cost calculations.
- Know the concept of challenger and defender.
- Know about how to find the depreciation of an asset.

**TEXT BOOKS:**

1. Panneer Selvam, R, "Engineering Economics", Prentice Hall of India Ltd, New Delhi, 2nd Edition, 2014.
2. Suma Damodaran, "Managerial Economics", Oxford University Press, 2nd Edition, 2010.

**REFERENCE BOOKS:**

1. Donald.G. Newman, Jerome.P.Lavelle, "Engineering Economics and Analysis", Engg. Press, Texas, 2013.
2. Luke M Froeb & Brian T McCann, "Managerial Economics - A Problem solving approach", Thomson learning, 2013.
3. Chan S.Park, "Contemporary Engineering Economics", Prentice Hall of India, 2010.
4. Ted G Eschenbach, "Engineering Economy: Applying Theory to Practice", 3rd Edition, 2010.
5. L.J.Truett & T.B.Truett, "Managerial Economics- Analysis, problems & cases", Wiley India, 8th Edition, 1999.
6. Degarmo, E.P., Sullivan, W.G and Canada, J.R, "Engineering Economy", Mcmillan, New York, 1996.

| | Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Co1 | Get knowledge on basics of economics. | 3 | 1 | - | - | - | - | - | - | - | - | - | 3 | 2 | - | - |
| Co2 | Know about the make or buy decisions. | 1 | 2 | - | - | - | - | - | - | - | 1 | - | - | 2 | 1 | - |
| Co3 | Become familiar with cost calculations. | 2 | 2 | - | - | - | - | - | - | - | - | - | 2 | 2 | 2 | - |
| Co4 | Know about the concept of challenger and defender. | 3 | 2 | - | - | - | - | - | - | - | - | - | - | 2 | 1 | 1 |
| Co5 | Know about how to find the depreciation of an asset. | 2 | 2 | - | - | - | - | - | - | - | - | - | - | 1 | - | - |

| Course Code | Course Title | Hours/Week | | | Credits | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | C | CA | EA | Total |
| 815MEE04 | INDUSTRIAL SAFETY AND HAZARDS MANAGEMENT | 3 | 0 | 0 | 3 | 50 | 50 | 100 |

**OBJECTIVES:**
1. To know about safety and hazards regulations and also about industrial hygiene.
2. To know about the preventive and protective management from fires and explosion.
3. To know about hazard identification.
4. To gain the knowledge on leakage of liquids, vapours, gases, etc.
5. To prepare a case study on fire fighting and hazard management.

**UNIT I FIRE AND EXPLOSION                                           10**
Introduction-Industrial processes and hazards potential, mechanical electrical, thermal and process hazards. Safety and hazards regulations, Industrial hygiene. Factories Act, 1948 and Environment (Protection) Act, 1986 and rules thereof. Shock wave propagation, vapour cloud and boiling liquid expanding vapours explosion (VCE and BLEVE), mechanical and chemical explosion, multiphase reactions, transport effects and global rates.

**UNIT II RELIEF SYSTEMS                                                8**
Preventive and protective management from fires and explosion-inerting, static electricity passivation, ventilation and sprinkling, proofing, relief systems – relief valves, flares, scrubbers.

**UNIT III TOXICOLOGY                                                  10**
Hazards identification-toxicity, fire, static electricity, noise and dust concentration; Material safety data sheet, hazards indices- Dow and Mond indices, hazard operability (HAZOP) and hazard analysis (HAZAN).

**UNIT IV LEAKS AND LEAKAGES                                          12**
Spill and leakage of liquids, vapors, gases and their mixture from storage tanks and equipment; Estimation of leakage/spill rate through hole, pipes and vessel burst; Isothermal and adiabatic flows of gases, spillage and leakage of flashing liquids, pool evaporation and boiling; Release of toxics and dispersion. Naturally buoyant and dense gas dispersion models; Effects of momentum and buoyancy; Mitigation measures for leaks and releases.

**UNIT V CASE STUDIES                                                  5**
Flixborough, Bhopal, Texas, ONGC offshore, HPCL Vizag and Jaipur IOC oil-storage depot incident; Oil, natural gas, chlorine and ammonia storage and transportation hazards.

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**COURSE OUTCOMES:**
Student will be able to
- Understand about safety and hazards regulations and also about industrial hygine.
- Understand preventive and protective management from fires and explosion.
- Understand hazard identification.
- Gain the knowledge on leakage of liquids, vapours, gases, etc.
- Prepare a case study on fire fighting and hazard management.

**TEXT BOOK:**
1. Crowl D.A. and Louvar J.F., "Chemical Process Safety: Fundamentals with Applications", 2nd Edition, Prentice Hall, 2001.

**REFERENCE BOOKS:**
1. Mannan S., "Lee's Loss Prevention in the Process Industries", Vol.I, 3rd Ed., Butterworth Heinemann, 2004.
2. Mannan S., "Lee's Loss Prevention in the Process Industries", Vol.II, 3rd Ed., Butterworth Heinemann, 2005.
3. Mannan S., "Lee's Loss Prevention in the Process Industries", Vol.III, 3rd Ed., Butterworth Heinemann, 2005.

| | Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Co1 | Shock wave propagation, mechanical and chemical explosion. | - | - | 1 | - | 1 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 1 | - | - |
| Co2 | Ventilation and sprinkling, proofing and relief systems. | - | - | 1 | - | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | - | - |
| Co3 | Hazards indices like Dow and Mond indices. | - | - | 1 | - | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | - | - |
| Co4 | Mitigation measures for leaks and releases. | - | - | 1 | - | 1 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 1 | - | - |
| Co5 | Chlorine and ammonia storage and transportation hazards. | - | - | 1 | - | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | - | - |

| Course Code | Course Title | Hours/Week | | | Credits | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | C | CA | EA | Total |
| **815MEE09** | **TOTAL QUALITY MANAGEMENT** | **3** | **0** | **0** | **3** | **50** | **50** | **100** |

**OBJECTIVES:**
1. To understand the basic concepts of TQM and to know about various philosophies of TQM.
2. To know about the concepts of motivation, PDSA cycle and Kaizen.
3. To gain knowledge in old and new seven management tools and concepts like six sigma and bench marking.
4. To gain knowledge in implementation of QFD.
5. To know about the quality certificates such as ISO 9000 and ISO 14000.

**PRE-REQUISITES:** Knowledge of Principles of Management is required.

**UNIT I INTRODUCTION                                                9**
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 - Philosophies of Deming, Juran and Crosby - Barriers to implement TQM.

**UNIT II TQM PRINCIPLES                                            9**
Leadership - Strategic quality planning, Quality statements - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition, Reward and Performance appraisal - Continuous process improvement - PDSA cycle, 5s, Kaizen - Supplier partnership - Partnering, Supplier selection and Supplier Rating.

**UNIT III TQM TOOLS AND TECHNIQUES I                              9**
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 and Types.

**UNIT IV TQM TOOLS AND TECHNIQUES II                             9**
Quality circles - Quality Function Deployment (QFD) – House of Quality - Taguchi quality loss function – Total Productive Maintenance - Concepts, improvement needs - Cost of Quality - Performance measures.

**UNIT V QUALITY SYSTEMS                                           9**
Need for ISO 9000- ISO 9000-2000 Quality System - Elements, Documentation and Quality auditing- QS 9000 - ISO 14000 - Concepts, Requirements and Benefits - Case studies of TQM implementation in manufacturing and service sectors including IT.

**TOTAL: 45 PERIODS**

## COURSE OUTCOMES:

- The Student will get knowledge in the philosophies of management and basic concepts.
- The students will have an ability to gain the knowledge on leadership qualities and management tools of quality and statistical concepts.
- The students will be able to have exposure on concepts like Benchmarking and Failure Mode Effective Anaysis.
- The students will be able to gain knowledge on Quality Function Deployment and Total Productive Maintenance.
- The students will be able to gain knowledge on the Quality certification procedure on ISO 9000, QS14000 and information on auditing.

## TEXT BOOKS:

1. Dale H.Besterfield, at., "Total Quality Management", Pearson Education Asia, Third Edition, Indian Reprint, 2012.
2. Suganthi,L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2008.

## REFERENCE BOOKS:

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, South-Western (Thomson Learning), 2010.
2. Janakiraman.B and Gopal. R.K, "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd, 1st Edition, 2007.
3. Oakland, J.S. "TQM - Text with Cases", Butterworth - Heinemann Ltd., Oxford, 3rd Edition, 2003.

| | Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Co1 | The Student will get the knowledge on philosophies of management and basic concepts. | 2 | - | - | - | - | - | - | 1 | - | - | - | 2 | 3 | - | - |
| Co2 | The students will have an ability to gain the knowledge on leadership qualities and management tools of quality and statistical concepts. | 3 | - | - | - | - | - | - | - | - | 1 | 1 | - | 2 | - | - |
| Co3 | The students will be able to have exposure on concepts like Benchmarking and Failure Mode Effective Analysis. | 2 | - | 3 | - | 1 | - | - | - | - | - | 1 | - | 3 | 1 | - |
| Co4 | The students will be able to gain knowledge on Quality Function Deployment, and Total Productive Maintenance. | 2 | - | 3 | - | 1 | - | - | - | - | - | 1 | - | 3 | 1 | - |
| Co5 | The students will be able to gain knowledge on the Quality certification procedure on ISO 9000, QS14000 and information on Auditing can be obtained. | 1 | 2 | - | - | - | - | - | - | - | 1 | - | - | 2 | - | - |

| Course Code | Course Title | Hours/Week | | | Credits | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | C | CA | EA | Total |
| **815MEE14** | **ENTREPRENEURSHIP AND E-BUSINESS** | **3** | **0** | **0** | **3** | **50** | **50** | **100** |

**OBJECTIVES:**
1. The aim of the course is to provide the students, with an opportunity to gain the knowledge in the field of entrepreneur, entrepreneurship and management of resources.
2. The student learns the function, types, role of entrepreneur in economic growth of a country. And also studies the different stages of entrepreneurial process.
3. To gain the knowledge to start up small scale industries with the support (consultancy & finance) from government, institutes & others.
4. To impart motivation studies and training.
5. To study its need and source of finance related to entrepreneurships.

**PRE-REQUISITES:** Knowledge of Principles of Management and Business Concepts is required

**UNIT I ENTREPRENEURSHIP**         **9**

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

**UNIT II MOTIVATION**         **9**

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**         **9**

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 FINANCE AND ACCOUNTING**         **9**

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**         **9**

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.

**TOTAL : 45 PERIODS**

**COURSE OUTCOMES:**

- The students will understand the necessity of management in the field of engineering and it realizes the importance of entrepreneurship in the modern world.
- The students will have an ability to define, characteristics and role of SSI in economic Development. Impact of privatization and globalization on SSIs and understand the meaning of project and project identification.
- The students are well trained to analyze the parameters of project like project appraisal, identification of business Opportunities, market feasibility study, technical feasibility study etc.
- The students will be able to understand the motivation techniques and the financial analysis in entrepreneurships.
- Students will understand the concept of management as a science, art and profession and appreciate the role of planning in management.

**TEXT BOOKS:**

1. S.S.Khanka, "Entrepreneurial Development", S.Chand & Co. Ltd., Ram Nagar, New Delhi, Reprint, 2012.
2. Kuratko & Hodgetts, "Enterprenuership - Theory, Process and Practices", Cenagage learning, 8th Edition, 2012.

**REFERENCE BOOKS:**

1. Hisrich R D and Peters M P, "Entrepreneurship", 6th Edition, Tata McGraw-Hill, 2012.
2. Mathew J Mandimala, "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.

| Course Outcome | | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Co1 | The students will understand the necessity of management in the field of engineering and it realizes the importance of entrepreneurship in the modern world. | 1 | - | - | 1 | - | - | 2 | 1 | 1 | - | 3 | 3 | 2 | 3 | - |
| Co2 | The students will have an ability to define, characteristics and role of SSI in economic Development. Impact of privatization and globalization on SSIs and understand the meaning of project and project identification. | 3 | - | - | - | - | - | 3 | - | - | - | 3 | 2 | - | 3 | - |
| Co3 | The students are well trained to analyze the parameters of project like project appraisal, identification of business Opportunities, market feasibility study, technical feasibility study etc. | 3 | 2 | - | - | 2 | 3 | - | 2 | - | 2 | 1 | 3 | 1 | 3 | - |
| Co4 | The students will be able to understand the motivation techniques and the financial analysis in entrepreneurships. | 2 | 1 | 1 | - | - | - | - | - | - | - | 1 | 2 | 1 | 3 | - |
| Co5 | Students will understand the concept of management as a science, art and profession and appreciate the role of planning in management. | 1 | - | - | - | - | - | - | 1 | 3 | - | 1 | 3 | - | 3 | - |