COURSE STRUCTURE (R20)

I - SEMESTER

S.No	Course Code	Course Title	Contact hours/week			Credits	Scheme of Valuation		
			L	T	P		CIE	SEE	Total
Theory Courses									
1	20FE01	Professional Communication-I	2	0	0	2	30	70	100
2	20FE03	Differential Equations	2	1	0	3	30	70	100
3	20FE05	Applied Chemistry	3	0	0	3	30	70	100
4	20ME01	Engineering Graphics	2	0	4	4	30	70	100
5	20EE02	Basic Electrical and Electronics Engineering	3	0	0	3	30	70	100
Laboratory Courses									
6	20FE52	Applied Chemistry Lab	0	0	3	1.5	15	35	50
7	20EE52	Basic Electrical and Electronics Engineering Lab	0	0	3	1.5	15	35	50
8	20ME51	Engineering Workshop	0	0	3	1.5	15	35	50
Total			12	1	13	19.5	195	455	650

II - SEMESTER

S.No	Course Code	Course Title	Contact hours/week			Credits	Scheme of Valuation		
			L	T	P		CIE	SEE	Total
Theory Courses									
1	20FE02	Professional Communication-II	2	0	0	2	30	70	100
2	20FE04	Linear Algebra and Transformation Techniques	2	1	0	3	30	70	100
3	20FE08	Engineering Physics	2	1	0	3	30	70	100
4	20CS01	Programming for Problem Solving using C	3	0	0	3	30	70	100
5	20ME02	Engineering Mechanics	2	1	0	3	30	70	100
6	20MC01	Constitution of India	2	0	0	0	30	70	100
Laboratory Courses									
7	20FE51	Professional Communication Skills Lab	0	0	2	1	15	35	50
8	20FE55	Engineering Physics Lab	0	0	3	1.5	15	35	50
9	20CS51	Programming for Problem Solving using C Lab	0	0	3	1.5	15	35	50
10	20ME52	Engineering Mechanics and Fuel Testing Lab	0	0	3	1.5	15	35	50
Total			13	3	11	19.5	240	560	800

III SEMESTER

S. No	Course code	Course Title	Contact hours/week			Credits	Scheme of Valuation		
			L	T	P		CIE	SEE	Total
Theory Courses									
1	20FE10	Numerical Methods and Integral Calculus	2	1	-	3	30	70	100
2	20ME03	Fluid Mechanics and Hydraulic Machinery	2	1	-	3	30	70	100
3	20ME04	Thermodynamics	2	1	-	3	30	70	100
4	20ME05	Metallurgy and Material Science	3	-	-	3	30	70	100
5	20ME06	Mechanics of Solids	2	1	-	3	30	70	100
6	20MC02	Environmental Science	2	0	0	0	30	70	100
Laboratory Courses									
7	20ME55	Fluid Mechanics and Hydraulic Machinery Lab	-	-	2	1	15	35	50
8	20ME56	Mechanics of Solids and Metallurgy Lab	-	-	3	1.5	15	35	50
9	20AD53	Programming Using Python Lab	1	-	2	2	15	35	50
10	20MES1	Technical Drawing using Drafting Package	1	0	2	2		50	50
		Total	**15**	**4**	**9**	**21.5**	**225**	**575**	**800**

IV SEMESTER

S. No	Course code	Course Title	Contact hours/week			Credits	Scheme of Valuation		
			L	T	P		CIE	SEE	Total
Theory Courses									
1	20FE09	Probability and Statistics	3	-	-	3	30	70	100
2	20ME07	Applied Thermodynamics	2	1	-	3	30	70	100
3	20ME08	Production Technology	3	-	-	3	30	70	100
4	20ME09	Theory of Machines	3	-	-	3	30	70	100
5	20HS01	Universal Human values 2: Understanding Harmony	3	-	-	3	30	70	100
Laboratory Courses									
6	20ME57	Production Technology Lab	-	-	3	1.5	15	35	50
7	20ME58	Theory of Machines Lab	-	-	2	1	15	35	50
8	20ME59	Computer Aided Machine Drawing Lab	1	-	2	2	15	35	50
9	20MES2	Structural and Modal Analysis Using ANSYS	1	0	2	2		50	50
		Total	**16**	**1**	**9**	**21.5**	**195**	**505**	**700**
Honours/Minor Courses						**4**			

V - SEMESTER

S.No	Course Code	Course Title	Contact hours/week			Credits	Scheme of Valuation		
			L	T	P		CIE	SEE	Total
Theory Courses									
1	20ME10	IC Engines and Gas Turbines	2	1	-	3	30	70	100
2	20ME11	Machine Tools and Metrology	3	-	-	3	30	70	100
3	20ME12	Design of Machine Elements-I	2	1	-	3	30	70	100
4		**PROGRAM ELECTIVE – I**	3	-	-	3	30	70	100
	20ME13	Non-Conventional Energy Sources							
	20ME14	Robotics							
	20ME15	Mechanical Vibrations							
	20ME16	Operations Research							
5		**OPEN ELECTIVE – I**	3	-	-	3	30	70	100
Laboratory Courses									
6	20ME60	Thermal Engineering Lab	-	-	3	1.5	15	35	50
7	20ME61	Machine Tools and Metrology Lab	-	-	3	1.5	15	35	50
8		Skill Advanced Course	-	-	-	2	-	50	50
9	20PI01	Summer Internship	-	-	3	1.5	-	50	50
		TOTAL	**13**	**02**	**09**	**21.5**	**180**	**520**	**700**
Honors / Minor Courses						4			

VI - SEMESTER

S.No	Course Code	Course Title	Contact hours/week			Credits	Scheme of Valuation		
			L	T	P		CIE	SEE	Total
Theory Courses									
1	20ME17	Heat Transfer	2	1	-	3	30	70	100
2	20ME18	CAD/CAM	3	-	-	3	30	70	100
3	20ME19	Design of Machine Elements-II	2	1	-	3	30	70	100
4		**PROGRAM ELECTIVE – II**	3	-	-	3	30	70	100
	20ME20	Computational Fluid Dynamics							
	20ME21	Modern Machining Processes							
	20ME22	Condition Monitoring and Fault Diagnosis							
	20ME23	Automation in Manufacturing							
5		**OPEN ELECTIVE – II**	3	-	-	3	30	70	100
Laboratory Courses									
6	20ME62	Heat Transfer Lab	-	-	2	1	15	35	50
7	20ME63	CAD/CAM Lab	-	-	3	1.5	15	35	50
8	20ME64	Robotics and Simulation Lab	1	-	2	2	15	35	50
9	20HSS1	Soft Skills Course	1	-	2	2	-	50	50
		TOTAL	**15**	**02**	**09**	**21.5**	**195**	**505**	**700**
Honors/Minor Courses						4			

VII - SEMESTER

S.No	Course Code	Course Title	Contact hours/week			Credits	Scheme of Valuation		
			L	T	P		CIE	SEE	Total
Theory Courses									
1		**PROGRAM ELECTIVE - III**	3	-	-	3	30	70	100
	20ME24	Refrigeration and Air Conditioning							
	20ME25	Additive Manufacturing							
	20ME26	Finite Element Methods							
	20ME27	Project Management							
2		**PROGRAM ELECTIVE - IV**	3	-	-	3	30	70	100
	20ME28	Alternate Fuels and Pollution Control							
	20ME29	Automobile Engineering							
	20ME30	Production Planning and Control							
	20ME31	Tribology							
3		**PROGRAM ELECTIVE - V**	3	-	-	3	30	70	100
	20ME32	Power Plant Engineering							
	20ME33	Principles of Energy Conservation and Management							
	20ME34	Composite Materials							
	20ME35	Total Quality Management							
4		**OPEN ELECTIVE– III**	3	-	-	3	30	70	100
5		**OPEN ELECTIVE– IV**	3	-	-	3	30	70	100
6	20HS03	Industrial Economics and Management	3	-	-	3	30	70	100
Laboratory Courses									
7	20PI02	Industrial/Research Internship	-	-	-	3	-	50	50
8		Skill Advanced Course	-	-	-	2	-	50	50
		TOTAL	18	-	-	23	180	520	700
		Honors / Minor Courses				4			

VIII - SEMESTER

S.No	Course Code	Course Title	Contact hours/week			Credits	Scheme of Valuation		
			L	T	P		CIE	SEE	Total
Laboratory Courses									
1	20PI03	Project Work	0	0	24	12	60	140	200

OPEN ELECTIVES

Course Code	Course Name	Offered to the branches
20AD81	Introduction to Artificial Intelligence	ASE, CE, ECE, EEE, & ME
20AD82	Introduction to Data Science	ASE, CE, ECE, EEE, & ME
20AD83	Introduction to Machine Learning	ASE, CE, ECE, EEE, & ME
20AD84	Fundamentals of Deep Learning	ASE, CE, ECE, EEE, & ME
20AE81	Principles of Flight	AI&DS, CE, CSE, CSE(AI&ML), ECE, EEE, IT & ME
20AE82	Space Science	AI&DS, CE, CSE, CSE(AI&ML), ECE, EEE, IT & ME
20AE83	Aircraft Systems	AI&DS, CE, CSE, CSE(AI&ML), ECE, EEE, IT & ME
20AE84	Air Transportation Systems	AI&DS, CE, CSE, CSE(AI&ML), ECE, EEE, IT & ME
20CE81	Basics of Civil Engineering	AI&DS, ASE, CSE, CSE(AI&ML), ECE, EEE, IT & ME
20CE82	Disaster Management	AI&DS, ASE, CSE, CSE(AI&ML), ECE, EEE, IT & ME
20CE83	Fundamentals of Geospatial Technologies	AI&DS, ASE, CSE, CSE(AI&ML), ECE, EEE, IT & ME
20CE84	Environmental Sanitation	AI&DS, ASE, CSE, CSE(AI&ML), ECE, EEE, IT & ME
20CS81	Unix and Shell Programming	ASE, CE, ECE, EEE, & ME
20CS82	Introduction to Algorithm Techniques	ASE, CE, ECE, EEE, & ME
20CS83	Principles of Computer Architecture	ASE, CE, ECE, EEE, & ME
20CS84	PHP Programming	ASE, CE, ECE, EEE, & ME
20CS85	Object Oriented Software Engineering	ASE, CE, ECE, EEE, & ME
20EC81	Satellite Technology	AI&DS, ASE, CE, CSE, CSE(AI&ML), EEE, IT & ME
20EC82	Elements of Communication Systems	AI&DS, ASE, CE, CSE, CSE(AI&ML), EEE, IT & ME
20EC83	Microprocessors and Interfacing	AI&DS, ASE, CE, CSE, CSE(AI&ML), EEE, IT & ME
20EC84	Analog and Digital Communications	AI&DS, ASE, CE, CSE, CSE(AI&ML), EEE, IT & ME
20EC85	Systems and Signal Processing	AI&DS, ASE, CE, CSE, CSE(AI&ML), EEE, IT & ME
20EC86	Cellular Technology	AI&DS, ASE, CE, CSE, CSE(AI&ML), EEE, IT & ME

OPEN ELECTIVES

Course Code	Course Name	Offered to the branches
20EE81	Linear Control Systems	AI&DS, ASE, CE, CSE, CSE(AI&ML), ECE, IT & ME
20EE82	Basics of Electrical Measurements	AI&DS, ASE, CE, CSE, CSE(AI&ML), ECE, IT & ME
20EE83	Utilization of Electrical Energy	AI&DS, ASE, CE, CSE, CSE(AI&ML), ECE, IT & ME
20EE84	Electric Vehicles	AI&DS, ASE, CE, CSE, CSE(AI&ML), ECE, IT & ME
20IT81	OOP through JAVA	ASE, CE, ECE, EEE, & ME
20IT82	Web Technologies using PHP	ASE, CE, ECE, EEE, & ME
20IT83	Mobile Application Development	ASE, CE, ECE, EEE, & ME
20IT84	Cyber Security & Digital Forensics	ASE, CE, ECE, EEE, & ME
20ME81	Renewable Energy Sources	AI&DS, CE, CSE, CSE(AI&ML), ECE, EEE & IT
20ME82	Robotics in Automation	AI&DS, CE, CSE, CSE(AI&ML), ECE, EEE & IT
20ME83	Operations Research Techniques	AI&DS, CE, CSE, CSE(AI&ML), ECE, EEE & IT
20ME84	Elements of Automobile Engineering	AI&DS, CE, CSE, CSE(AI&ML), ECE, EEE & IT

	L	T	P	Cr.
B.Tech. (I Sem.) 20FE01 - PROFESSIONAL COMMUNICATION - I	2	0	0	2

Pre-requisites: Nil

Course Educational Objectives: To improve English language proficiency of the students in various aspects like vocabulary, grammar, communication skills, listening skills, reading & writing skills.

Course Outcomes: At the end of the course, the student will be able to

CO1 : Write sentences and paragraphs using proper grammatical structures and word forms (**Remember – L1**)
CO2 : Comprehend the given text by employing suitable strategies for skimming and scanning and draw inferences (**Understand – L2**)
CO3 : Write summaries of reading texts using correct tense forms & appropriate structures (**Remember – L1**)
CO4 : Write Formal Letters, Memos & E-Mails (**Apply – L3**)
CO5 : Edit the sentences/short texts by identifying basic errors of grammar/vocabulary/syntax (**Understand – L2**)

Unit - I
Exploration - 'A Proposal to Girdle the Earth – Nellie Bly'; Reading: Skimming for main idea; Scanning for specific information; Grammar & Vocabulary: Content Words; Function Words; Word Forms: verbs, nouns, adjectives and adverbs; Nouns: Countable and Uncountable, Singular and Plural forms; Wh - Questions; Word Order in Sentences; Writing: Paragraph Analysis; Paragraph Writing; Punctuation and Capital Letters

Unit – II
On Campus- 'The District School as it Was by One Who Went to it – Warren Burton'; Reading: Identifying Sequence of Ideas; Grammar & Vocabulary: Cohesive Devices: Linkers/Signposts/Transition signals, Synonyms, Meanings of Words/Phrases in the context; Writing: Memo Drafting.

Unit – III
Working Together-'The Future of Work'
Reading: Making basic inferences; Strategies to use text clues for comprehension; Summarizing; Grammar & Vocabulary: Verbs: Tenses; Reporting Verbs for Academic Purpose; Writing**:** Rephrasing what is read; Avoiding redundancies and repetitions; Abstract Writing/ Summarizing.

Unit – IV
'A.P.J.Abdul Kalam'; Grammar & Vocabulary: Direct & Indirect Speech; Articles and their Omission; Writing: E-Mail Drafting.

Unit – V
'C.V.Raman'; Grammar & Vocabulary: Subject-Verb Agreement; Prepositions; Writing: Formal Letter Writing.

Text Books:

1. Prabhavati. Y & et al, "English All Round – Communication Skills for Undergraduate Learners", Orient BlackSwan, Hyderabad, 2019.
2. "Panorama – A Course on Reading", A collection of prose selections, Oxford University Press, New Delhi, 2016.

Reference Books:

1. Swan, M., "Practical English Usage", Oxford University Press, 2016.
2. Kumar,S and Latha, P, "Communication Skills", Oxford University Press, 2018.
3. Rizvi Ashraf M., "Effective Technical Communication", Tata Mc Graw Hill, New Delhi, 2008.
4. Baradwaj Kumkum, "Professional Communication", I.K. International Publishing House Pvt. Ltd., New Delhi, 2008.
5. Wood, F.T., "Remedial English Grammar", Macmillan, 2007.

L	T	P	Cr.
2	1	0	3

B.Tech. (I Sem.)   **20FE03 - DIFFERENTIAL EQUATIONS**

Pre-requisites: Nil

Course Educational Objective: The objective of this course is to introduce the first order and higher order differential equations, functions of several variables. The students also learn solving of first order partial differential equations.

Course Outcomes: At the end of this course, the student will be able to

CO1: Apply first order and first-degree differential equations to find orthogonal trajectories **(Apply – L3)**

CO2: Distinguish between the structure and methodology of solving higher order differential equations with constant coefficients **(Understand – L2)**

CO3: Apply various Numerical methods to solve initial value problem **(Apply – L3)**

CO4: Generate the infinite series for continuous functions and investigate the functional Dependence **(Understand – L2)**

CO5: Solve partial differential equations using Lagrange's method **(Apply – L3)**

UNIT –I

Differential Equations of First Order and First Degree
Differential equations of first order and first degree –Exact and Non Exact differential Equations, Applications of differential equations – Orthogonal Trajectories.

UNIT –II
Linear Differential Equations of Higher Order
Homogeneous and Non Homogeneous Linear differential equations of second and higher order with constant coefficients with R.H.S. functions e^{ax}, sin $(ax+b)$, cos $(ax+b)$, x^m, $e^{ax}V(x)$, $xV(x)$, Method of variation of parameters.

UNIT – III
Numerical solution of Ordinary Differential Equations
Numerical solution of Ordinary Differential equations, Solution by Taylor's series - Picard's Method of successive approximations.
Euler's Method - Runge- Kutta Methods.

UNIT –IV
Functions of several variables
Generalized Mean Value Theorem (without proof), Maclaurin's series, Functions of several variables, Jacobians (Cartesian and polar coordinates), Functional dependence. Maxima and Minima of function with two variables.

UNIT – V

Partial Differential Equations

Formation of Partial Differential Equations by elimination of arbitrary constants and arbitrary functions.Solution of first order and first degree linear partial differential equation – Lagrange's method.

Text Books:

1. B.S. Grewal, "*Higher Engineering Mathematics*", 42ndEdition, Khanna Publishers, New Delhi, 2012.

2. B. V. Ramana, "*Higher Engineering Mathematics*", 1stEdition, TMH Publications, New Delhi, 2010

Reference Books:

1. M. D. Greenberg, "*Advanced Engineering Mathematics*", 2nd Edition, TMH Publications, New Delhi, 2011.

2. Erwin Kreyszig, *"Advanced Engineering Mathematics"*, 8th Edition, John Wiley & sons, New Delhi, 2011.

3. W.E. Boyce and R. C. Diprima, " *Elementary Differential Equations"*, 7th Edition, John Wiley & sons, New Delhi, 2011.

4. S. S. Sastry, *"Introductory Methods of Numerical Analysis",* 5th Edition, PHI Learning Private Limited, New Delhi, 2012.

	L	T	P	Cr.
B.Tech.(I_Sem) **20FE05 - APPLIED CHEMISTRY**	3	0	0	3

Pre-requisites: Nil

Course Educational Objective: It enables the students to understand the fundamental concepts of chemistry and to provide them with the knowledge of industrial problems and finding the solutions. It helps to strengthen thebasic concepts of water, fuel technologies, electrochemistry, corrosion and advanced materials used in technologies.

Course Outcomes: At the end of the course, student will be able to:

CO1: Identify the troubles due to hardness of water and its maintenance in industrial applications.**(Understand - L2)**

CO2: Understand the issues related to conventional fuels, biofuels and photo-voltaic cells in energy production.**(Understand - L2)**

CO3: Apply Nernst Equation for calculating electrode cell potentials and compare batteries for different applications.**(Apply - L3)**

CO4: Apply principles of corrosion for design and effective maintenance of various equipment.**(Apply - L3)**

CO5: Analyse the suitability of engineering materials like polymers, lubricants, nano materials and composites in technological applications**.(Understand – L2)**

UNIT – I
WATER TECHNOLOGY
Sources of water and quality; Hardness of Water - Temporary and permanent hardness, units and their inter relation, problems on hardness and disadvantages of hard water in industries. Boiler troubles - Reasons, disadvantages and methods of prevention for Scale and sludge formation, caustic embrittlement, boiler corrosion and carry over (priming and foaming), W.H.O standards of potable water; Water softening: Ion-Exchange Process, merits and demerits; Desalination of brackish water - Electro dialysis and reverse osmosis; Treatment of industrial waste water.

UNIT – II
FUEL TECHNOLOGY
Classification of fuels (solid, liquid and gaseous fuels, merits and demerits) and characteristics of a good fuel; Calorific value -Definition, gross and net calorific values (definition only).Solid fuels - Coal – origin, proximate analysis of coal and significance; Liquid Fuels - Petroleum-origin, types of crude oil and refining of petroleum. Cracking - moving bed catalytic cracking and synthetic petrol –Fischer Tropsch's process; Gaseous fuels - Natural gas composition and C.N.G - advantages.Bio fuels - Characteristics of bio fuels, sources of bio mass and advantages -Production of biodiesel from rape seed oil; Photo-voltaic Cell - Design, working, schematic diagram, advantages and disadvantages.

UNIT – III
ELECTRO CHEMISTRY & BATTERIES
Types of Electrodes - Calomel Electrode, Glass Electrode**,** Calculation of EMF of Cell**,** Applications of Nernst Equation**,** Applications of Electro chemical Series
Batteries -Lead-acid Battery, Lithium ion Battery, H_2– O_2 Fuel Cell, Mg-Cu reserve battery.

UNIT – IV
SCIENCE OF CORROSION
Dry Corrosion (Direct Chemical corrosion) - Types of dry corrosion-oxidative corrosion, Pilling Bed worth rule, corrosion by other gases and liquid metal corrosion; Wet Corrosion (Electro Chemical corrosion) - Mechanism- oxygen absorption, hydrogen evolution, types of wet corrosion, Galvanic Corrosion, Concentration Cell Corrosion, passivity and Galvanic series; Factors Influencing Corrosion -Nature of metal (purity, position in galvanic series, relative area of cathode & anode, nature of surface film) and nature of environment (temperature, humidity, atmospheric pollution and nature of ions in the medium); Control of Corrosion - Cathodic Protection - Sacrificial anode and impressed current methods, electro plating and metal cladding.

UNIT – V
CHEMISTRY OF ENGINEERING MATERIALS
Polymers - Differences between thermoplasts and thermosets, Types of polymerization with examples, Preparation properties and engineering applications of PVC, Teflon, BUNA-S and Polyurethane;
Lubricants -Characteristics of a good lubricant and properties of lubricants (viscosity, flash and fire points, cloud and pour points, aniline point) and applications;
Nano Materials -Introduction, definition, extraordinary changes observed at nano size of materials and reasons, types of nano-materials, Gas-Phase Synthesis of nanomaterials, Applications;
Composites -Advantageous characteristics of Composites, Constituents, Fibre reinforced composites (GFRP, CFRP), Reasons for failure of composites.

TEXT BOOKS:
1. Shashi Chawla, "A Text book of Engineering Chemistry", Dhanpat Rai Publishing Company, New Delhi, 3rd Edition, 2003.
2. Jain, Jain, "A Text book of Engineering Chemistry", Dhanpat Rai Publishing Company, New Delhi, 16th Edition, 2015.

REFERENCE:
1. Shikha Agarwal, "A text book of Engineering Chemistry", Cambridge University Press, New Delhi, 1st Edition, 2015.
2. S.S. Dara, S.S. Umare, "A Text book of Engineering Chemistry", S. Chand Publications, New Delhi, 12th Edition, 2010.
3. Y. BharathiKumari, Jyotsna Cherukuri, "A Text book of Engineering Chemistry", VGS Publications, Vijayawada, 1st Edition, 2009.

	L	**T**	**P**	**Cr.**
20ME01 - ENGINEERING GRAPHICS	2	0	4	4

B.Tech. (I Sem.)

Pre-requisites : Nil

Course Educational Objective:
To recognize the Bureau of Indian Standards of Engineering Drawing and develop an ability to get familiarized with orthographic projections and isometric views of solid objects.

Course Outcomes: At the end of the course, the student will be able to:

CO1:   Identify the geometrical objects considering BIS standards. **(Remember-L1)**
CO2:   Comprehend the basics of orthographic projections and deduce orthographic projections   of a point and a line at different orientations. **(Understand-L2)**
CO3: Represent graphically the geometrical planes at different positions and orientations. **(Understand-L2)**
CO4: Analyze and draw solid objects at different positions and orientations. **(Apply- L3)**
CO5: Visualize isometric and orthographic views of geometrical objects and convert one form to another. **(Understand-L2)**

UNIT – I
INTRODUCTION TO ENGINEERING DRAWING:
Introduction: Introduction**,** Principles of Engineering Drawing and their significance - Drawing Instruments and their use-Conventions in Drawing- Lettering and Dimensioning – BIS conventions – Geometrical Constructions.
Engineering Curves: Conic Sections- Ellipse, Parabola, Hyperbola and Rectangular Hyperbola- General method and other methods; Cycloid, Epi-Cycloid and Hypo-Cycloid; Involutes.

UNIT – II
ORTHOGRAPHIC PROJECTIONS:
Introduction, Principle of Orthographic Projection-Method of Projections – First and third angle projection methods- Projections of Points – Projections of straight lines of different orientations - True lengths and traces.

UNIT – III
PROJECTIONS OF PLANES: Introduction, Planes parallel to one of the reference planes-Inclined to one reference plane and perpendicular to other-Oblique planes.

UNIT – IV
PROJECTIONS OF SOLIDS: Introduction, Regular Polyhedral, Solids of Revolution**,** Projection of solids in simple position - Axis inclined to one of the reference planes and parallel to the other-Axis inclined to both Principle Planes.

UNIT – V
ISOMETRIC VIEWS: Introduction-theory of isometric projection, isometric views, isometric axes, scale, lines and planes-Isometric view of prism, pyramid, cylinder and cone-non isometric lines-methods to generate an isometric drawing.
TRANSFORMATION OF PROJECTIONS: Conversion of Orthographic Projections to Isometric Views of composite objects, Conversion of Isometric Views to Orthographic Projections**.**

TEXT BOOKS:

1   N. D. Bhatt, Engineering Drawing, 51th Revised and Enlarged Edition, Charotar publishers, 2012

BOS APPROVED REFERENCE BOOKS:

1   Narayana K L, Kannaiah P, Textbook on Engineering Drawing, 2nd Edition, SciTech publishers.
2   R.K.Dhawan, Engineering Drawing, S.Chand Company LTD.
3   Venugopal, Engineering Drawing and Graphics, New Age publishers
4   Dhananjay A. Jolhe, Engineering Drawing, Tata McGraw Hill Publishers
5   N.S.Parthasarathy, Vela Murali, Engineering Drawing, Oxford Higher Education

<table>
<tr><td rowspan="2" colspan="2">**20EE02 - BASIC ELECTRICAL AND ELECTRONICS ENGINEERING**</td><td>**L**</td><td>**T**</td><td>**P**</td><td>**Cr.**</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
</table>

B.Tech. (I_Sem.)

Prerequisite: Physics

Course Educational Objective: This course enables student to illustrate the basics of applied electricity and electronics.

Course Outcomes: At the end of the course, the student will be able to:

   CO1: Apply network reduction techniques to simplify electrical circuits. **(Apply-L3)**
   CO2: Illustrate the working principle of DC machines and transformers. **(Understand-L2)**
   CO3: Understand V-I characteristics of semiconductor devices. **(Understand-L2)**
   CO4: Illustrate the configuration of Transistors and their applications. **(Understand-L2)**

UNIT – I: Electrical Circuit Fundamentals
Basic definitions, Types of elements-active and passive, Ohm's Law, Kirchhoff's Laws-Network reduction techniques- series, parallel, star to delta, delta to star transformations, source transformation (for resistive networks), mesh analysis, nodal analysis (Basic problems).

UNIT – II: DC Network Theorems and AC Fundamentals
Theorems-Superposition, Thevenin's, Norton's and Maximum Power Transfer (Basic problems in DC excitation only)
Peak, R.M.S, average, instantaneous values, form factor and peak factor– periodic waveforms – Phase and Phase difference –concepts of reactance, impedance, susceptance and admittance, real, reactive and apparent powers, Power Factor- resonance-bandwidth-quality factor.

UNIT – III: DC Machine Fundamentals and Single-Phase Transformers
DC generator principle, constructional details, emf equation, types of generators (Theory only).
DC motor principle, Back emf, types of motor (Theory only).
Construction and Principle of operation of single-phase transformers-Emf equation

UNIT–IV: P-N Junction Diode and Zener Diode
P-N Junction Diode: Operation and V-I characteristics of PN junction diode, Rectifiers-Half Wave Rectifier, Full Wave Rectifier-Bridge type, Zener Diode-Voltage Regulator.

UNIT – V: Transistors
Construction, Principle of Operation, Symbol, CB, CE configurations, JFET, MOSFET and application of transistor as an amplifier (Theory only).

TEXT BOOKS:
   1. A.Sudhakar and Shyammohan S Palli, "Electrical Circuits" Tata McGraw-Hill, 3rd Edition.2017
   2. M.S.Sukhija, T.K.Nagsarkar, "Basic Electrical and Electronics Engineering", Oxford University Press, 2016 Edition.
REFERENCE:
   1. Kothari and Nagarath, "Basic Electrical Engineering", TMH Publications, 3rd Edition.2013
   2. G.S.N.Raju, "Electronic Devices and Circuits", I.K.International.2006

	L	T	P	Cr.
B.Tech.(I_Sem)　　**20FE52 - APPLIED CHEMISTRY LAB**	0	0	3	1.5

Pre-requisites: Nil

Course Educational Objectives:
This course enables thestudents to analyze water samples and perform different types of volumetric titrations. It provides them with an overview of preparation of polymers and properties of fuels.

Course Outcomes: At the end of the course, the students will be able to
CO1: Assess quality of water based on the procedures given.(**Understand-L2**)
CO2: Distinguish different types of titrations in volumetric analysis after performing the experiments listed in the syllabus.(**Understand-L2**)
CO3: Acquire practical knowledge related to preparation of polymers.(**Understand-L2**)
CO4: Exhibit skills in performing experiments based on theoretical fundamentals. (**Apply-L3**)

List of Experiments
(Any of the 10 experiments are required to be conducted)

Model Experiment
1) Determination of amount of Na_2CO_3 using standard HCl solution.

Water Analysis
2) Determination of alkalinity of water sample**.**
3) Determination of total Hardness of water by EDTA method.
4) Determination of permanent hardness of water by EDTA method.

Preparation of Polymers
5) Nylon Fibers
6) Bakelite

Redox Titrations
7) Estimation of Mohr's salt by using potassium permanganate.
8) Estimation of Mohr's salt by using potassium dichromate.
9) Determination of Copper(II) using standard hypo solution.

Demonstration Experiments
10) Determination of pH of the given sample solution/ soil using pH meter.
11) Determination of Turbidity of the given sample water.

Estimations
12) Determination of ferrous content in the given sample of iron ore against potassium dichromate using potassium ferricyanide as external indicator.
13) Determination of Iron(III) by colorimetric method.

Fuels
14) Determination of flash and fire points of a given fuel/lubricant.

REFERENCES
　　Lab manual

	L	T	P	Cr.

B.Tech. (I Sem.)   **20EE52 - BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LAB**

L	T	P	Cr.
0	0	3	1.5

Pre-requisites : Nil

Course Educational Objective: This lab course enables the student to demonstrate the knowledge of electrical and electronic equipment and analysis of electric circuits. It also deals with plotting characteristics of basic semiconductor devices.

Course Outcomes: At the end of the course, the student will be able to:

CO1: Examine electrical circuits using network theorems. **(Apply-L3)**

CO2: Analyze VI characteristics of semiconductor devices. **(Understand-L2)**

CO3: Analyze electrical circuits.**(Understand-L2)**

CO4: Design Resonance circuits. **(Apply-L3)**

List of Experiments
(Any of the 10 experiments are required to be conducted)

1. V-I relations of passive elements (R, L, C).
2. Verification of Kirchhoff's Laws (KCL and KVL.).
3 Measurement of active power, reactive power and power factor of ACcircuits.
4. Calculation of Resonant frequency, Bandwidth and Quality factor of resonant circuits.
5. Verification of Superposition theorem.
6. Verification of Thevenin's and Norton's theorems.
7. Verification of Maximum power transfer theorem.
8. Plot the V-I characteristics of a p-n junction diode.
9. Plot the V-I characteristics of Zener diode.
10. Plot the V-I characteristics of BJT.
11. Calculation of ripple factor and regulation of Full Wave Rectifier with and without filters .
12. Plot the V-I characteristics of MOSFET.

	L	T	P	Cr.
20ME51 - ENGINEERING WORKSHOP	0	0	3	1.5

B.Tech. (I Sem.)

PRE-REQUISITES: Nil

COURSE EDUCATIONAL OBJECTIVE:

The objective of this course is to get familiarized with various trades used in Engineering Workshop and learn the safety precautions to be followed in the workshops while working with the different tools.

COURSE OUTCOMES: After completion of the course students will be able to:

CO1: Develop different prototypes in the carpentry section. **(Understand-L2)**

CO2: Fabricate various basic prototypes in fitting trade. **(Understand-L2)**

CO3: Demonstrate various operations related to plumbing, tin smithy and black smithy. **(Understand-L2)**

CO4: Perform various basic house wiring techniques. **(Apply-L3)**

(Conduct at least 4 Trades with 2 exercises from each Trade and demonstrate about 2 Trades)

Trade –1: CARPENTRY SHOP

Introduction to various types of wood such as Teak, Sal, Oak, Beach, Neam, Wallnut Mango, Shisham, Deodar, Babul. demonstration, function and use of carpentry hand-tools and their safety precautions. Introduction to various types of wooden joints, their relative advantages and uses.
Job I - Marking, sawing, plaining and chiselling operations.
Job II - Preparation of half lap-joint
Job III – Preparation of Mortise and Tenon Joint

Trade –2: FITTING SHOP

Introduction to fitting shop tools, common materials used in fitting shop, description, demonstration, care, use of tools and safety precautions.
Job I- Making a L-Fit from a rectangular piece of Mild Steel Flat (MS).
Job II-Making a T-Fit from a rectangular piece of MS Flat.
Job III-Making a V-Fit from a rectangular piece of MS Flat
Job IV-Making a Half round fit from a rectangular piece of MS flat.

Trade -3: TIN- SMITHY SHOP

Introduction to tin-smithy, specification and use of hand tools, accessories and the safety precautions.
Job I - Preparation of a rectangular tray using GI sheet.
Job II - Preparation of an open scoop/ funnel using GI sheet.
Job III - Preparation of a Single Seam Joint and Double Seam Joint using GI sheet.
Job IV - Preparation of a Corner Seam Joint using GI sheet.

Trade –4: PLUMBING SHOP

Introduction to plumbing – demonstration, use of hand tools, accessories and safety precautions.

Job I – preparation of pipe layout.

Job II – Pipe threading.

Trade -5: BLACK SMITHY

Introduction–demonstration of tools, equipment and safety precautions.

Job I – Preparation of S–Hook.

Job II – Preparation of Chisel

Trade -6: HOUSE WIRING

Demonstration and identification of common electrical materials such as wires, cables, switches, fuses, PVC Conduits. Study of electrical safety measures and demonstration about use of protective devices such as fuses, and relays including earthling.

Job I – One lamp controlled by one-way switch.

Job II – Two lamps in series and parallel connection with one-way switch.

Job III- Florescent lamp and calling bell circuit.

Job IV - One lamp connection with two 2- way switches (stair case connection).

Job V -- House wiring circuit.

REFERENCES

1. LBRCE Workshop Lab Manual.
2. S.K.HajraChoudary and A.K.Choudary, ‒Workshop Technology-I& II, MediaPromotersand Publishers Pvt.Ltd., Mumbai,2012.
3. B.S.Raghuvamsi, ‒Workshop Technology-I& II, Dhanpatrai and company, New Delhi, 2014.
4. P.Khannaiah, K.L.Narayana, ‒Workshop Manual‖,ScitechPublications India Pvt.Ltd, 2015.

	L	T	P	Cr.
B.Tech.(II-Sem.) **20FE02 - PROFESSIONAL COMMUNICATION - II**	2	0	0	2

Pre-requisites: Nil

Course Educational Objective: To improve English language proficiency of the students in various aspects like vocabulary, grammar, communication skills, listening skills, reading & writing skills.

Course Outcomes: At the end of the course, the student will be able to

CO1: Produce a coherent paragraph interpreting a figure/graph/chart/table (**Understand – L2**)

CO2: Comprehend the given texts thoroughly by guessing the meanings of the words contextually (**Understand – L2**)

CO3: Use language appropriately fordescribing /comparing/contrasting/givingdirections & suggestions (**Remember – L1**)

CO4: Write formal/informal dialogues with an understanding of verbal/non-verbal features of communication. (**Understand – L2**)

CO5: Write well structured essays; Reports &Résumé (**Apply – L3**)

UNIT - I
Fabric of Change- 'H.G. Wells and the Uncertainties of Progress – Peter J. Bowler'; Reading: Studying the use of Graphic elements in texts; Grammar & Vocabulary**:** Quantifying Expressions; Adjectives and adverbs; Comparing and Contrasting; Degrees of Comparison;
Writing: Information Transfer

UNIT - II
Tools for Life - 'Leaves from the Mental Portfolio of a Eurasian – Sui Sin Far'; Reading: Global Comprehension; Detailed Comprehension; Grammar & Vocabulary**:** Active & Passive Voice; Idioms & Phrases; Writing: Structured Essays using suitable claims and evidences

UNIT - III
'Homi Jahangir Bhabha';
Grammar & Vocabulary: Words often confused; Common Errors; Writing**:** Incident & Investigation Reports

UNIT - IV
'Jagadish Chandra Bose'; Grammar & Vocabulary: Use of Antonyms; Correction of Sentences; Writing**:** Dialogue Writing

UNIT - V
'**Prafulla Chandra Ray'**; Grammar & Vocabulary: Analogy; Sentence Completion; Writing**:** Writing a Résumé

TEXT BOOKS:
1. Prabhavati. Y & et al, "English All Round – Communication Skills for Undergraduate Learners", Orient Black Swan, Hyderabad, 2019.
2. "The Great Indian Scientists" published by Cengage Learning India Pvt. Ltd., Delhi, 2017

REFERENCE BOOKS:
1. Swan, M., "Practical English Usage", Oxford University Press, 2016.
2. Kumar,S and Latha, P, "Communication Skills", Oxford University Press, 2018.
3. Rizvi Ashraf M., "Effective Technical Communication", Tata Mc Graw Hill, New Delhi, 2008.
4. Baradwaj Kumkum, "Professional Communication", I.K.International Publishing House Pvt.Ltd., New Delhi, 2008.
5. Wood,F.T., "Remedial English Grammar", Macmillan, 2007.

B.Tech. (II Sem.)	20FE04 - LINEAR ALGEBRA AND TRANSFORMATION TECHNIQUES	L	T	P	Cr.
		2	1	0	3

Pre-requisites: Nil

Course Educational Objective: In this course, students learn Matrix Algebra and introduced with transformation techniques such as Laplace Transforms and Z – Transforms.

Course Outcomes: At the end of the course, the student will be able to
CO1: Investigate the consistency of the system of equations and solve them **(Apply – L3)**
CO2: Determine the eigen vectors and inverse, powers of a matrix using Cayley – Hamilton Theorem **(Apply - L3)**
CO3: Use the concepts of Laplace Transforms to various forms of functions **(Understand – L2)**
CO4: Solve ordinary differential equations by using Laplace Transforms **(Apply – L3)**
CO5: Apply Z - Transforms to solve difference equations **(Apply – L3)**

UNIT – I
System of Linear Equations
Matrices - Rank- Echelon form, Normal form, PAQ form– Solution of Linear Systems – Homogeneous system of equations and Non-Homogeneous system of equations.

UNIT – II
Eigen Values and Eigen Vectors
Eigen values – Eigen Vectors – Properties – Cayley-Hamilton Theorem – Inverse and Powers of a matrix by using Cayley-Hamilton Theorem.

UNIT – III
Laplace Transforms
Laplace transforms of standard functions –Linear Property - Shifting Theorems, Change of Scale Property
Multiplication and Division by 't' - Transforms of derivatives and integrals – Unit step function – Dirac's delta function.

UNIT – IV
Inverse Laplace Transforms
Inverse Laplace transforms– Linear Property - Shifting Properties - Convolution theorem, Applications of Laplace transforms to ordinary differential equations.

UNIT – V
Z-Transforms
Z-transform – properties – Damping rule – Shifting rule – Initial and final value theorems - Inverse Z –transform - Convolution theorem – Solution of difference equation by Z-transforms.

Text Books:

1. B.S. Grewal, "*Higher Engineering Mathematics*", 42ndEdition, Khanna Publishers, New Delhi, 2012.
2. B. V. Ramana, "*Higher Engineering Mathematics*", 1stEdition, TMH Publications, New Delhi, 2010.

Reference Books:

1. M. D. Greenberg, "*Advanced Engineering Mathematics*", 2nd Edition, TMH Publications, New Delhi, 2011.
2. Erwin Kreyszig, *"Advanced Engineering Mathematics"*, 8th Edition, John Wiley & sons, New Delhi, 2011.
3. W.E. Boyce and R. C. Diprima, " *Elementary Differential Equations"*, 7th Edition, John Wiley & sons, New Delhi, 2011.

	L	T	P	Cr.
B.Tech.(II Sem.) **20FE08 - ENGINEERING PHYSICS**	2	1	0	3

Pre-requisites: Nil

Course Educational Objectives: It enables the students to understand the fundamental concepts of elastic behaviour of materials, lasers, optical fibers, acoustics, ultrasonics, magnetic, dielectric, superconducting and nano materials.

Course Outcomes: At the end of the course, the student will be able to,

  CO1: Analyse the different mechanical properties of materials**(Understand – L2).**

  CO2: Apply the lasers and optical fibres in different fields**(Apply - L3).**

  CO3: Summarize the properties of sound waves**(Understand – L2).**

  CO4: Classify the different types of magnetic and dielectric materials**(Understand - L2).**

  CO5: Identify the properties of superconducting and nano materials**(Understand – L2).**

UNIT – I
Elasticity
Stress, Strain, Hooke's Law, Elastic behavior of a material, Factors affecting elasticity, Classification of elastic modulus, relation between Young's, bulk and rigidity modulus, bending of beam – bending moment of a beam and Cantilever (qualitative treatment).

UNIT – II
Lasers and Optical fibers
Lasers**:** Introduction- Principle of laser (absorption, spontaneous and stimulated emission of radiation), Einstein Coefficients, Nd - YAG laser, Helium Neon laser - applications.
Optical Fibers: Optical Fiber principle, Structure of optical fiber, numerical aperture and acceptance angle, types of optical fibers - applications.

UNIT – III
Acoustics &Ultrasonics
Acoustics: Introduction **–** Reverberation - Reverberation time - Sabine's formula (Derivation using growth and decay method) – absorption coefficient and its determination.
Ultrasonics: Production of ultrasonics by Magnetostriction - Detection of ultrasonics - acoustic grating – Non - Destructive Testing - Through transmission method and pulse echo method - Applications.

UNIT – IV
Magnetic & Dielectric materials
Magnetic parameters, Classification of magnetic materials-Diamagnetic, paramagnetic and ferromagnetic materials, Hysteresis loop, soft and hard magnetic materials, Applications of Ferro magnetic materials.
Dielectric polarization - Electronic and ionic polarization, orientation polarization (Qualitative), Local field, ClaussiusMosotti equation, Applications of dielectric materials.

UNIT – V

Superconducting and   nanomaterials

Introduction - Meissner effect, Type I and Type II super conductors, Josephson Effect, Applications of super conductors.

Nanomaterials**:** Introduction, classification, properties, different methods of preparation and applications.

TEXT BOOKS
1. V. Rajendran, "*Engineering Physics*", TMH, New Delhi, 6th Edition, 2011.
2. M.N. Avadhanulu, P.G. Kshirsagar, "Engineering *Physics*", S. Chand & Co., 2ndEdition, 2014.

REFERENCE BOOKS
1. M.N. Avadhanulu, TVS Arun Murthy, "Applied *Physics*", S. Chand & Co., 2ndEdition, 2007.
2. P.K. PalaniSamy, "*Applied Physics*", Sci. Publ. Chennai, 4th Edition, 2016.
3. P. Sreenivasa Rao, K Muralidhar, "*Applied Physics*", Him. Publi. Mumbai, 1st Edition, 2016.
4. Hitendra K. Mallik , AK Singh " *Engineering Physics*", TMH, New Delhi, 1st Edition, 2009.

	L	T	P	Cr.
B.Tech. (II Sem.) **20CS01 - PROGRAMMING FOR PROBLEM SOLVING USING C**	3	0	0	3

Pre-requisite   :   Nil

Course Educational Objective: The Objective of the course is to make learn the basic elements of C programming, control structures, derived data types, Modular programming, user defined structures, basics of files and its I/O operations.

Course Outcomes: At the end of this course, the student will be able to

CO1: Familiar with syntax and semantics of the basic programming language constructs. **(Understand - L2)**

CO2: Construct derived data types like arrays in solving problem.**(Apply - L3)**

CO3: Decompose a problem into modules and reconstruct it using various ways of user-defined functions. **(Apply - L3)**

CO4: Use user-defined data types like structures and unions and its applications to solve problems.**(Apply- L3)**

CO5: Discuss various file I/O operations and its application.**(Understand - L2)**

UNIT – I
Introduction to Problem solving through C-Programming: Problem Specification, Algorithm / pseudo code, flowchart, examples.
C-Programming: Structure of C program, identifiers, basic data types and sizes, Constants, variables, Input-output statements, A sample c program, operators, expressions, type conversions, conditional expressions, precedence of operators and order of evaluation.
Control statements: if, if else, else if ladder and switch statements, while, do-while and for statements, break, continue, go to and labels.

UNIT – II
Arrays- concept, declaration, definition, accessing elements, storing elements, two dimensional and multi-dimensional arrays.
Character Arrays: declaration, initialization, reading, writing strings, string handling functions, pre-processor Directives, and macros.
Applications of Arrays: Linear search, Binary search, Bubble Sort.

UNIT – III
Pointers- concepts, declaring & initialization of pointer variables, pointer expressions, pointer arithmetic, pointers and arrays, pointers and character arrays, pointers to pointers.
Functions: basics, category of functions, parameter passing techniques, recursive functions-comparison with Iteration, Functions with arrays, Standard library functions, dynamic memory management functions, command line arguments.
Storage classes - auto, register, static and extern.

UNIT – IV

Derived types- structures- declaration, definition, and initialization of structures, accessing structures, nested structures, arrays of structures, structures and functions, pointers to structures, self-referential structures, unions, typedef.

UNIT – V

Files – concept of a file, text files and binary files, streams, standard I/O, Formatted I/O, file I/O operations, error handling.

Textbook:
1. ReemaThareja, Programming in C, Oxford University Press, 2nd Edition, 2015

Reference books:
1. Jeri R.Hanly, Elliot B.Koffman, Problem Solving and Program Design in C, Pearson Publishers, 7th Edition, 2013
2. E Balagurusamy, Computer Programming, McGraw Hill Education, 8th Edition.
3. C: The Complete Reference, McGraw Hall Education,4th Edition.
4. PradeepDey, Manas Ghosh, Programming in C, Oxford University Press, 2nd Edition, 2011.
5. Stephen G.Kochan, Programming in C, Pearson Education, 3rd Edition, 2005.

	L	T	P	Cr.
B.Tech. (II Sem.) **20ME02- ENGINEERING MECHANICS**	2	1	0	3

PRE-REQUISITES : Physics, Mathematics

COURSE EDUCATIONAL OBJECTIVE:

The main objective of this course is to develop the ability to predict the behaviour of rigid solid bodies under the action of external forces in real world scenario.

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Apply free body diagram concepts to analyze rigid bodies in static conditions. **(Apply-L3)**
CO2: Apply the equilibrium Equations of rigid bodies associated with frictional forces. **(Apply-L3)**
CO3: Identify the location of centroid / centre of gravity and evaluate the moment of inertia of plane sections/solids. **(Apply-L3)**
CO4: Understand the behavior of moving bodies in rectilinear motion using kinematic equations or motion curves. **(Understand-L2)**
CO5: Examine the behavior of moving bodies using dynamic equilibrium conditions. **(Apply-L3)**

UNIT-I
SYSTEM OF FORCES: Introduction, Basic terminology in Mechanics, laws of Mechanics, characteristics of force, system of forces-types, Resolution and Composition of forces, Resultant of coplanar concurrent force system, Resultant of coplanar non-concurrent force system-moment of a force and couple.
EQUILIBRIUM OF SYSTEM OF FORCES: Free Body Diagram, Lami's theorem, Equilibrium of a rigid body subjected to coplanar concurrent forces and non-concurrent forces, Equilibrium of connected bodies.

UNIT-II
FRICTION: Introduction, Frictional force, laws of Coulomb friction, angle of friction, limiting friction and angle of repose, problems on blocks resting on horizontal and inclined planes.

UNIT - III
CENTROID AND AREA MOMENT OF INERTIA: Introduction, centroid, axis of symmetry, centroid of simple figures from first principles, centroid of simple composite sections, area moment of inertia, polar moment of inertia, theorems of moment of inertia, moment of inertia of rectangle, circle, semi-circle, I and T cross sections.

CENTRE OF GRAVITY AND MASS MOMENT OF INERTIA: Centre of gravity, centre of gravity of solid cylinder, right circular cone, hemi sphere, mass moment of inertia, radius of gyration, mass moment of inertia of uniform rod, rectangular plate, circular plate and solid cylinder only.

UNIT –IV
KINEMATICS: Introduction, **g**eneral principles in dynamics, types of motion, rectilinear motion, motion curves, motion with uniform velocity, motion with uniform acceleration, motion with varying acceleration, angular motion, relationship between linear and angular motions.

UNIT – V
KINETICS: Introduction, Newton's second law of motion-inertia force, D-Alembert's principle, bodies in rectilinear translation, fixed axis rotation of rigid bodies.

TEXT BOOKS
1. S.S. Bhavikatti and K.G. Rajashekarappa, Engineering Mechanics, New Age, 2012.
2. N.H. Dubey, Engineering Mechanics, Mc Graw Hill, 2013.

REFERENCES
1. F. L. Singer, Engineering Mechanics, Harper – Collins, 1994
2. B. Bhattacharya, Engineering Mechanics, Oxford University Press, 2008
3. A.K.Tayal, Engineering Mechanics, Umesh Publications, 2012.
4. R.K.Bansal, Engineering Mechanics, Laxmi Publications, 1996.
5. R.K.Rajput, A Text book of Applied Mechanics, Laxmi Publications, 2011.

		L	**T**	**P**	**Cr.**
B.Tech. (II Sem.)	**20MC01 - CONSTITUTION OF INDIA**	2	0	0	0

Course Objectives

• To enable the student to understand the importance of constitution.

• To understand the structure of Executive, Legislature and Judiciary.

• To understand Philosophy of fundamental rights and duties.

• To understand the autonomous nature of constitution bodies like SupremeCourt and High Court Controller and Auditor General of India and ElectionCommission of India.

• To understand the Central and State relation, financial and administrative.

Course Outcomes: At the end of the course, the student shall be able to

Upon successful completion of the course, the students will be able to

CO1: Understand history and philosophy of constitution with reference to Preamble,Fundamental Rights and Duties (**Understand – L2**).

CO2: Understand the concept of Unitary and Federal Government along with therole of President, Prime Minister and Judicial System (**Understand – L2**).

CO3: Understand the structure of the state government, Secretariat, Governor and Chief Ministerand their functions (**Understand – L2**).

CO4:learn local administration viz. Panchayat, Block, Municipality and Corporation (**Understand – L2**).

CO5:learn about Election Commission and the process and about SC, ST, OBCand women (**Understand – L2**).

UNIT – I:

Introduction to Indian Constitution: 'Constitution' meaning of the term, IndianConstitution – Sources and Constitutional History, Features – Citizenship,Preamble, Fundamental Rights and Duties, Directive Principles of State Policy.

UNIT – II:

Union Government and its Administration Structure of the Indian Union: FederalismCentre – State relationship, President: Role, Power and Position. Prime Minister(PM) and Council of Ministers, Cabinet and Central Secretariat, Lok Sabha, RajyaSabha. The Supreme Court and High Court: Powers and Functions.

UNIT – III:

State Government and its Administration Governor – Role and Position – ChiefMinister (CM) and Council of Ministers. State Secretariat: Organization, Structureand Functions.

UNIT – IV:

A Local Administration – District's Administration Head – Role and Importance,Municipalities – Mayor and Role of Elected Representative – Chief ExecutiveOfficer (CEO) of Municipal Corporation Panchayati Raj : Functions PanchayatiRaj Institution (PRI), Zilla Panchayat, Elected Officials and their roles, CEO ZillaPanchayat: Block level organizational Hierarchy – (Different Departments), Villagelevel – Role of Elected and Appointed officials – Importance of grass root democracy.

UNIT – V:

Election Commission: Election Commission – Role of Chief Election Commissionerand Election Commissionerate State Election Commission: Functions andCommissions for the welfare of SC/ST/OBC and Women.

Reference Books

1. Durga Das Basu, Introduction to the Constitution of India, Prentice – Hall ofIndia Pvt.Ltd., New Delhi.

2. Subash Kashyap, Indian Constitution, National Book Trust.

3. J.A. Siwach, Dynamics of Indian Government and Politics.

4. D.C. Gupta, Indian Government and Politics.

5. H.M.Sreevai. Constitutional Law of India, 4th edition in 3 volumes (UniversalLaw Publication).

6. J.C. Johari, Indian Government and Politics Hans.

7. J.Raj, Indian Government and Politics.

8. M.V. Pylee, Indian Constitution, Durga Das Basu, Human Rights inConstitutional Law, Prentice – Hall of India Pvt. Ltd., New Delhi.

9. Noorani, A.G. (South Asia Human Rights Documentation Centre), Challengesto Civil Right). Challenges to Civil Rights Guarantees in India, OxfordUniversity Press 2012.

E-Resources:

1. nptel.ac.in/courses/109104074/8.

2. nptel.ac.in/courses/109104045.

3. nptel.ac.in/courses/101104065.

4. www.hss.iitb.ac.in/en/lecture-details.

5. www.iitb.ac.in/en/event/2nd-lecture-institute-lecture-series-indianconstitution.

* * *

	L	T	P	Cr.
B.Tech. (II Sem.) **20FE51 - PROFESSIONAL COMMUNICATION SKILLS LAB**	0	0	2	1

Pre-requisites : Nil

Course Educational Objective: To improve the proficiency of students in English with an emphasis on better communication in formal and informal situations; Develop speaking skills required for expressing their knowledge and abilities and to face interviews with confidence.

Course Outcomes: At the end of this course, the student will be able to

CO1: Introduce oneself and others using appropriate language and details (**Understand – L2**)

CO2: Comprehend short talks and speak clearly on a specific topic using error free English(**Understand – L2**)

CO3: Report effectively after participating in informal discussions ethically (**Remember –L1**)

CO4: Interpret data aptly, ethically & make oral presentations (**Apply – L3**)

Syllabus: Professional Communication Skills Lab (PCS) shall have two parts:

- **Computer Assisted Language Learning (CALL) Lab** for 60 students with 60 systems, LAN facility and English language software for self- study by learners.
- **Interactive Communication Skills (ICS) Lab** with movable chairs and audio-visual aids with a P.A System, a T. V., a digital stereo – audio & video system and camcorder etc.

Exercise – I

CALL Lab: Understand - Sentence structure

ICS Lab: Practice - Listening: Identifying the topic, the context and specific information
Speaking: Introducing oneself and others

Exercise – II

CALL Lab: Understand - Framing questions

ICS Lab: Practice - Listening: Answering a series of questions about main idea and supporting ideas after listening to audio text
Speaking: Discussing in pairs/small groups on specific topics; Delivering short structured talks using suitable cohesive devices (JAM)

Exercise – III

CALL Lab: Understand - Comprehension practice – Strategies for Effective Communication

ICS Lab: Practice - Listening: Listening for global comprehension and summarizing
Speaking: Discussing specific topics in pairs/small groups, reporting what is discussed

Exercise – IV

CALL Lab: Understand- Features of Good Conversation – Strategies for Effective Communication.

ICS Lab: Practice -Listening: Making predictions while listening to conversations/transactional dialogues with/without video
Speaking: Role – plays – formal & informal – asking for and giving information / directions / instructions / suggestions

Exercise – V

CALL Lab: Understand - Features of Good Presentation, Methodology of Group Discussion
ICS Lab: Practice - Introduction to Group Discussions
Listening: Answering questions, identifying key terms and understanding concepts
Speaking: Formal Oral & Poster presentations on topics from academic contexts without the use of PPT

Lab Manual:

1. Prabhavati. Y & et al, "English All Round – Communication Skills for Undergraduate Learners", Orient BlackSwan, Hyderabad, 2019.

Suggested Software:

1. Digital Mentor: Globarena, Hyderabad, 2005
2. Sky Pronunciation Suite: Young India Films, Chennai, 2009
3. Mastering English in Vocabulary, Grammar, Spelling, Composition, Dorling Kindersley,USA,2001
4. Dorling Kindersley Series of Grammar, Punctuation, Composition, USA, 2001
5. Oxford Talking Dictionary, The Learning Company, USA, 2002
6. Learning to Speak English - 4 CDs. The Learning Company,USA,2002
7. Cambridge Advanced Learners English Dictionary (CD). Cambridge University Press, New Delhi,2008.

L	T	P	Cr.
0	0	3	1.5

B.Tech.(II Sem.)   **20FE55 - ENGINEERING PHYSICS LAB**

Pre - requisites: Nil

Course Educational Objectives: This course enables the students to acquire theoretical ideas, analytical techniques, and graphical analysis, by completing a host of experiments with the procedures and observational skills for appropriate use of simple and complex apparatus.

Course Outcomes: At the end of the course, the student will be able to,
CO1: Analyze the wave characteristics of light**(Understand – L2).**
CO2: Determine the wavelength of laser source and width of slit**(Apply - L3).**
CO3: Estimate the magnetic field using Stewart's and Gee's apparatus and the rigidity modulus of material using Torsional Pendulum**(Understand - L2).**
CO4: Identify the phenomena of resonance in strings**(Understand – L2).**
CO5: Improve report writing skills and individual team work with ethical values**(Understand – L2)**

List of Experiments
(Any of the 10 experiments are required to be conducted)

General experiments:

1. Determine the frequency of AC supply by using Sonometer.
2. Verification of Laws of vibrations in stretched strings - Sonometer.
3. Determine the frequency of a tuning fork by using Melde' s arrangement.
4. Study the magnetic field along the axis of a current carrying circular coil using Stewart's& Gee's apparatus and to verify Biot - Savart's law.
5. Determine the rigidity modulus of a given material using Torsional pendulum.
6. Determination of Young's modulus by the method of single Cantilever oscillations.
7. Measurement of magnetic susceptibility by Gouy's method.
8. Determination of ultrasonic velocity in Liquid.
9. Determination of dielectric constant by charging and discharging method.
10. Determination of velocity of sound by Volume resonator method.

Optics lab experiments:

11. Determine the wavelength of a laser radiation.
12. Determine the width of a single slit by forming diffraction pattern.
13. Determine the acceptance angle and numerical aperture of a fiber.
14. Measure the bending losses in the optical fiber cable at different wavelengths.

L	T	P	Cr.
0	0	3	1.5

B.Tech. (II Sem.)   **20CS51 - PROGRAMMING FOR PROBLEM SOLVING USING C LAB**

Pre-requisite : NIL

Course Educational Objective: The objective of the course is to learn the basic elements of C Programming Structures like Data Types, Expressions, Control Statements, and Various I/O Functions and to solve simple mathematical problems using control structures. Design and implementation of various software components, which solve real world problems.

Course Outcomes (CO): At the end of this course, the student will be able to:

CO1: Apply control structures of C in solving computational problems.(**Apply - L3**)

CO2: Implement derived data types & use modular programming in problem solving(**Apply- L3**)

CO3: Implement user defined data types and perform file operations.(**Apply- L3**)

CO 4: Improve individual / teamwork skills, communication & report writing skills with ethical values.(**Apply- L3**)

# of modules at most 10 can be taught and all the modules should be in line with theory.

Module 1: Introduction to Raptor Tool.

Module 2: Problem solving using Raptor Tool.

Module 3: Exercise Programs on Basics of C-Program.

Module 4: Exercise Programs on Control Structures.

Module 5: Exercise Programs on Loops & nesting of Loops.

Module 6: Exercise Programs on Arrays & Strings.

Module 7: Exercise Programs on Pointers.

Module 8: Exercise Programs on Functions.

Module 9: Exercise Programs on user defined data types.

Module 10: Exercise Programs on Files.

	L	T	P	Cr.
B.Tech. (II Sem.) **20ME52 - ENGINEERING MECHANICS AND FUEL TESTING LAB**	0	0	3	1.5

PRE-REQUISITES: Engineering Mechanics, Applied Chemistry

COURSE EDUCATIONAL OBJECTIVE:

The main objective of this course is to demonstrate the concepts of Engineering Mechanics and fuels through experiments.

COURSE OUTCOMES:
At the end of the course, the student will be able to:

CO1: Verify the basic laws of Mechanics in static environment. **(Apply-L3)**

CO2: Evaluate the forces in the mechanical systems. **(Apply-L3)**

CO3: Estimate various properties of fuel like Viscosity Flash and Fire point. **(Apply-L3)**

CO4: Determine calorific-value of fuels. **(Apply-L3)**

LIST OF EXPERIMENTS:
At least 10 experiments are to be conducted

1. Verification of polygon law of forces using Universal-Table apparatus.
2. Verification of Lami's Theorem.
3. Study of the equilibrium of parallel forces using Beam Reaction apparatus.
4. Determination of coefficient of friction between the two materials using Tilting-plane method.
5. Estimate Time period of oscillations of a simple and compound pendulum.
6. Verification of Newton 's second law.
7. Determination of viscosity of given oil using Saybolt Viscometer.
8. Determination of Calorific value of given fuel using Junkers Gas Calorimeter.
9. Determination of viscosity of given oil using Red-wood-II Viscometer.
10. Determination of viscosity of given oil using Englers Viscometer.
11. Determination of Flash and Fire point of given oil using ABELS Apparatus.
12. Determination of Calorific value of given fuel using BOMB Calorimeter.

REFERENCES:

Lab-Manual

	20FE10-NUMERICAL METHODS AND INTEGRAL CALCULUS (Common to AE, CE, EEE, ECE, MECH)	L	T	P	Cr.
R20					
B.Tech.(III Sem.)		2	1	--	3

Pre-requisites : **None**

Course Educational Objective: The main objective of this course is to enable the students learn Numerical Techniques for solving the equations and apply interpolation techniques. They will also learn about the Fourier analysis of single valued functions, Multiple Integrals in different coordinate systems and Vector differentiation.

Course Outcomes: At the end of the course, the student will be able to:

CO1: Estimate the best fit polynomial for the given tabulated data using Interpolation.**(Understanding-L2)**

CO2: Apply numerical techniques in solving of equations and evaluation of integrals. **(Applying-L3)**

CO3: Discriminate among Cartesian, Polar and Spherical coordinates in multiple integrals and their respective applications to areas and volumes.**(Applying-L3)**

CO4: Generate the single valued functions in the form of Fourier series and obtain Fourier series representation of periodic function.**(Applying-L3)**

CO5: Evaluate the directional derivative, divergence and angular velocity of a vector function.**(Applying-L3)**

UNIT – I
Interpolation and Finite Differences
Interpolation: Introduction – Finite differences- Forward Differences- Backward Differences-Central differences – Symbolic relations and separation of symbols-Differences of a polynomial-Newton's formulae for interpolation – Lagrange's Interpolation formula.

UNIT – II
Numerical Solution of Equations and Numerical Integration
Solutions of Algebraic and Transcendental Equations – Regula Falsi method and Newton Raphson Method in one variable.
Numerical Integration
Trapezoidal rule – Simpson's 1/3 Rule –Simpson's 3/8 Rule.

UNIT – III
Multiple Integrals
Multiple integrals - double and triple integrals (Cartesian, polar, spherical coordinates) – Changing the order of Integration.

UNIT IV
Fourier series
Determination of Fourier coefficients – Fourier series – even and odd functions – Fourier series in an arbitrary interval– Half-range sine and cosine series

UNIT – V
Vector Differentiation
Vector Differentiation: Gradient- Directional Derivatives -Divergence – Solenoidal fields- Curl – Irrotational fields-potential surfaces - Laplacian and second order operators

Text Books:

1. B.S. Grewal, "Higher Engineering Mathematics", 42ndEdition, Khanna Publishers, New Delhi, 2012.
2. B. V. Ramana, "Higher Engineering Mathematics", 1stEdition, TMH Publications, New Delhi, 2010.
3. S. S. Sastry, "Introductory Methods of Numerical Analysis" 5th Edition, PHI Learning Private Limited, New Delhi, 2012.

Reference:

1. M. D. Greenberg, " Advanced Engineering Mathematics", 2nd Edition, TMH Publications, New Delhi,2011.
2. Erwin Krezig, "Advanced Engineering Mathematics" , 8th Edition, John Wiley & sons, New Delhi,2011.
3. W.E. Boyce and R. C. Diprima, " Elementary Differential Equations" , 7th Edition, John Wiley & sons, New Delhi,2011.

R20	20ME03 - FLUID MECHANICS AND HYDRAULIC MACHINERY	L	T	P	Cr.
B.Tech. (III Sem.)		2	1	--	3

Pre Requisites: Engineering Physics and Mathematics

Course Educational Objective: To understand the fundamental concepts of fluid mechanics, various flow measuring devices, boundary layer separation and performance characteristics of hydraulic machines.

Course Outcomes:
After completion of the course the students are able to
CO1: Understand the fundamentals of fluid mechanics and dimensional analysis and similarity concepts. **(Understanding-L2)**
CO2: Comprehend the kinematics and dynamics of fluid flows. **(Understanding - L2)**
CO3: Analyze boundary layer flow and friction losses in pipes. **(Analyzing-L4)**
CO4: Apply impulse momentum concept to impact of jet problems. **(Applying-L3)**
CO5: Evaluate the performance parameters of hydraulic turbines and pumps. **(Applying-L3)**

UNIT-I
FLUID STATICS: Dimensions and Units: Physical Properties of Fluids-Specific Gravity, Viscosity, Surface Tension, Vapour Pressure and their Influence on Fluid Motion, Atmospheric Gauge and Vacuum Pressure – Measurement of Pressure – Piezometer, U-Tube and Differential Manometers.
DIMENSIONAL ANALYSIS AND SIMILARITY: Introduction, Principle of dimensional homogeneity, Rayleigh's method, Buckingham's Pi theorem method.

UNIT-II
FLUID KINEMATICS: Stream Line, Path Line, Streak Line, Stream Tube, Classification of Flows -Equation of Continuity for One Dimensional Flows.
FLUID DYNAMICS: Surface and Body Forces-Euler's Equation, Bernoulli's Equations For Flow along a Stream Line, Momentum Equation and Its Application on Force on Pipe Bend. Reynolds Experiment, Darcy's -Weisbach Equation-Minor Losses In Pipes, Pipes In Series, Parallel-Total Energy Line-Hydraulic Gradient Line, Measurement Of Flow-Pitot Tube, Venturimeter, Orifice Meter.

UNIT-III
BOUNDARY LAYER FLOW: Laminar and Turbulent Boundary Layer, Boundary Layer Thickness, Displacement Thickness, Energy Thickness, Momentum Thickness, Boundary Layer Separation.
IMPACT OF JETS: Hydro dynamic forces of Jets on Stationary and moving flat, Inclined, Curved vanes, Jet striking centrally and a tip for Symmetrically and Un-symmetrically vanes, Velocity diagrams, work done and efficiency, Flow over radial vanes.

UNIT-IV

HYDRAULIC TURBINES: Classification of Turbines, Pelton Wheel, work done and efficiencies of Pelton Wheel, Working proportions of Pelton Wheel, Francis Turbine, work done andEfficiencies of Francis Turbine, Working proportions of Francis Turbine, Kaplan Turbine, work done, heads and efficiencies.

PERFORMANCE OF THE HYDRAULIC TURBINES: Specific speed, Specific Quantities, Unit Quantities, Draft Tube and its types, Performance characteristic curves, Governing of Turbines, Cavitations in Turbines.

UNIT-V

CENTRIFUGAL PUMPS: Working of Centrifugal Pumps, Types of Centrifugal Pumps, Work done by The Impeller –Losses and Efficiencies, Specific Speed, Pumps in Series and Parallel.
RECIPROCATING PUMPS: Main components and working of a Reciprocating Pumps, Types of Reciprocating Pumps, work done by Reciprocating Pump, Percentage of Slip and Negative slip of pump.

TEXTBOOKS
1. P.N.Modi and S.M.Seth, Hydraulics, "Fluid Mechanics and Hydraulic Machinery, 15th Edition, Standard Book House, 2004.
2. Philip J, Robert W.fox, Fluid mechanics, 7th edition, John Wiley & sons, 2011.

REFERENCES
1. R.K.Bansal, "Fluid Mechanics and Hydraulic Machines", 9th Edition, laxmi publications.
2. Banga & Sharma, "Hydraulic Machines", Edition, Khanna publishers, 6th Edition, 1999.
3. Rama Durgaiah, "Fluid Mechanics and Machinery", Edition, New Age International, 1st edition, 2006.
4. D.S.Kumar, "Fluid Mechanics and Fluid power engineering", 5th Edition, S.K.Kataria& Sons.

	20ME04 – THERMODYNAMICS	**L**	**T**	**P**	**Cr.**
R20 **B.Tech. (III Sem.)**		2	1	--	3

Pre-requisites : Engineering Physics

Course Educational Objective:
To provide an intuitive understanding of thermodynamics to emphasize on physics of thermodynamic systems and this covers the heat and work interactions. It also provides insights on laws of thermodynamics and its applications, properties of pure substances, ideal gases and different thermodynamic cycles.

Course Outcomes (COs):
At the end of the course, the student will be able to:

CO1: Classify the various thermodynamic systems, properties and processes with examples and temperature scale of a system.**[Remembering-L1]**

CO2: Differentiate open and closed system and built up the heat and work transfer relations of thermal systems.**[Understanding-L2]**

CO3: Apply the laws of thermodynamics to find the thermodynamic properties and parameters of various thermal systems. **[Applying-L3]**

CO4: Understand the properties of pure substance and gases to compute the non reactive mixture parameters.**[Understanding-L2]**

CO5: Analyse the performance parameters of various thermodynamic cycles.**[Analyzing-L4]**

UNIT – I
Basic Concepts and Zeroth Law of Thermodynamics
Basic Concepts: Introduction, Classification of thermodynamic systems, Macroscopic and Microscopic view point, Control mass, Control volume, Properties of system, State, Change of state, Path, Process - reversible and irreversible processes, Quasi static process, Equilibrium, Path and Point Functions, Specific Heat, Internal Energy, Enthalpy.
Zeroth Lawof Thermodynamics: Introduction, Zeroth law of thermodynamics, Measurementof temperature, comparison of thermometers, working of constant volume gas thermometer, Advantages of gas thermometers over liquid thermometers and Thermocouple.

UNIT – II
First Law of Thermodynamics
First Law Analysis of Closed Systems: Introduction**,** First law for a closed system undergoing change of state and cycle, Representation of Thermodynamic processes on P-V planes, Different forms of stored energy, Forms of energy, Mechanical and Non mechanical forms of Work transfer, pdV work and other types of work transfer.
First Law Analysis of Open Systems: Introduction**,** Control Volume**,** Flow work ,Steady Flow Process, Mass and Energy balance in simple steady flow process -Steady Flow Energy Equation (SFEE), Steady Flow Engineering Devices-Nozzles, Diffusers, Turbine, Compressors, Throttling Valves, Heat Exchangers, Limitations on first law of thermodynamics,PMM1.

UNIT – III
Second Law of Thermodynamics
Second Law Analysis of Thermodynamics: Introduction, Energy Reservoirs, Heat Engines, Refrigerators, Heat Pumps, Kelvin-Planck & Clausius Statements of Second law of Thermodynamics, Equivalence of Kelvin-Plank and Clausius Statements, Differences between Reversibility and Irreversibility, Carnot Cycle, Carnot Theorem, PMM II.

Entropy: Introduction, Characteristics of entropy, Principle of increase of entropy, t-s plot of different processes, TdS relations, Entropy change for ideal gases, Clausius inequality, Applications of Entropy principle, Entropy and disorder.

UNIT – IV
Properties of Pure Substances and Gases
Properties of Pure Substance: Introduction, Phases of pure substance, *p-v, p-T, T-s* and *h-s* diagrams for pure substance, *p-v-T* Surface, Properties of steam, quality or dryness fraction, phase change processes, Mollier diagram for a pure substance.

Properties of Ideal Gases: Equation of state of a gas, Avogadro's law, Ideal gas, perfect gas, real gas, properties of mixture of gases – Dalton's law and Amagat's law of partial pressures, Internal energy, enthalpy and specific heats of gas mixtures, Entropy of gas mixtures.

UNIT – V
Thermodynamic Cycles

Introduction**,** working of Carnot vapour cycle, working of simple Rankine cycle, Problems on Carnot vapour cycle and simple Rankine cycle, Gas power cycles -Otto, Diesel, Dual and Brayton Cycle, Refrigeration Cycles - Reversed Carnot cycle, Bell-Coleman cycle and simple vapour compression refrigeration Cycle (Theory).

TEXT BOOKS
1.P.K.Nag, "Engineering Thermodynamics"- McGraw-Hill. 6th Edition, 2017

2.Y.A. Cengel, and M.A.Boles, "Thermodynamics: An Engineering Approach", McGraw-Hill,8th Edition, 2017.

REFERENCES
1. G.J.Van Wylen & Sonntag, "Fundamentals of Thermodynamics", John Wiley& sons, publications Inc. 5th Edition 1998.
2.E.Rathakrishnan, "Fundamentals of Engineering Thermodynamics", PHI, 2nd Edition, 2010.
3. R.K.Rajput, Engineering Thermodynamics, Laxmi Publications (P) Ltd, 3rd Edition 2007.

R20	20ME05- METALLURGY AND MATERIAL SCIENCE	L	T	P	Cr.
B.Tech. (III Sem.)		3	-	-	3

Prerequisite Subject: Engineering Physics, Engineering Chemistry

Course Educational Objectives: The objective of this course is to acquire knowledge on the structure, properties and applications of metals and alloys and also understand the effect of mechanical working and heat treatment on materials.

Course Outcomes:

After completion of the course students will be able to:

1. Comprehend the structure of materials, alloys and correlated the material properties with structure.**(Remembering-L1)**
2. Illustrate the procedure of drawing the equilibrium diagrams and apply the principle of equilibrium diagrams in evaluating the materials properties.**(Understanding-L2)**
3. Recall the properties, applications of ferrous, non ferrous and composite materials.**(Remembering-L1)**
4. Apply the principle of mechanical working on metals and heat treatment on materials.**(Applying-L3)**
5. Identify the types of composite materials and the manufacturing processes of fiber reinforced composites.**(Understanding-L2)**

UNIT – I

STRUCTURE OF METALS: Crystal structures-Body cantered cubic, Face cantered cubic, closed packed hexagonal, crystallographic planes. Mechanism of crystallization of metals, grain and grain boundaries, Effect of grain boundaries on the properties of metal / alloys – Determination of grain size.

CONSTITUTION OF ALLOYS: Necessity of alloying, Solid solutions-Interstitial Solid Solution and Substitution Solid Solution, Hume Rothery's rules.

UNIT – II

EQUILIBRIUM DIAGRAMS: Experimental methods of construction of equilibrium diagrams, Classification of equilibrium diagrams- isomorphous, eutectic, partial eutectic equilibrium diagrams. Equilibrium cooling and heating of alloys, lever rule, coring. Transformations in the solid state – allotropy, eutectic, eutectoid, peritectoid reactions. Study of Cu-Ni and Bi-Cd equilibrium diagrams.

UNIT – III

FERROUS METALS AND ALLOYS: Study of Iron-Iron carbide equilibrium diagram

STEEL: Classification of steels, structure, properties and applications of plain carbon steel-low carbon steel, medium carbon steel and high carbon steel.

CAST IRONS: Structure, properties and applications of white cast iron, malleable cast iron, grey cast iron, spheroidal graphite cast iron.

NON-FERROUS METALS AND ALLOYS: structure, properties and applications of copper and its alloys, Aluminium and its alloys.

UNIT - IV

MECHANICAL WORKING: Hot working, Cold working, Strain hardening, Recovery, Recrystallisation and Grain growth. Comparison of properties of cold and hot worked parts.

HEAT TREATMENT OF ALLOYS: Annealing, normalizing and hardening. Construction of TTT diagram for eutectoid steel. Hardenability- jominy end quench test. Surface - hardening methods and age hardening treatment and application.

UNIT – V

COMPOSITE MATERIALS: Classification of composites, various methods of component manufacture of fiber reinforced composites-Hand layup process, Filament winding process, SMC processes, Continuous pultrusion processes, Resin transfer moulding.

TYPES OF COMPOSITES: Introduction to metal ceramic mixtures, Metal – Matrix composites and C – C composites and applications

TEXT BOOKS:

1. Sidney H. Avener, Introduction to Physical Metallurgy, Tata McGraw-Hill, 3rdEdition, 2011.
2. V.D.Kotgire, S.V.Kotgire, Material Science and Metallurgy, Everest Publishing House, 24th Edition, 2008.

REFERENCES:

1. Richard A.Flinn, Paul K.Trojan, Engineering Materials and Their Applications, Jaico Publishing House, 4thEdition, 1999.
2. William and callister, Materials Science and engineering, Wiley India private Ltd., 2011.
3. U.C Jindal and Atish Mozumber, Material since and metallurgy, Pearson education- 2012

R20	20ME06- MECHANICS OF SOLIDS	L	T	P	Cr.
B.Tech. (III Sem.)		2	1	-	3

Pre-requisites   : Engineering Mechanics

Course Educational Objective:
The objective of the course is to identify nature of the stress and compute the deformations in mechanical members due to various loads.

Course Outcomes:
At the end of the course, the student will be able to:
CO1   :   Compute the stresses and deformations of a member subjected to various types of loading. **(Applying-L3)**
CO2   Construct the shear force and bending moment diagrams along the length of beam. **(Applying-L3)**
CO3   :   Comprehend the variation of bending and shear stresses across the cross section of the beams. **(Understanding-L2)**
CO4   :   Analyze the structural members subjected to biaxial stresses.**(Analyzing-L4)**
CO5   :   Formulate the equations for stresses and deformations due to various loads. **(Applying-L3)**

UNIT- I
SIMPLE STRESSES AND STRAINS: Stress and strain due to axial force, Hooke's law, Strains, Poisson's ratio, Stepped bars - Stresses in composite bars due to axial force - Relationship between elastic constants.

UNIT - II
SHEAR FORCE AND BENDING MOMENT: Relationship between loading, shear force and bending moment - Shear force and bending moment diagrams for cantilever, simply supported beams subjected to concentrated loads and uniformly distributed loads only - Maximum bending moment and Point of contra flexure.

UNIT – III
STRESSES IN BEAMS: Theory of simple bending - Assumptions - Derivation of flexure equation – Section modulus - Normal stresses due to flexure applications.
SHEAR STRESSES: Derivation of formula – Shear stress distribution across beam cross sections like Rectangular, Circular sections only.

UNIT - IV
ANALYSIS OF COMBINED STRESSES: State of plane stress at a point in stressed body, Normal and Tangential stresses on inclined planes - Principal stresses and their planes - Plane of maximum shear.

UNIT - V
DEFLECTION OF BEAMS: Differential equation of elastic line - Deflection in statically determinate beams – Double Integration method - Macaulay's method.
THIN AND THICKCYLINDRICAL SHELLS: Hoop stress and longitudinal stress- Thin and Thick cylinders –Lame's equations.

TEXT BOOKS

1. E.P. Popov, Engineering Mechanics of Solids, PHILearning, 2009.
2. Sadhu Singh, Strength of Materials, Khanna Publishers, 2013.

REFERENCES

1. S.Ramamrutham, Strength of Materials,DhanpatRai& Sons, 2011.
2. M.L. Gambhir, Fundamentals of Solid Mechanics, PHI Learning, 2009
3. M.Chakraborti, "Strength of Materials", S.K.Kataria& Sons.
4. R.Subramanian, "Strength of Materials", Oxford University Press, 2010.
5. R.K.Bansal, "Strength of Materials", Laxmi Publishers, 2013.

		L	T	P	Cr.
R20					
B.Tech. (III Sem.)	**20MC02-ENVIRONMENTAL SCIENCE**	2	-	-	0

Course Objectives:

In this course the student will learn about

- Environmental issues like over population, human health etc related to local, regional and global levels.
- The necessity of resources, their exploitation and sustainable management.
- The interactions of human and ecosystems and their role in the food web in the natural world.
- The global biodiversity, threats to biodiversity and its conservation.
- Environmental problems like pollution, disasters and possible solutions.
- The importance of environmental decision making in organizations through audits.

Course Outcomes:

After the completion of this course, the students will able to

CO1: Identify environmental problems arising due to engineering and technological activities that help to be the part of sustainable solutions.**(Remembering-L1)**

CO2: Evaluate local, regional and global environmental issues related to resources and their sustainable management.**(Understanding-L2)**

CO3: Realize the importance of ecosystem and biodiversity for maintaining ecological balance.**(Understanding-L2)**

CO4: Acknowledge and prevent the problems related to pollution of air, water and soil.**(Applying-L3)**

CO5: Identify the significance of implementing environmental laws and abatement devices for environmental management.**(Understanding-L2)**

Unit I

Nature and scope of Environmental Problems

- Introduction to Environmental Science
- Population explosion, variations among nations
- Resettlement and Rehabilitation - Issues and possible solutions
- Environmental hazards – causes and solutions. Biological hazards – AIDS, Malaria, Chemical hazards- BPA, PCB, Phthalates, Mercury, Nuclear hazards- Risk and evaluation of hazards.
- Role of Information Technology in environmental management and human health

Unit II

Natural Resources and Conservation

- Introduction and classification of Natural Resources
- Forest resources: Use and over-exploitation, deforestation, Timber extraction, mining, dams and their effects on forests and tribal people
- Water resources: Use and over-utilization of surface and ground water, conflicts over water, interlinking of rivers, dams-benefits and problems, Rain water harvesting
- Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources
- Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, soil salinity

- Energy resources: Growing energy needs renewable, non-renewable and alternate energy resources

Unit III
Ecology and Biodiversity

- Structure and functions of an Ecosystem, Food chains and Food webs, Ecological succession, Ecological pyramids, Biogeochemical cycles
- Biodiversity, Values of biodiversity, Bio geographical classification of India. Endangered and endemic species of India, Threats to biodiversity; Man and wild life conflicts, Conservation of biodiversity: In-situ and Ex-situ conservation methods

Unit IV
Environmental Pollution

- Introduction to Environmental Pollution Causes, effects and control measures of:
  Air pollution, Water pollution, Noise pollution, Solid Waste Management – Sources, Classification, effects and control measures of Municipal solid waste, Biomedical waste & Hazardous and e-waste, Disaster Management.

Unit V
Environmental Management

- Sustainable development and unsustainability
- Climate disruption, Green house effect, Ozone layer depletion and Acid rain. Stockholm Conference
- Environmental Impact Assessment (EIA)
- Green building
- Environmental Law- Air, Water, Wild life, Forest, and Environmental protection act

Text Books:

1. Anubha Kaushik, C.P.Kaushik, "*Perspectives in Environmental Studies*", 5nd edition, New age international publishers, Delhi, 2016.
2. G. Tyler Miller, Scott Spoolman, *"Introduction to Environmental Studies"*, 13th Edition, Cengage Learning, New Delhi, 2009.

Reference Books:

1. M. Anji Reddy, "*Textbook of Environmental Sciences and Technology*", 2nd Edition, BS Publications, Delhi 2011.
2. Deeshita Dave, P. Udaya Bhaskar, "*Environmental Studies*", 2nd Edition, Cengage Learning, New Delhi, 2012.
3. S.Deswal, A. Deswal, "*A Basic course in Environmental Studies*", 2nd Edition, Educational & Technical Publishers, Delhi, 2014.
4. R. Rajagopalan, *"Environmental Studies (From Crisis to Cure)"*, 3rd Edition, Oxford University Press, New Delhi, 2012.
5. De, A.K, *"Environmental Chemistry"*, 5th Edition, New Age International (P) Limited, New Delhi, 2003.
6. Dr.K.V.S.G. Murali Krishna, *"Environmental Studies"*, 1st Edition, VGS Techno Series, Vijayawada, 2010.
7. Mahua Basu, S.Xavier, "*Fundamentals of Environmental Studies*", 1st edition, Cambridge University Press, Delhi, 2016.

R20	20ME55 - FLUID MECHANICS AND HYDRAULIC MACHINERY LAB	L	T	P	Cr.
B.Tech. (III Sem.)		-	-	2	1

Pre-requisites : Engineering Mechanics

COURSE EDUCTIONAL OBJECTIVE:

Determine the discharge of various flow measuring devices, estimation of friction factor and performance parameters of hydraulic machines.

COURSE OUTCOMES:

After completion of the course students will be able to

CO1: Identify the need and use ofvarious flow measuring devices. **(Understanding-L2)**

CO2: Apply the Bernoulli's equation for energy balance of fluid flow system. **(Applying - L3)**

CO3: Determine the friction losses of fluid flow through different pipes.**(Applying-L3)**

CO4: Evaluate the performance characteristics of hydraulic pumps, turbines and impact of jets.**(Applying-L3)**

LIST OF EXPERIMENTS

Atleast 10 Experiments are required to be conducted.

1. Verification of Bernoulli's Theorem.
2. Calibration of Venturi meter.
3. Calibration of Orifice meter.
4. Determination of friction factor for a given pipe line.
5. Determination of loss of head due to sudden contraction in a pipe line.
6. Impact of jets on Vanes.
7. Performance Test on Pelton Wheel.
8. Performance Test on Kaplan Turbine.
9. Performance Test on Single Stage Centrifugal Pump.
10. Performance Test on Multi Stage Centrifugal Pump.
11. Performance Test on Reciprocating Pump.
12. Turbine flow meter.
13. Reynolds experiment.
14. Flow Visualization study using Water Flow Channel.

REFERENCES: Lab Manuals

				L	**T**	**P**	**Cr.**

R20

B.Tech. (III Sem.)

20ME56 - MECHANICS OF SOLIDS AND METALLURGY LAB

L	**T**	**P**	**Cr.**
-	-	3	1.5

Prerequisite Subjects: Mechanics of solids, Metallurgy and Material science

COURSE EDUCATIONAL OBJECTIVES:
The main objective of the course is to determine various mechanical properties of materials by testing under different load conditions and observe the microstructure of various materials and perform heat treatment of materials.

COURSE OUTCOMES:
After completion of the course students are able to:
CO1: Evaluate the mechanical properties of materials by conducting various tests.**(Applying-L3)**
CO2: Estimate the behaviour of various materials under different loading.**(Understanding-L2)**
CO3: Identify the material by observing the microstructure.**(Remembering-L1)**
CO4: Perform the hardness test and heat treatment of steels.**(Applying-L3)**

PART-A : MECHANICS OF SOLIDS
LIST OF EXPERIMENTS
Any6 Experiments are required to be conducted
1. Compression test on helical spring.
2. Tension test on mild steel rod.
3. Double shear test on metals.
4. Torsion test on mild steel rod.
5. Impact test on metal specimen.
   (a) Izod Impact Test (b) Charpy Impact Test
6. Hardness test on metals. (a) Rockwell Hardness Test (b) Brinell Hardness Test
7. Deflection test on beams. (a) Cantilever Beam (b) Simply Supported Beam
8. Compression test on brittle materials.

PART-B: METALLURGY
Any 6 Experiments are required to be conducted
1. Preparation and study of the microstructure of pure metals like Iron, Cu and Al.
2. Preparation and study of the microstructure of low carbon steels, medium carbon steel and high carbon steels.
3. Study of the microstructures of gray cast iron, malleable cast iron and nodular cast iron.
4. Study of the microstructures of brass.
5. Study of the microstructures of heat treated steels.
6. Hardenability of steels by Jominy end quench test.
7. Hardness of various treated and untreated steels.

REFERENCE BOOKS
    Lab Manual

	L	T	P	Cr.
B.Tech. (III Sem.) **20AD53 - Programming using Python Lab**	1	-	2	2

Pre-requisite   :   Programming languages like C Language.

Course Educational Objective:

The Objective of Python course is to lead the students from the basics of writing and running Python scripts in problem solving and also to design and implement the modules and understands the working of classes and objects in python.

Course Outcomes (COs):*At the end of the course, the student shall be able to*

CO 1:   Identify various programming constructs available in Python and apply them in solving computational problems. (**Apply - L3**)

CO 2:   Demonstrate data structures available in Python and apply them in solving computational problems. (**Apply - L3**)

CO 3:   Implement modular programming, string manipulations and Python Libraries (**Apply - L3**)

CO 4:   Improve individual / teamwork skills, communication & report writing skills with ethical values.

Introduction: Language basics and example problems (Two weeks)

Implement Python Script for checking the given year is leap year or not.

Implement Python Script for finding biggest number among 3 numbers.

Implement Python Script for displaying reversal of a number.

Implement Python Script to check given number is Armstrong or not.

Implement Python Script to print sum of N natural numbers.

Implement Python Script to check given number is palindrome or not.

Implement Python script to print factorial of a number.

Implement Python Script to print all prime numbers within the given range.

Implement Python Script to calculate the series: S=1+x+x2+x3+.......xn

Implement Python Script to print the following pattern:

```
        *
      *   *
    *   *   *
```

Modue 1:   Exercise Programs on Lists.

Write a Python script to display elements of list in reverse order.

Write a Python script to find the minimum and maximum elements without using built-in

operations in the lists.

Write a Python script to remove duplicates from a list.

Write a Python script to append a list to the second list.

Write a Python script to count the number of strings in a list where the string length is 2 or more.

Module 2:   Exercise Programs on Tuples.

Write a Python script to create a tuple with different data types.

Write a Python script to find the repeated items of a tuple.

Write a Python script to replace last value of tuples in a list.

Sample list: [(10, 20, 40), (40, 50, 60), (70, 80, 90)]

 Expected Output: [(10, 20, 100), (40, 50, 100), (70, 80, 100)]

Write a Python script to sort a tuple by its float element.

Sample data: [('item1', '12.20'), ('item2', '15.10'), ('item3', '24.5')]

Expected Output: [('item3', '24.5'), ('item2', '15.10'), ('item1', '12.20')]

Module 3:   Exercise Programs on Sets.

Write a Python script to add member(s) in a set.

Write a Python script to perform Union, Intersection, difference and symmetric difference of given two sets.

Write a Python script to test whether every element in S is in T and every element in T is in S.

Module 4:   Exercise Programs on Dictionaries

Write a Python script to sort (ascending and descending) a dictionary by value.

Write a Python script to check whether a given key already exists or not in a dictionary.

Write a Python script to concatenate following dictionaries to create a new one.

Sample Dictionary : dic1={1:10, 2:20} dic2={3:30, 4:40} dic3={5:50,6:60}

Expected Result : {1: 10, 2: 20, 3: 30, 4: 40, 5: 50, 6: 60}

Write a Python script to print a dictionary where the keys are numbers between 1 and 15 (both included) and the values are square of keys.

Write a Python program to map two lists into a dictionary.

Module 5:   Exercise Programs on functions and recursion.

a) Define a function max_of_three() that takes three numbers as arguments and returns the largest of them.

b) Write a program which makes use of function to display all such numbers which are divisible by 7 but are not a multiple of 5, between given range X and Y.

c) Define functions to find mean, median, mode for the given numbers in a list.

d) Define a function which generates Fibonacci series up to n numbers.

e) Implement a python script for factorial of number by using recursion.

f) Implement a python script to find GCD of given two numbers using recursion.

Module 6: Exercise programs on Strings

a) Implement Python Script to perform various operations on string using string libraries.

b) Implement Python Script to check given string is palindrome or not.

c) Implement python script to accept line of text and find the number of characters, number of vowels and number of blank spaces in it.

d)Implement python script that takes a list of words and returns the length of the longest one.

Module 7: Exercise programs on Regular Expressions

a) Write a Python script to check that a string contains only a certain set of characters (in this case a-z, A-Z and 0-9).

b) Write a Python script to check whether password is valid or not.

   Conditions for a valid password are:

   Should have at least one number.

   Should have at least one uppercase and one lowercase character.

   Should have at least one special symbol.

   Should be between 6 to 20 characters long.

Module 8 : Exercise programs on Matplotlib Library

a) Write a Python program to draw a line with suitable label in the x axis, y axis anda title.

b) Write a Python program to plot two or more lines with legends, different widths and colors.

c) Write a Python program to create multiple plots.

d) Write a Python programming to display a bar chart using different color for eachbar.

e) Write a Python programming to create a pie chart with a title.

f) Write a Python program to draw a scatter plot with empty circles taking a random distribution in X and Y and plotted against each other.

****

		L	T	P	Cr.
R20 **B.Tech. (III Sem.)**	**20MES1 – TECHNICAL DRAWING USING DRAFTING PACKAGE**	1	-	2	2

PRE-REQUISITES: Engineering Graphics

COURSE EDUCATIONAL OBJECTIVE:

      The main objective of this course is to improve the skill sets of students in drafting packages (Auto CAD/CATIA) and enable them to draw the diagrams related to mechanical engineering components/applications.

COURSE OUTCOMES: After completion of the course students will be able to:

CO1: Understand the Auto-CAD basics for 2D sketches used in industries. **(Understanding - L2).**

CO2: Draw the machine components using 3D modelling commands. **(Applying –L3)**

CO3: Edit the 3D solid Models using solid editing commands. **(Understanding - L2)**

CO4: Extract the Orthographic views of the models in Wire Frame, Surface & Solid Modelling. **(Applying –L3)**

Exercises to be conducted using Auto CAD software:

Expt. No.	Type of Drawings	Name of the Experiment
1.	Basic drawing Commands	Exercise on Basic Drawing Commands
2.	Modify commands	Exercise on Modify Commands
3.	Isometric Diagrams using 2D commands	Exercise on isometric views
4.	3D Modelling Commands	Exercise on 3D Modelling Commands-I
5.		Exercise on 3D Modelling Commands-II
6.		Exercise on 3D Modelling Commands-III
7.	3D Solid Editing Commands	Exercise on 3D Solid Editing Commands-I
8.		Exercise on 3D Solid Editing Commands-II
9.		Exercise on 3D Solid Editing Commands-III
10.	Wire Frame, Surface & Solid Modelling	Perform Wire Frame, Surface & Solid Modelling from 3D Models
11.	Drafting	Extraction of Ortho Graphics Views from 3D model-I
12.		Extraction of Ortho Graphics Views from 3D model-II

WEB REFERENCES:

1. https://www.slideshare.net/qarni888/auto-cad-introduction
2. https://www.slideshare.net/Vgroksoo7/presentation-on-auto-cad
3. https://www.autodesk.in/shortcuts/autocad
4. https://www.youtube.com/watch?v=uy2GvFwVJU4&list=PL970B66C256FA05E1
5. https://www.youtube.com/watch?v=HDTwvQ06zDI&list=PL970B66C256FA05E1&index=62

	20FE09-PROBABILITY AND STATISTICS		**L**	**T**	**P**	**Cr.**
R20	**(Common to AI&DS, CSE, IT & MECH)**					
B.Tech (IV Sem.)			3	--	--	3

Pre-requisite(s)   : None

Course Educational Objective: The objective of this course is to provide students with the foundations and applications of probabilistic and statistical methods mainly used in varied applications in engineering and science.

Course Outcomes: At the end of the course, the student will be able to

CO1: Understand various probabilistic situations using the various laws of probability and random variables **(Understand - L2)**

CO2: Apply probability distributions like Binomial, Poisson, Normal and Exponential distributions in solving engineering problems **(Apply - L3)**

CO3: Calculate the standard error of sampling distribution and confidence intervals for parameters like mean and proportion based on the sample data. **(Apply - L3)**

CO4: Analyze the data scientifically with the appropriate statistical methodologies to apply the suitable test of hypothesis **(Analyze - L4)**

CO5: Construct the regression lines to predict the dependent variables and calculate the Correlation Coefficient for a bivariate statistical data.**(Apply – L3)**

Unit-1:
Probability and Random variables
Probability, Sample space and events, Additive Rule, Conditional probability, Multiplicative rule, Baye's theorem.
Random variables – Discrete and continuous Random Variables, distribution function. Mathematical Expectation of one-dimensional Random Variable.

Unit-2:
Probability Distributions
Binomial distribution , Poisson distribution , Poisson approximation to Binomial distribution, Exponential distribution, Normal distribution , Normal approximation to Binomial distribution.

Unit-3:
Sampling distribution & Estimation
Population, sample, parameter, statistic, sampling distribution, Standard error, Types of sampling, Sampling distribution of means and sampling distribution of variance, Parameter estimations –point estimation and interval estimation for mean and proportions.

Unit-4:
Tests of Hypothesis
Hypothesis, Null and Alternate Hypothesis, , Type I and Type II errors, level of significance.
Z-test for means and proportions, t-test for single mean, difference of means, paired t-test, F-test for equality of population variances, χ^2 - test for goodness of fit and independence of attributes.

Unit-5:

Correlation & Regression

Karl Pearson's coefficient of correlation, linear Regression, Regression lines, Regression coefficients, Spearman's Rank correlation coefficient, Spearman's Rank correlation for repeated ranks.

Text books

1. Jay L.Devore "Probability and Statistics for engineering and the sciences", 8th edition, Cengage Learning India, 2012.
2. S.C.Gupta, V.K.Kapoor, "Fundamentals of Mathematical Statistics", 11thEdition, Sultan Chand and sons, New Delhi, 2014.

Reference Books

1. Miller & Freund's "Probability and Statistics for Engineers",8th edition. PHI, New Delhi,2011.
2. B.V. Ramana, "Higher Engineering Mathematics", 1st Edition, TMH, New Delhi, 2010

	L	T	P	Cr.

R20

B.Tech. (1V Sem.)　　　　**20ME07– APPLIED THERMODYNAMICS**

L	T	P	Cr.
2	1	-	3

PRE-REQUISITES : Thermodynamics

COURSE EDUCATIONAL OBJECTIVE: This course provides the analysis of vapour power cycle, principle of working, thermodynamic analysis, performance and applications of its components.

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO1: Describe the working of a vapour power cycles and identify the suitable fuels for power plants. **(Understanding-L2)**

CO2: Identify the need of various boilers and draught systems for a thermal power plant. **(Remembering-L1)**

CO3: Apply thermodynamic analysis to study the characteristics of steam nozzles and steam condensers. **(Applying-L3)**

CO4: Evaluate the performance characteristics of an impulse and reaction turbines. **(Applying-L3)**

CO5: Comprehend the different compressors used in thermal systems. **(Understanding-L2)**

UNIT – I

VAPOUR POWER CYCLES: Introduction, Carnot Vapour Power Cycle, Rankine Cycle, Actual Vapour Power Cycle, Methods to improve efficiency of Rankine cycle, Reheating of steam, Regeneration-Open and Closed Feed Water Heaters. Fuels used in power plant.

UNIT – II

BOILERS: Introduction, Boiler systems-Function and Classification, Fire Tube Cornish, Lancashire, Cochran, Water Tube-Babcock and Wilcox, High pressure boilers-Loeffler and Benson boilers, Boiler Mountings and Accessories.

DRAUGHT SYSTEM: Functions, Types, Natural Draft-Height of chimney for given draught and discharge, Condition for maximum discharge, Efficiency of chimney, artificial draught-induced and forced.

UNIT – III

STEAM NOZZLES: Introduction**,** Types of nozzle, Flow through nozzles-thermodynamic Analysis, velocity of nozzle at exit, condition for maximum discharge, critical pressure ratio, Ideal and actual expansion in nozzle, velocity coefficient.

STEAM CONDENSERS: Introduction, Elements of a condenser plant, Types of Condensers-Jet condensers, Surface Condensers–working principle.

UNIT – IV

STEAM TURBINES: Introduction, Classification.

IMPULSE TURBINES –Mechanical details, Working principle, Velocity diagram–effect of friction–power developed, axial thrust, blade or diagram efficiency–condition for maximum efficiency. De-Laval Turbine – its features. Method store ducerotor speed-velocity compounding (Curtis Turbine), Pressure compounding (Rateau Turbine) and pressure and velocity compounding.

REACTION TURBINES: Introduction, Parson's reaction turbine, performance analysis, degree of reaction, condition for maximum efficiency.

UNIT – V

COMPRESSORS– Introduction, Classification

RECIPROCATING COMPRESSORS: Principle of operation, Work required, Isothermal Efficiency, Volumetric efficiency and Effect of clearance volume, Multistage Compression.

ROTARY COMPRESSORS: Roots blower and Vane's sealed compressor-principle of working and applications. Centrifugal and Axial flow compressors: Construction, Principle of operation and applications.

TEXT BOOKS:

T1 Mahesh. M. Rathore, Thermal Engineering,1st Edition, 2012, TMH.

T2 R.K.Rajput, Thermal Engineering, 5th Edition, 2005, Laxmi publications.

REFERENCE BOOKS:

R1 T.D. Eastop and A. McConkey, Applied Thermodynamics, Pearson, 5th Edition, 2013.

R2 R. Yadav, Thermodynamics and Heat Engines, 5th Edition, Volume-II, 1999.

R20

L	T	P	Cr.
3	-	-	3

B.Tech. (1V Sem.)   **20ME08–PRODUCTION TECHNOLOGY**

PRE-REQUISITES: Metallurgy and Material Science

COURSE EDUCATIONAL OBJECTIVE:

The main objective of this course is to understand the various manufacturing processes available for mechanical engineer and apply them in producing the components.

COURSE OUTCOMES:

At the end of the course, the student will be able to

CO1: Classify various manufacturing processes and illustrate the casting processes.**[Understanding – L2]**

CO2: Recall the various welding techniques and explain gas welding and arc welding.**[Understanding – L2]**

CO3: Illustrate resistance welding, special welding, soldering and brazing processes.**[Understanding – L2]**

CO4: Understand the nature of plastic deformation and identify the types of metal forming processes. **[Remembering – L1]**

CO5: Distinguish various types of metal forming processes. **[Understanding – L2]**

UNIT – I

INTRODUCTION TO MANUFACTURING: Historical perspective; Importance of manufacturing; Classification of manufacturing processes.

CASTING: Steps involved in making a casting, advantage and limitations of casting and its applications. Patterns – Types of patterns and pattern allowances, pattern Materials, Cores and core prints, Chaplets, Moulding sands and Properties of moulding sand, Principles of Gating system, types of gates and Gating ratio, Risers – Types, Function and Design, special casting processes: Centrifugal casting, Die casting, Investment casting, cleaning of castings, casting defects and remedies, non destructive testing of castings.

UNIT – II

WELDING: Classification of welding process, Principle of gas welding, Oxy- acetylene welding equipment, Process and applications, Hydrogen welding, Gas cutting process and applications.

ELECTRIC ARC WELDING: Principle, equipment, electrodes and electrode polarities, Consumable and non consumable welding process. MIG welding Sub-merged arc welding (SAW) processes and applications. Inert gas welding, Tungsten Inert Gas Welding (TIG) process and applications, Carbon arc welding.

UNIT - III

RESISTANCE WELDING: Principle and types of resistance welding and applications, Thermit welding, friction welding, explosive welding and induction welding.

SOLDERING AND BRAZING:Soldering, brazing and braze welding processes and applications, welding defects, causes and remedies. Non-destructive examination of weldments.

UNIT – IV

METAL FORMING PROCESSES: Nature of plastic deformation, Hot working and Cold working, Principles of Rolling fundamentals – Theory of rolling, Types of Rolling mills, Drawing and its types – Wire drawing and Tube drawing – Coining – Hot and cold spinning processes.

FORGING: Principles of forging – Tools and dies – Types of forging operations – Smith forging, Drop Forging and Machine forging, Forging defects, Causes and remedies. Applications of forming and forging processes.

UNIT – V

EXTRUSION OF METALS: Basic extrusion process, its characteristics and applications. Hot extrusion and cold extrusion - Forward extrusion and backward extrusion – Impact extrusion, and Hydrostatic extrusion.

SHEET METAL OPERATIONS: Stamping, Forming and other cold working processes, Blanking and piercing – Bending and stretch forming, Embossing and coining.

TEXT BOOKS

1) P.N. Rao ,Manufacturing Technology – Vol I & II, TMH, 5th Edition, 2018.
2) Richard W Heine, Philp Rosenthal& Karl R.Loper, Principles of metal casting, TMH Edition, 2017.

REFERENCES:

1) S. Kalpakjain, S.R.Schmid, Manufacturing Engineering and Technology, Pearson Edu., 7thEdition, 2014.
2) R.K. Jain , Production Technology /Khanna Publishers, 19thEdition, 2020.
3) Lindberg, Process and materials of manufacturing, PE, 4th Edition, 2015.
4) Sarma P C, Production Technology, S Chand & Company Ltd, 8th Edition, 2014.
5) B.S. Raghuvamsi, Workshop Technology, Dhanapatirai and co. 12thEdition, 2013.

	L	T	P	Cr.
	3	-	-	3

R20
B.Tech. (IV Sem.)   **20ME09 – THEORY OF MACHINES**

PRE-REQUISITES: Mechanics of Solids

COURSE EDUCATIONAL OBJECTIVE:
The main objective of this course is to identify the basic components, layout and kinematics of mechanisms & familiarize the standard mechanisms used for speed and stability control under the effects of vibrations.

COURSE OUTCOMES:
At the end of the course, students will be able to
   CO1. Comprehend the layout and working of various mechanisms. **[Understanding-L2]**
   CO2. Analyze the velocity and accelerations of various kinematic links in a mechanism.**[Analyzing-L4]**
   CO3. Analyze the gear kinematics and turning moment diagrams of engines.**[Analyzing-L4]**
   CO4. Analyze the speed regulations in various types of governors.**[Analyzing-L4]**
   CO5. Solve the balancing of the rotating parts and undamped, damped free vibrating mechanical systems. **[Applying-L3]**

UNIT – I
MECHANISMS: Elements – Classification –Types of kinematic pairs –Types of motions - Degree of freedom- Mechanism and Machines – Classification of mechanisms – Kinematic chain – Inversion of mechanism - Inversions of quadric cycle chain – Single and Double slider crank chains.

UNIT – II
VELOCITY AND ACCELERATION ANALYSIS: Absolute and Relative motions - Instantaneous centre - Kennedy's theorem- Determination of angular velocity of links for simple mechanisms -Relative velocity method –Velocity Polygon-Acceleration Polygon- Velocity and acceleration diagrams for simple mechanisms -Coriolis component of acceleration.

UNIT – III
GEARS: Terminology – Law of gearing- Profile for gears- Involute action- Path of contact, Arc of contact, Contact ratio- Velocity of sliding –Interference and Undercutting.
TURNING MOMENT DIAGRAMS: Turning moment – Angular velocity and acceleration of connecting rod –Piston effort, Crank effort and torque diagrams - Fluctuation of energy - Flywheels.

UNIT – IV
GOVERNORS: Introduction, types of governors - Watt, Porter and Proell governors - Hartnell governor, Sensitiveness, Stability - Isochronism – Hunting.

UNIT – V
BALANCING: Introduction – Balancing of Rotating Masses – Single and Multiple – Single plane and Different planes.
BASICS OF VIBRATIONS: Introduction, Types of vibrations-longitudinal, torsional and transverse vibrations, Undamped free vibrations of spring mass system using energy method, under damped free vibrations of spring mass system, logarithmic decrement.

TEXT BOOKS

1. S.S.Rattan, Theory of Machines, Tata McGraw-Hill, 2007.
2. J.E.Shigley and J.J. Uicker, Theory of Machines and Mechanisms, Tata McGraw Hill, 1995.

REFERENCES

1. J.S.Rao and R.V.Dukkipati, Mechanism and Machine Theory, New Age, 2007.
2. Thomas Bevan, Theory of Machines, CBS Publishers, 1984.
3. B.SadhuSingh,Theory of Machines, Pearson Education, 2002.
4. P.L.Ballaney, Theory of Machines, Khanna Publishers,1990.
5. A. Ghosh and A.K.Mallik, Theory of Mechanisms and Machines, EW Press, 1988.

		L	T	P	Cr.
R20	**20HS01 – UNIVERSAL HUMAN VALUES 2: UNDERSTANDING HARMONY**	3	-	-	3
B.Tech. (IV Sem.)					

Pre-requisites: Nil

Course Educational Objective: To become more aware of themselves, and their surroundings (family, society, nature); they would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.

COURSE OUTCOMES:

At the end of the course, the student will be able to

CO1: Apply the value inputs inlife and profession.(**Applying – L3**)

CO2: Distinguish between values and skills, happiness and accumulation of physical facilities, the self, and the Body. (**Understanding – L2**)

CO3: Understand the role of a human being in ensuring harmony in society.(**Understanding – L2**)

CO4: Understand the role of a human being in ensuring harmony in the nature and existence.(**Understanding – L2**)

CO5: Distinguish between ethical and unethical practices. (**Applying – L3**)

UNIT-I:

Need, Basic Guidelines, Content and Process for Value Education

'Natural Acceptance' and Experiential Validation- as the process for self-exploration; Continuous Happiness and Prosperity- A look at basic Human Aspirations; Right understanding, Relationship and Physical Facility, Understanding Happiness and Prosperity

UNIT-II:

Understanding Harmony in the Human Being - Harmony in Myself!

Understanding human being as a co-existence of the sentient 'I' and the material 'Body'; Understanding the needs of Self ('I') and 'Body' - happiness and physical facility; Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer);

Understanding the characteristics and activities of 'I' and harmony in 'I'; Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail

UNIT-III:

Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship

Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship;

Understanding the harmony in the society: Resolution, Prosperity, fearlessnessand co-existence as comprehensive Human Goals; Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family, Gratitude as a universal value in relationships.

UNIT-IV:

Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

Understanding the harmony in the Nature; Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self regulation in nature; Understanding Existence as Co-existence of mutually interacting units in all-pervasive space; Holistic perception of harmony at all levels of existence.

UNIT-V:

Implications of the above Holistic Understanding of Harmony on Professional Ethics

Natural acceptance of human values; Definitiveness of Ethical Human Conduct; Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order; Competence in professional ethics, Strategy for transition from the present state to Universal Human Order.

Text Book:

Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010.

Reference Books:

1. Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi.

	L	T	P	Cr.

R20

B.Tech. (IV Sem.)   20ME57- PRODUCTION TECHNOLOGY LAB

L	T	P	Cr.
-	-	3	1.5

Prerequisite Subject(s): Engineering Workshop, Engineering Graphics

COURSE EDUCATIONAL OBJECTIVE:
The objective of the course is to provide hands-on experience inprimary production processes to design, fabricate, testing and evaluation of mechanical components of different materials using casting, welding, press working and moulding techniques.

COURSE OUTCOMES:
After completion of the course, students will be able to:
1. Choose a suitable primary production process to design an industrial component. **(Understanding-L2)**
2. Select a suitable production process for fabrication of designed component. **(Applying-L3)**
3. Choose a suitable mechanical press working operation to get the required shape of component. **(Remembering-L1)**
4. Manufacture a plastic component using various plastic processing techniques. **(Applying-L3)**

I. METAL CASTING
1. Pattern Design and making
2. Moulding sand properties testing and evaluation
3. Mould Making, Melting and Casting

II WELDING

1. ARC Welding
2. Resistance Welding
3. Special Welding Techniques
4. Brazing and Soldering

III MECHANICAL PRESS WORKING

1. Study of simple, compound, and progressive press tools.
2. Hydraulic Press - Operations

IV PROCESSING OF PLASTICS

1. Injection Moulding
2. Blow Moulding

Ref: Production Technology Lab Manual

	L	T	P	Cr.
	-	-	2	1

R20
B.Tech. (IV Sem.)   **20ME58– THEORY OF MACHINES LAB**

PRE-REQUISITES: Engineering Mechanics and Theory of Machines

COURSE EDUCATIONAL OBJECTIVE:
The main objective of this course is to demonstrate the concepts of theory of machines.

COURSE OUTCOMES:
At the end of the course, the student will be able to
CO 1.   Apply the dynamics of cams, gyroscopes for any practical problems.**(Applying-L3)**
CO 2.   Evaluate the speed regulations in governors.**(Applying-L3)**
CO 3.   Execute the static and dynamic balancing for rotating parts of a machine.**(Applying-L3)**
CO 4.   Analyze the vibration parameters of oscillating bodies.**(Analyzing-L4)**

LIST OF EXPERIMENTS:
At least 10 experiments are to be conducted
1. Study the cam jump phenomenon of various cams and followers.
2. Determination of gyroscopic couple on Motorized Gyroscope.
3. Determination of centrifugal forces and draw the characteristics curve of Watt and Porter governor.
4. Determination of centrifugal forces and draw the characteristics curve of Proell governor.
5. Determination of centrifugal forces and draw the characteristics curve of Hartnell governor.
6. Balance the given rotor system dynamically with the aid of the force polygon and the couple polygon.
7. Determination of whirling speed of rotating shaft with various boundary conditions.
8. Determination of natural frequency of the spring-mass damped and undamped systems.
9. Determination of natural frequency of torsional vibrations of a single rotor system.
10. Verification of dunkerley's formula for transverse vibrations of beams with different end conditions.
11. Determination of damped and undamped forced vibrations of beams.
12. Determination of radius of gyration of the Bifilar suspension system.

REFERENCES:
> Lab-Manual

	20ME59 - COMPUTER AIDED MACHINE DRAWING LAB	**L**	**T**	**P**	**Cr.**
R20		1	-	2	2
B.Tech. (IV Sem.)					

Pre-requisites : Engineering Graphics, Engineering Drawing with AutoCAD

Course Educational Objective:
The main objectives of the course are to familiarize the basic conventions and various machine elements used in design and to understand the assembly drawings for engine parts, machine parts, valves etc.

Course Outcomes:
At the end of the course, the student will be able to:
CO1 : Comprehend basic conventions needed for machine drawing.**(Understanding-L2)**
CO2 : Construct the machine elements with suitable proportions used in mechanical systems. **(Applying-L3)**
CO3 : Execute the assembly drawings of engine parts. **(Analyzing-L4)**
CO4 : Execute the assembly drawings of machine parts. **(Analyzing-L4)**

UNIT- I
I.MACHINE DRAWING CONVENTIONS:
Need for drawing conventions – introduction to IS conventions
   a) Conventional representation of materials, common machine elements and parts such as screws, nuts, bolts, keys, gears, webs and ribs.
   b) Types of sections – selection of section planes and drawing of sections and auxiliary sectional views, Parts not usually sectioned.
   c) Methods of dimensioning, general rules for sizes and placement of dimensions for holes, centres, curved and tapered features.
   d) Title boxes, their size, location and details - common abbreviations & their liberal usage
   e) Types of Drawings – working drawings for machine parts.

II.DRAWING OF MACHINE ELEMENTS AND SIMPLE PARTS:
1. Sections of Solids: Introduction, Sections of Prisms, Pyramids, Cylinders and Cones
2. Selection of views, additional views for the following machine elements and parts with every drawing proportion.
   a) Popular forms of screw threads, bolts, nuts, stud bolts, tap bolts and set screws.
   b) Keys, cotter joints and knuckle joint.
   c) Riveted joints for plates
   d) Shaft coupling, spigot and socket pipe joint.
   e) Journal, pivot and collar and foot step bearings.

III.ASSEMBLY DRAWINGS:
Drawings of assembled views for the part drawings of the following using conventions and easy drawing proportions.
a) Engine parts – Stuffing box, Cross head, Eccentric, Connecting rod, Piston assembly.
b) Other machine parts - Screws jack, Bench Vice, Pipe vice, Plummer block, Tailstock, Universal joint.

List of Experiments:

S.No.	Type of Drawing	Name of the Experiment	No. of Hours
1	Conventional Drawing	Conventional representations of various materials	03
2		Conventional representations of various machine parts	03
3		Sectional Views	03
4	Drawing of Machine elements for simple parts	Thread Profiles	03
5		Bolt with Nut and Washer	03
6		Flanged Coupling	03
7		Riveted Joint	03
8	Assembly Drawing	Stuffing box	03
9		Piston Assembly	03
10		Plummer block	03
11		Universal Joint	03
12		Screw Jack	03

TEXT BOOK

1. K.L.Narayana, P.Kannaiah& K. Venkata Reddy, Machine Drawing, 4th Edition New Age Publishers. 2004.

2. P.S Gill, Machine Drawing, 18th Edition Eastern Publisher, 2013.

REFERENCES

1. N.Sidheshwar, Machine Drawing, 4th Edition, Tata McGraw Hill, 2001.

2. Dhawan, Machine Drawing, revised edition, S.Chand Publications, 2002.

3. K. C. JOHN, Machine Drawing 6th Edition, Stronck publishers, 2007.

4. N.D.Bhatt, V.M.Panchal Machine Drawing Charotar Publishing House, 2005.

					L	T	P	Cr.

R20

B.Tech. (IV Sem.)

20MES2– STRUCTURAL AND MODAL ANALYSIS USING ANSYS

L	T	P	Cr.
1	-	2	2

PRE-REQUISITES: Strength of Materials.

COURSE EDUCATIONAL OBJECTIVE:

The main objective of this course is to improve the modelling and analysis skills of students in ANSYS workbench and enable them to solve problems related to structures and machine members.

COURSE OUTCOMES:

At the end of the course, the student will be able to

CO 1: Understand the basics and fundamentals related to Finite Element Method.
   (Understanding - L2)

CO 2: Apply the knowledge of ANSYS to solve the engineering problems.**(Applying- L3)**

CO 3: Perform the static structural analysis in 1D, 2D and 3D using ANSYS work bench.
   (Applying- L3)

CO 4: Analyze the mode shapes of structures and machine elements. (**Analyzing- L4**)

Exercises are to be conducted using ANSYS Workbench software:

1. Introduction to Finite Element Method
2. Basics of ANSYS interface and its utilities
3. Structural Analysis of Stepped Bar and Tapered Bar.
4. Static Analysis of a Planar Truss.
5. Static Analysis of a Cantilever Beam.
6. Static Analysis of a Simply Supported Beam with Point Load.
7. Static Analysis of a Simply Supported Beam with Uniformly Distributed Load.
8. Static Analysis of a Simply Supported Beam with Uniformly Varying Load.
9. Static Analysis of a Fixed Beam Subjected to Axial Load.
10. Stress Analysis of Flat Plates and Simple Shells.
11. Stress Analysis of Axi-symmetric Components.
12. Vibration Analysis of Spring-Mass Systems.
13. Mode - Frequency Analysis of Beamsand Machine Elements.

WEB REFERENCES:

1. https://www.slideshare.net/nageshsurner/introduction-to-ansys-workbench-80635115
2. https://www.youtube.com/watch?v=C8WvCQpzT2A
3. https://www.youtube.com/watch?v=FwKkjAr9Kbk
4. https://www.youtube.com/watch?v=6QaFX1CG-ZE

L	T	P	Cr.
2	1	-	3

B.Tech. (V Sem.)   **20ME10 - IC ENGINES AND GAS TURBINES**

PRE-REQUISITES: Thermodynamics

COURSE EDUCATIONAL OBJECTIVE:

The objective of this course is to acquire knowledge on fundamentals of IC engine cycles and its performance analysis and the salient features of gas turbine and jet propulsion systems.

COURSE OUTCOMES: At the end of the course students will be able to

CO1: Describe the construction and functioning of internal combustion engines, fuel supply systems for SI and CI engines, modern automotive engines and electric vehicles. **(Understanding - L2)**

CO2: Comprehend the combustion characteristics of SI engines and CI engines. **(Understanding - L2)**

CO3: Compute the IC engine performance parameters. **(Applying - L3)**

CO4: Understand the construction and functioning of gas turbines. **(Understanding - L2)**

CO5: Apply gas turbine cycles for aircraft propulsion systems. **(Applying - L3)**

UNIT - I

INTRODUCTION: Basic Engine components and Nomenclature, Classification of Engines, The working principles of 2-stroke and 4-stroke SI and CI engines, Comparison of 2-Stroke and 4-Stroke Engines; CI and SI Engines, Ideal and Actual Working Cycles and their analysis, Valve timing Diagrams and Port timing diagrams.

CARBURETORS & FUEL INJECTION: Air Fuel Mixture Requirements, Construction and Working of Simple Carburetor, Calculation of Air-Fuel Ratio, Parts of Carburetor. Requirement of Injection Systems, Classification of Injection Systems, Working principles of Fuel Injector, Injection in SI and CI Engines.

UNIT - II

COMBUSTION IN SI ENGINE: Stages of combustion in SI engine, Normal and abnormal combustion, effect of detonation, detonation and engine variables and other factors affecting knocking and its prevention, theory of detonation in SI engines, combustion chamber requirements, types of combustion chamber, Octane number.

COMBUSTION OF CI ENGINE: Stages of combustion in CI engines, variables effecting delay period, diesel knock, methods of controlling diesel knock, CI engine combustion chamber requirements, types of combustion chambers, cold starting of CI engine, Cetane number.

UNIT - III

PERFORMANCE PARAMETERS FOR IC ENGINES: Engine Power, Engine Efficiencies, Performance Characteristics, Variables Effecting Performance Characteristics, Methods of Improving Engine Performance, Heat Balance.

MODERN AUTOMOTIVE ENGINES: Changes in Fuel injection Methods in S.I and C.I engines, Common Rail Direct Injection System, Gasoline Direct Injection, Variable Valve Technology, DTSi technology.

ELECTRIC VEHICLES: Fundamentals of Electric Vehicles.

UNIT - IV

GAS TURBINES: Introduction to Gas Turbines, Development, Classification and Application of Gas Turbines, Ideal and Actual Cycles; Effect of Inter cooling, Reheating, Regeneration, Combined cycle,

UNIT - V

GAS TURBINE CYCLES FOR AIRCRAFT PROPULSION: Criteria of performance, Intake, and propelling nozzle efficiencies, Simple Turbojet Cycle, The turboprop engine, Thrust augmentation, Gas turbine combustion systems, Combustion chamber designs, Gas Turbine Emissions.

TEXT BOOKS

1. I.C. Engines/ V. Ganesan- Mc Graw Hill, 4th Edition, 2017.
2. Gas Turbines/V. Ganesan- Mc Graw Hill, 3rd Edition, 2017.
3. Internal Combustion Engine Fundamentals/ John.B Heywood,Mc Graw Hill, 4th Edition, 2017.

REFERENCE BOOKS

1. Fundamentals of Internal Combustion Engines / H.N Gupta / PHI, 2nd Edition, 2013.
2. Gas Turbine Theory/ HIH Saravanamuttoo, Cohen, Rogers/ Pearson, 7th Edition, 2019.

L	T	P	Cr.
3	-	-	3

B.Tech. (V Sem.)   20ME11 - MACHINE TOOLS AND METROLOGY

PRE-REQUISITES: Production Technology

COURSE EDUCATIONAL OBJECTIVE:

The main objective of this course is to provide an overview of machine tools and various principles of measurements.

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Understand the concepts of metal cutting theory. (**Understanding - L2**)

CO2: Differentiate various machining processes. (**Understanding - L2**)

CO3: Comprehend the principles of finishing processes. (**Understanding - L2**)

CO4: Identify the instruments to measure linear, angular, and surface texture parameters (**Understanding - L2**)

CO5: Apply limits and fits on machine components and perform alignment tests on machine tools. (**Applying - L3**)

UNIT –I

METAL CUTTING THEORY: Elements of cutting process – Methods of Metal Cutting, Geometry of Single Point Cutting Tool, Chip formation, Mechanism and types of chips, Merchant's Force Diagram, Measurement of cutting forces, Machining parameters calculations, Tool wear life and machinability.

UNIT-II

LATHE: Principle of working and specifications of lathe – Types of lathes – Lathe accessories-Operations on Lathe machine - Taper turning-Thread turning and lathe attachments.

SHAPING, SLOTTING AND PLANING MACHINES: Principle of working – Principal parts – Specifications, classifications, operations performed.

UNIT-III

DRILLING MACHINES: Principle of working, specifications, types of drilling machines, various operations performed.

MILLING MACHINES: Principle of working – Specifications – Classifications of milling machines – Machining operations.

GRINDING MACHINES – Fundamentals – Theory of grinding – Classification of grinding machine – Cylindrical and surface grinding machines – Tool and cutter grinding machine – special types of grinding machines.

UNIT-IV METROLOGY

LINEAR AND ANGULAR MEASUREMENTS: Introduction to Metrology, Standards of measurements - line and end standards, basic principle and applications of slip gauges, dial indicator and micrometers, angle slip gauges – sine bar.

SURFACE TEXTURE: Introduction, Factors effecting surface roughness, reasons for controlling surface texture, Differences between surface roughness and surface waviness, Elements of surface texture -Numerical assessment of surface finish – C.L.A., R.M.S Values – R_a values, and R_z values, Basic principle of profilometer and Tomlinson surface meter.

UNIT-V

LIMITS AND FITS: Introduction, Normal size, Tolerance limits, Deviations, Allowance, Fits and their types – unilateral and bilateral tolerance system, hole and shaft basis systems – interchangeability and selective assembly.

ALIGNMENT TESTS: Alignment tests on Lathe.

TEXT BOOK

1. P.N.Rao, Manufacturing Technology- Volume 2, McGraw Hill Education, 3e.
2. I.C.Gupta, A Text Book of Engineering Metrology, Dhanpat Rai Publications.

REFERENCES

1. Kalpakjain S, Manufacturing Engineering and Technology, Pearson Education, 4TH edition 2001.
2. J.P.Kaushish, Manufacturing Processes, PHI, Second Edition, 2010.
3. M. Mahajan, A text book of Metrology, Dhanpat Rai & Co.
4. R.K.Jain, Engineering Metrology, Khanna Publishers.3rd edition, 2003.

	L	T	P	Cr.
B.Tech. (V Sem.) **20ME12 - DESIGN OF MACHINE ELEMENTS-I**	2	1	-	3

PRE-REQUISITES: Mechanics of Solids

COURSE EDUCATIONAL OBJECTIVE:

The main objective of this course is to familiarize the steps involved in the design process of various machine elements.

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Comprehend the simple stresses in machine parts subjected to static loads. (**Understanding – L2)**

CO2: Analyze the failure criterion of mechanical parts subjected to fatigue loads**. (Analyzing – L4)**

CO3: Estimate the strengths of welded & threaded joints subjected to various types of loads. **(Applying – L3**)

CO4: Design the shafts for various applications of engineering**. (Applying – L3)**

CO5: Design the various machine elements such as keys, cotter, knuckle joints & shaft couplings. **(Applying – L3**)

UNIT – I

INTRODUCTION: Basic procedure of machine design– Basic requirements of machine elements – Design analysis- Design synthesis – Introduction to Indian standards-Selection of Preferred numbers.

DESIGN FOR STATIC STRENGTH: Modes of failure – Factor of safety – Simple stresses in machine parts – Torsional and bending stresses- Theories of failure-Maximum Principal stress theory-Maximum shear stress theory-Distortion Energy theory.

UNIT – II

DESIGN FOR FATIGUE STRENGTH: Stress concentration – Stress concentration factors – Methods of reducing stress concentration- Fluctuating stresses, Fatigue failure – Endurance limit – S-N diagram – Soderberg and Goodman Theories – Design for infinite life.

UNIT – III

WELDED JOINTS: Butt joints -Strength of butt welds - Fillet joints, Strength of parallel fillet welds-Strength of transverse fillet welds.

THREADED JOINTS: Threaded Joints-Terminology of screw threads- Eccentric load with perpendicular to axis of bolt - Bolts of uniform strength.

UNIT – IV

SHAFTS: Shaft design on strength basis-Shafts subjected to combined twisting moment and bending Moment-Design of shafts based on rigidity.

UNIT – V

KEYS, COTTER AND KNUCKLE JOINTS: Types of keys- Design of square and flat keys-Cotter Joints-Socket and Spigot cotter joint-Design of Knuckle joint.

SHAFT COUPLINGS: Requirements – Rigid couplings – Muff coupling – Clamp coupling, Flange coupling – Bushed pin flexible coupling.

TEXT BOOKS

1. V.B, Bhandari, Design of Machine Elements, Tata McGraw Hill-2010.
2. J.E. Shigley and C.R.Mischke, Mechanical Engineering Design,Tata McGraw-Hill, 2003.

REFERENCES

1. A.C.Ugural, Mechanical Design, An Integral Approach, Tata McGraw-Hill, 2004.
2. M.F.SpottsandT.E. Shoup, Design and Machine Elements" Pearson Education, 2004.
3. R.C.Juvinall and K.M. Marshek, Fundamentals of Machine component Design, John Wiley & Sons, 2002.
4. R.L. Norton, Design of Machinery, Tata McGraw Hill-2001.

L	T	P	Cr.
3	-	-	3

B.Tech. (V Sem.)   20ME13 - NON-CONVENTIONAL ENERGY SOURCES

PRE-REQUISITES: Thermodynamics, Applied Thermodynamics

COURSE EDUCATIONAL OBJECTIVE:

To provide the insights on different non-conventional energy sources, potential, salient features and utilization of solar, wind, geothermal, ocean thermal energy, bio energy and direct energy conversion systems.

COURSE OUTCOMES: At the end of the course, the student will be able to:

CO1: Estimate the potentials of nonconventional energy sources and solar energy harnessing devices. **(Understanding - L2)**

CO2: Apply the principles of energy conversion to study wind and geothermal energy plants. **(Applying - L3)**

CO3: Understand the power generating capacities of tidal energy, wave energy and ocean thermal energy plants. **(Understanding - L2)**

CO4: Describe the biomass production system technologies and their capacities for generating power. **(Understanding - L2)**

CO5: Comprehend the direct energy conversion principles, systems and potential for power generation. **(Understanding - L2)**

UNIT - I

INTRODUCTION: Energy Scenario – Survey of Energy Resources – Classification – Need for Non-Conventional Energy Resources.

SOLAR ENERGY: The Sun - Sun-Earth Relationship –Solar radiation – Attenuation –Radiation measuring Instruments.

SOLAR ENERGY APPLICATIONS: Solar water Heating, Space Heating – Active and Passive heating – Energy storage – selective surface – solar stills and ponds – solar refrigeration systems – basic principle of power generation in photovoltaic cell.

UNIT - II

WIND ENERGY: Wind – characteristics – wind energy conversion systems – types – Betz model – Interference Factor – Power Coefficient – Torque Coefficient and thrust coefficient – Lift and Drag, site selection requirements.

GEOTHERMAL ENERGY: Structure of Earth – Geothermal Sources – Hot springs – Hot Rocks – Interconnection of geothermal fossil systems – Prime movers for geothermal energy conversion.

UNIT - III

TIDAL ENERGY: Introduction, Origin of Tides, Tidal Power generation, Classification of Tidal Power Plant, Site requirements.

WAVE ENERGY: Introduction, Wave energy and Power, Wave Energy devices – Merits and Demerits.

OCEAN THERMAL ENERGY: Introduction, Working principle of Ocean Thermal Energy Conversion, OTEC Systems, Advantages and Disadvantages of OTEC plants.

UNIT - IV

BIO – ENERGY: Introduction, Biomass Energy Sources – Plant Productivity, Biomass Wastes – Aerobic and Anaerobic bio-conversion processes – Raw Materials and properties of Bio-gas. Bio-gas plant technology and status — Biomass gasification, Types and application of gasifier.

UNIT - V

DIRECT ENERGY CONVERSION SYSTEMS: Introduction to direct energy conversion systems, Peltier effect, seebeck effect, Thomson effect, Fuel Cells-types, efficiency of Fuel Cells, and Solar Cells–Thermionic and Thermoelectric Generation – MHD Generator-Open and Closed Systems, applications of direct energy conversion systems.

TEXT BOOKS:

1. G.D.Rai, Non-Conventional Energy Sources, 5th Edition 2011, Khanna Publishers, New Delhi, India.
2. Non-Conventional Energy Resources, G.S.Sawhney ,1ST Edition, PHI Learning Pvt.Ltd, 2012.
3. Kreith, F and Kreider, J. F., Principles of Solar Engineering, Third Edition, McGraw-Hill, 1980.

REFERENCE BOOKS:

1. John Twidell & Tony Weir, Renewable Energy Resources – Third Edition, Taylor & Francis, 2015.
2. G.N.Tiwari, Solar Energy – Fundamentals, Design, Modelling and Applications – Narosa Publication Ltd., 2010.
3. Ashok V Desai, Non-Conventional Energy- Wiley Eastern, 2000.

L	T	P	Cr.
3	0	0	3

B.Tech. (V Sem.)   **20ME14 - ROBOTICS**

PRE-REQUISITES: Engineering Mechanics, Theory of Machines

COURSE EDUCATIONAL OBJECTIVES:

The main objective of this course is to cultivate the interest and ability to develop robotic systems for social and industrial needs.

COURSE OUTCOMES: At the end of the course, the student will be able to

CO 1:   Understand the anatomy of robots, end effectors and its applications. **(Understanding - L2)**

CO 2:   Familiarize the working principle of actuators and sensors for robots. **(Understanding - L2)**

CO 3:   Comprehend the forward and inverse kinematics of robots and apply D-H parameters for solving robot kinematic problems. **(Applying - L3)**

CO 4:   Solve the dynamic behavior of robot. **(Applying - L3)**

CO 5:   Analyze the trajectory of robotic motion and comprehend the applications of robots. **(Applying - L3)**

UNIT - I

INTRODUCTION: Introduction, Basic concepts – Robot anatomy –Components of robots- Robot motions – Degrees of Freedom – Workspace and work envelope, Robot Configurations, Advantages, Limitations, and applications, precision movement of robotic arm.

ROBOT END EFFECTORS: Introduction – Types of end effectors – Mechanical grippers – Vacuum cups, magnetic grippers, adhesive grippers, and others – Robot / End effectors interface – Considerations in gripper selection and design.

UNIT - II

ACTUATORS: Introduction, Characteristics of actuating system- pneumatic actuators-hydraulic actuators- electric actuators, Advantages, Limitations, and applications.

SENSORS: Introduction, Sensor Characteristics-Position sensors: Potentiometers, LVDT, Resolvers, encoders, Magnetostrictive Displacement Transducers (MDT) – Velocity Sensors: encoders, tachometers, acceleration sensors, Advantages, Limitations, and Applications

UNIT – III

MANIPULATOR KINEMATICS: Introduction – Coordinate Frames, Description of Objects in space, Rotation Matrices, Homogeneous Transformation, Transformation of robotic arm for position and orientation, Numericals

D-H PARAMETER REPRESENTATION: D-H representation – Numericals on forward kinematics, Introduction to Inversion Kinematics

UNIT - IV

DYNAMICS: Introduction - Differential transformations- Jacobian – problems- Lagrange Euler formulation – Problems.

UNIT - V

TRAJECTORY PLANNING: Introduction – considerations on trajectory planning – joint Interpolated trajectory – Cartesian path trajectory – problems.

APPLICATIONS OF ROBOTS: Robot applications in Material transfer and machine loading / unloading applications – Processing operations – Assembly and inspection – Future applications.

TEXT BOOKS

1. Saeed B.Niku, Introduction to robotics- analysis ,systems &application, Second Edition, Willy India Private Limited, New Delhi,2011.

2. R.K.Mittal and IJ Nagrath, Robotics and Control, Tata McGraw–Hill Publishing company Limited, New Delhi, 2003.

REFERENCES

1. Mikell P.Groover, Mitchell Weiss, Roger N. Nagel and Nicholas G. Odrey,Ashish Dutta,, Industrial Robotics, Second Edition McGraw- Hill Education(India) PrivateLimited,2012

2. Robert J.Schilling, Fundamentals of robotics analysis & control, PHI learning private Limited, New Delhi,4th Edition 2002

3. John.JCriag, Introduction to Robotics-Mechanics and Control, Third Edition,Pearson Education, Inc., 2008.

L	T	P	Cr.
3	-	-	3

B.Tech. (V Sem.)   **20ME15 - MECHANICAL VIBRATIONS**

PRE-REQUISITES: Engineering Mechanics, Mechanics of solids

COURSE EDUCATIONAL OBJECTIVE:

The main objective of this course is to provide the knowledge of mathematical modeling of various degrees of freedom of systems under free and forced vibrations and also familiarize the systems to study the response of vibrating systems.

COURSE OUTCOMES: At the end of the course, students will be able to

CO1. Formulate the governing equations for un-damped free vibrations of single degree of freedom systems and its solutions**. (Applying – L3)**

CO2. Calculate the damped parameters of single degree of freedom of systems subjected to free vibrations. **(Applying – L3)**

CO3. Understand the response of various mechanical systems under harmonic excitation conditions**. (Understanding – L2)**

CO4. Analyze the two degree of freedom systems to get their response in terms of natural frequencies and mode shapes**. (Analyzing – L4)**

CO5. Analyze the multi degree of freedom systems to find the response by using different methods. **(Analyzing – L4)**

UNIT – I

UNDAMPED FREE VIBRATIONS OF SINGLE DEGREE OF FREEDOM SYSTEMS:

Introduction- Differential equation and Solution of various systems - Torsional vibrations – Equivalent stiffness of spring combinations -Springs in series – Springs in parallel – Natural frequency of a vibration system by energy method.

UNIT – II

DAMPED FREE VIBRATIONS OF SINGLE DEGREE OF FREEDOM SYSTEMS:

Introduction – Types of damping – Free vibrations with viscous damping – Over damped, critically damped and under damped systems -Logarithmic decrement – Viscous dampers, slosh dampers.

UNIT – III

FORCED VIBRATIONS OF SINGLE DEGREE OF FREEDOM SYSTEMS:

Introduction – Forced vibrations with constant harmonic excitation – Steady state vibrations – Forced vibration with rotating and reciprocating unbalance.

Forced vibrations due to excitation of the support –Vibration isolation and transmissibility - Typical isolators and mount types – vibration measuring instruments.

UNIT – IV

TWO DEGREES OF FREEDOM SYSTEMS: Introduction – Principal modes of vibrations – Other cases of simple two degrees of freedom systems – Two masses fixed on a tightly stretched string - Double pendulum – Torsional system – Undamped forced vibrations with harmonic excitation -Undamped dynamic vibration absorber.

UNIT – V

MULTI DEGREE OF FREEDOM SYSTEMS: Exact analysis- Undamped free vibrations of a multi degree of freedom system – Influence coefficients – Flexibility coefficients and Maxwell reciprocal theorem – Torsional vibrations of multi rotor systems – Vibrations of geared systems - Numerical method – Determination of natural frequency of vibration by Rayleigh's method.

TEXT BOOKS

1. G.K.Grover, Mechanical vibrations, 8th edition, Nemchand & Bros.2018.
2. W.T.Thomson, Theory of vibrations, 3rd edition, CBS Publications & Distributors, 1999.

REFERENCES

1. William W.Setio, Mechanical vibrations, Schaum outline series, 1964.
2. V.P.Singh, Mechanical vibrations, 3rd edition, DhanpatRai& Sons, 2001.
3. S.S.Rao, Mechanical Vibrations, Pearson Education, 2004.

L	T	P	Cr.
3	0	0	3

B.Tech. (V Sem.)   **20ME16 - OPERATIONS RESEARCH**

PRE-REQUISITES : Linear Algebra and Transformation Techniques, Numerical Methods and Integral Calculus

COURSE EDUCATIONAL OBJECTIVE:

The objective of this course is to introduce the concepts of formulating an engineering problem into a mathematical model to develop an optimal solution.

COURSE OUTCOMES: At the end of the course, the student will be able to

CO 1:   Apply linear programming approach for optimizing the objectives of industrial oriented problems. (**Applying - L3**).

CO 2:   Formulate and solve Transportation Models and assignment Models (**Applying - L3**).

CO 3:   Implement the strategies in competitive situations and identify the replacement period of the equipment. (**Applying - L3**).

CO 4:   Analyze the waiting situations in an organization and determine the optimum inventory level in the organization. (**Applying - L3**).

CO 5:   Resolve the complex problem into simple problems by dynamic programming approach and apply optimum strategies. (**Applying - L3**).

UNIT –I

INTRODUCTION: Introduction to Operations Research, operations research models, applications.

LINEAR PROGRAMMING: Linear Programming Problem Formulation, Graphical solution, Simplex method, artificial variables techniques, Two–phase method, Big-M method, Duality Principle.

UNIT-II

TRANSPORTATION PROBLEM: Formulation, Optimal solution, unbalanced transportation problem, Degeneracy.

ASSIGNMENT PROBLEM: Introduction, optimal solution, Variants of Assignment Problem-Traveling Salesman problem.

UNIT-III

GAME THEORY: Minimax (maximin) Criterion and optimal strategy, Solution of games with saddle points, Rectangular games without saddle points, 2 X 2 games – dominance principle – mX2 and 2Xn games, graphical method.

THEORY OF REPLACEMENT: Introduction, Replacement of Equipment that Deteriorates Gradually, Replacement of Equipment that fails suddenly, Group Replacement.

UNIT-IV

WAITING LINES: Single Channel – Poisson arrivals – exponential service times – with infinite population and finite population models.

INVENTORY MODELS: Introduction, terminology, EOQ, deterministic models — Instantaneous production, finite production, continuous demand, no set up cost, shortages are not allowed – purchase inventory models with one price break and multiple price breaks.

UNIT-V

DYNAMIC PROGRAMMING: Introduction, Bellman's Principle of optimality, Applications of dynamic programming, capital budgeting problem, shortest path problem, linear programming problem.

TEXT BOOK

1. S.D Sharma, ―Operation Research‖, Kedar Nath and RamNath - Meerut , 2020
2. Kantiswarup. P.K.Gupta, Man Mohan, Operations Research, Sultan Chand& Sons, Educational Publications, New Delhi, 15th Edition, 2021.

REFERENCES

1. Singiresu S Rao, Engineering Optimization: Theory and Practice, A Wiley- Interscience Publication, 5th edition,2019.
2. Hiller &Libermann, Introduction to O.R (TMH), 10th Edition, 2017
3. A.M.Natarajan, P.Balasubramani, A. Tamilarasi,Operations Research, Pearson Education, 2nd edition, 2014.
4. Hamdy A Taha, Introduction to O.R .PHI, 10th edition, 2017.

L	T	P	Cr.
-	-	3	1.5

B.Tech. (V Sem.)   **20ME60 – THERMAL ENGINEERING LAB**

PRE-REQUISITES : IC Engines and Gas Turbines, Applied Thermodynamics

COURSE EDUCATIONAL OBJECTIVE:

The main objective of this laboratory is to familiarize the basic principles and evaluation of various performance parameters of internal combustion engines, Refrigerator, Air Conditioner, and Air compressor apparatus.

COURSE OUTCOMES: At the end of the course, the student will be able to

CO 1:   Examine the valve timing diagram and port timing diagram of internal combustion engines (**Remembering – L1**)

CO 2:   Analyze the performance characteristics of an internal combustion engines (**Analyzing – L4**)

CO 3:   Estimate the energy distribution and frictional power of diesel engine using heat balance and morse test (**Applying - L3**)

CO 4:   Describe the performance parameters of refrigeration systems and air compressor (**Understanding - L2**).

LIST OF EXPERIMENTS

(Any 10 experiments may be conducted)

1. Study of Valve & Port Timing Diagrams of diesel engine and petrol engine.

2. Performance Test on Variable Compression Ratio single cylinder 4-Stroke petrol Engine By using Eddy Current Dynamometer

3. Test on single cylinder 4 -Stroke Diesel Engine by using Mechanical Dynamometer

4. Evaluation of performance parameters of twin cylinder 4-stroke diesel engine.

5. Determination of performance characteristics of 2-Stroke Petrol Engine.

6. Evaluation of engine friction power by conducting Morse test on Multi cylinder diesel engine.

7. Heat Balance of 4 stroke single cylinder diesel engine

8. Performance Test on Reciprocating Air – Compressor.

9. Determination of COP of Vapour Compression Refrigeration Unit.

10. Performance Test on Air Conditioning Unit.

11. Demonstration of automobile working components.

12. Measurement of exhaust emissions and smoke of diesel engine.

13. Analysis of combustion characteristics of the diesel engine.

14. Determination of calorific value of fuel using bomb calorimeter.

15. Test on solar parabolic trough collector to analyze various characteristics.

REFERENCES:

➢ Thermal engineering lab manual

	L	**T**	**P**	**Cr.**
20ME61 – MACHINE TOOLS AND METROLOGY				
B.Tech. (V Sem.) **LAB**	-	-	3	1.5

PRE-REQUISITES: Production Technology, Machine Tools and Metrology

COURSE EDUCATIONAL OBJECTIVE:

         The main objective of this course is to provide hands on experience in using machine tools and metrological instruments.

COURSE OUTCOMES: At the end of the course, the student will be able to

CO 1:   Develop sequence of machining operations to produce the component. (**Applying - L3**)

CO 2:   Capable of manufacturing components according to given drawings using various machine Tools. (**Applying - L3**)

CO 3:   Perform linear, angular and gear measurements of machined components. (**Applying - L3**)

CO 4:   Analyze the measurement of the surface roughness and perform alignment tests. (**Applying - L3**)

LIST OF EXPERIMENTS

PART-A: MACHINE TOOLS LAB (At least five experiments may be conducted)

1. Study of various machine tools.
2. To perform the step turning and taper turning operations on lathe machine.
3. To perform knurling and threading operations on lathe machine.
4. To prepare a single point cutting tool.
5. To produce a spur gear using milling machine.
6. To cut a rectangular groove or keyway using Shaper, Planar and Slotter machines.
7. To perform drilling and tapping operations using drilling machine.
8. To prepare a smooth flat surface using surface Grinding machine.

PART-B: METROLOGY LAB (At least five experiments may be conducted)

1. Measurement of lengths, heights, diameters using vernier calipers and micrometers.
2. Measurement of bores by dial bore indicators.
3. Taper measurement using balls and rollers.
4. Check the gear parameters of a gear using Gear Teeth Vernier Calipers
5. Machine tool alignment test on the lathe.
6. Measurement of screw thread parameters using Tool maker's microscope.
7. Angle and taper measurements using Bevel Protractor, Slip Gauges and Sine bars, etc.
8. Thread measurement by three wire method.
9. Surface roughness measurement by Taly Surf.

REFERENCES: Lab Manuals

L	T	P	Cr.
2	1	-	3

B.Tech. (VI Sem.)　　　**20ME17 - HEAT TRANSFER**

PRE-REQUISITES: Thermodynamics, Applied Thermodynamics

COURSE EDUCATIONAL OBJECTIVE:

　　　To learn the physical mechanisms on modes of heat transfer, differential equations in heat transfer applications and the significance of Non-Dimensional Numbers.

COURSE OUTCOMES: At the end of the course, the student will be able to

CO 1:　　Understand the basic heat transfer principles and their practical relevance in Planes, Cylinders and Spherical components. **(Understanding - L2)**

CO 2:　　Analyze steady and unsteady state heat transfer concepts and fins. **(Analyzing – L4)**

CO 3:　　Formulate the expressions to solve free and forced convection problems related to external　　　and internal flows. **(Applying -L3)**

CO 4:　　Apply the concepts of heat transfer in boiling, condensation and radiation thermal systems. **(Applying -L3)**

CO 5:　　Design the simple heat exchanger for engineering applications using the data hand book. **(Analyzing – L4)**

UNIT – I

INTRODUCTION: Basic Modes of Heat Transfer- Basic laws of Heat transfer-Applications of heat transfer- Steady, Unsteady and Periodic Heat Transfer- Heat conduction-Fourier's equation-Thermal conductivity-General heat conduction equation in Cartesian, Cylindrical and Spherical Coordinates and its simplification-Initial and boundary conditions.

ONE- DIMENSIONAL STEADY STATE CONDUCTION: Heat flow through plane wall and cylinder with constant thermal conductivity- Electrical analogy-Thermal resistance-Overall heat transfer coefficient-Applications-Heat flow through Composite Wall and Cylinder - Critical radius of insulation for Cylinder and Sphere

UNIT – II

ONE DIMENSIONAL STEADY STATE CONDUCTION: Heat flow through plane wall and cylinder with Variable Thermal conductivity - Uniform internal heat generation in Slabs and cylinders-Extended Surfaces- Analysis of Long Fin and Short fin with insulated tip - Fin efficiency and Effectiveness

ONE DIMENSIONAL TRANSIENT HEAT CONDUCTION: Systems with negligible internal resistance-Lumped Heat analysis–Significance of Biot and Fourier Numbers-systems with finite surface and internal resistance using Heisler Chart.

UNIT – III

DIMENSIONAL ANALYSIS: Introduction- Dimensional analysis -Buckingham Pi Theorem applied to Forced convection --Significance of Non Dimensional numbers-The boundary layer concept-The velocity and Thermal boundary layer.

FORCED CONVECTION: Introduction, applications- –convective heat transfer coefficient-External Flow-Laminar and Turbulent Flow over a Flat plate –Internal Flow through Circular pipe-Laminar and Turbulent Flows-Entry length and fully developed flow - Reynolds Colburn analogy.

NATURAL CONVECTION: Introduction, applications-Development of Hydrodynamic and thermal boundary layer along Vertical plate- Empirical correlations for Vertical plate, Vertical, Cylinder, Horizontal Plate and Horizontal Cylinder-Natural convection cooling in electronic equipment, heat pipe.

UNIT – IV

BOILING AND CONDENSATION: Applications of Boiling Heat transfer phenomena- Pool Boiling- Boiling regimes- Critical Heat Flux-Condensation-Film wise and Drop wise condensation-Laminar film wise condensation on Vertical plate.

THERMAL RADIATION: Introduction-Applications of Thermal Radiation-Nature of Thermal radiation-Emissive power-Absorption, Reflection and Transmission-Concept of Black body –Laws of Black Body Radiation- Radiation from Nonblack surfaces-Emissivity-Kirchhoffˈs law - radiation heat exchange between two black isothermal surfaces- shape factor- Heat exchange between nonblack infinite parallel plates- Radiation shields.

UNIT – V

HEAT EXCHANGERS: Introduction-Classification of heat exchangers -Flow arrangement, Temperature distribution- Overall heat transfer coefficient- Fouling factor- LMTD method of Heat exchanger analysis-Correction for LMTD for use with Multi pass and Cross flow Heat Exchangers, Effectiveness - NTU method of Heat Exchanger analysis-Applications of Heat Exchangers.

Data Hand Book:

1. C.P. Kothandaraman and Subramanian, Heat and Mass Transfer Data Book, New Age International Publications, 7th Edition, Reprint 2012

NOTE: Heat and Mass Transfer Data Hand Book by C.P. Kothandaraman and Subramanian- New Age Publications is to be allowed in Examination.

TEXT BOOKS

1. R.C.Sachdeva - Fundamentals of Engineering Heat and Mass Transfer -New Age Science Publishers, 3nd Edition, 2009.

2. Yunus. A. Cengel, Heat & Mass Transfer-A Practical Approach – Tata McGraw Hill, 4thEdition, 2012.

3. P.Holman, Heat transfer - Tata McGraw-Hill, 9th Edition, 2010

REFERENCES

1. M.NecatiOzisik, Heat Transfer- A basic Approach,4thEdition, McGraw-Hill book company, 1985.

2. P.K.Nag, Heat and Mass Transfer- TMH 2ndEdition, 2007.

3. P.S.Ghoshdastidar, Heat Transfer - Oxford Higher Education 6th Edition 2011.

4. C.P.Kothandaraman and Subramanian, Heat and Mass Transfer, New Age International Publications 7thEdition 2010.

L	T	P	Cr.
3	0	0	3

B.Tech. (VI Sem.)   **20ME18 – CAD/CAM**

PRE-REQUISITES: Design of Machine Elements -I, Machine Tools and Metrology

COURSE EDUCATIONAL OBJECTIVE:

The main objective of this course is to familiarize the principles of geometric modeling, numerical control and part programming.

COURSE OUTCOMES: At the end of the course, the student will be able to

CO 1: Comprehend the principles of CAD/CAM for design and manufacturing. **(Understanding - L2)**

CO 2: Formulate mathematical equations for geometrical entities like curves, surface, and solids. **(Applying - L3)**

CO 3: Write the program for part profiles to accomplish numerical control machining **(Applying - L3)**

CO 4: Discuss the codes for different parts using GT and apply in automated manufacturing systems. **(Understanding - L2)**

CO 5: Contrast CAQC techniques and comprehend the applications of Computer Integrated Manufacturing. **(Understanding - L2)**

UNIT - I

FUNDAMENTALS OF CAD: Introduction – Design process – Application of computers for design- Benefits of CAD.

COMPUTER GRAPHICS: Raster Scans Graphics-Transformation of geometry: Translation, scaling, reflection, rotation, shear and homogeneous transformations - Concatenated transformations.

UNIT – II

GEOMETRIC MODELING

REPRESENTATION OF CURVES: Introduction, wireframe models, wireframe entities, curve representation, parametric representation of analytical curves, parametric representation of Bezier and B-Spline curves.

REPRESENTATION OF SURFACES AND SOLIDS: Introduction to surfaces, surface models, surface entities. Introduction to solids, solid models, solid entities, fundamentals of solid modeling, boundary representation, CSG representation, sweep representation.

UNIT – III

COMPUTER NUMERICAL CONTROL: Introduction, numerical control, numerical control modes, numerical control elements, CNC machine tools, feedback devices, coordinate system.

PART PROGRAMMING: Part programming fundamentals – Manual part programming, computer aided part programming: APT Language.

UNIT - IV

GROUP TECHNOLOGY: Introduction – part families – part classifications and coding – OPITZ system – MICLASS system – CODE system – GT Machine cells – Benefits of GT – Computer Aided Process Planning (CAPP): Introduction, retrieval type and generative type

FLEXIBLE MANUFACTURING SYSTEM: Introduction – FMS components – Benefits of FMS

UNIT - V

COMPUTER AIDED QUALITY CONTROL: Introduction – computers in QC – Contact Inspection methods and Non-contact inspection methods: optical, non-optical – Computer Aided Testing-Integration of CAQC with CAD/CAM.

COMPUTER INTEGRATED MANUFACTURING SYSTEMS: Introduction–Integration of CIM – Benefits of CIM.

TEXT BOOKS

1. P.N Rao ,CAD/CAM Principle and applications, Tata McGraw Hill Education Private Ltd, New Delhi,8th edition 2013.

2. Ibrahim Zeid, Mastering CAD/CAM, TATA McGraw-Hill publishing CO.Ltd, NewDelhi 2011.

REFERENCES

1. Mikel P.Groover and Emory W.Zimmers, CAD/CAM-Prentice Hall of India Private Ltd. New Delhi, 20th edition, May 2010.

2. P.Radhakrishnan, S.Subramanyam & V.Raju, CAD/CAM/CIM, New Age International Publishers, 3rd edition 2010.

3. Mikel P.Groover, Automation, Production Systems and Computer Integrated Manufacturing, Prentice Hall of India Private Ltd. New Delhi, 3rd edition, May 2008.

4. Ibrahim Zeid and R. Sivasubramanian, CAD/CAM theory and practice, Tata McGraw Hill Publishing Co. Ltd, New Delhi 2009.

5. Tien-Chienchang, Richard A.Wysk and HSU-Pin (Ben) Wang, ―Computer Aided Manufacturing, 3rd Edition, 2006.

	L	T	P	Cr.
B.Tech. (VI Sem.) 20ME19 - DESIGN OF MACHINE ELEMENTS-II	2	1	-	3

PRE-REQUISITES: Mechanical Engineering Design –I

COURSE EDUCATIONAL OBJECTIVE:

The main objective of this course is to understand and apply the standard procedure available for the design of mechanical components and IC engine components.

COURSE OUTCOMES: At the end of the course, the student will be able to

CO 1: Select suitable bearings under different load, speed, and life conditions. **(Applying - L3)**

CO 2: Design internal combustion engine components for safe and continuous operation**. (Applying - L3)**

CO 3: Select the belt and rope drives for elevators, cranes, and hoisting machinery. **(Applying - L3)**

CO 4: Design the springs under static and dynamic loads. **(Applying - L3)**

CO 5: Estimate the performance parameters of the gears for various loading conditions**. (Applying - L3)**

UNIT – I

SLIDING CONTACT BEARINGS: Types of Journal bearings–Theory of lubrication–Bearing modulus – Full, partial, and fitted journal bearings–Heat generation and heat dissipation of bearings-Bearing materials– Journal bearing design.

ROLLING CONTACT BEARINGS: Ball and roller bearings – Static load carrying capacity – Dynamic load carrying capacity –Equivalent bearing load–Selection of bearing life –Design for cyclic loads and speeds.

UNIT – II

IC ENGINE COMPONENTS

PISTON: Forces acting on piston–Construction–Design and proportions of piston.

CONNECTING ROD: Forces on connecting rod– Buckling of connecting rod - Stress due to whipping action.

CRANK SHAFT: Crank shaft- Design of center crank.

UNIT – III

FLAT BELTS & PULLEYS: Flat belt drive – Materials –Design of belt and pulleys for flat belt drive.

V-BELTS & V-GROOVED PULLEYS: V-belts – Designation - Design of V-belt drive.

UNIT – IV

SPRINGS: Terminology – Types of springs- Stress and deflection equations- Spring materials- Surge in springs - Design of helical compression springs – Springs against fluctuating load - Energy storage capacity–Helical Torsion springs-Concentric springs- Leaf springs.

UNIT – V

SPUR & HELICAL GEARS: Introduction-Spur gears-Helical gears–Lewis's equation-Beam strength of gear tooth–Design of spur gears–Estimation of centre distance, module, and face width- Check for dynamic and wear strength.

TEXTBOOKS

1. Bhandari V.B, Design of Machine Elements, 3rd Edition, TataMcGraw-Hill2010.
2. Sundararajamoorthy T. V, Shanmugam. N, "Machine Design", Anuradha Publications, Chennai, 2003.

REFERENCES

1. Norton R.L–Design of Machinery, TataMcGraw-Hill Book Co, 2004.
2. Shigley J.E and Mischke C.R.―Mechanical Engineering Design‖, TataMcGraw-Hill, 2003.

HANDBOOKSTOBEALLOWED

1. Design Data book by PSG College of Technology, Coimbatore.
2. Design Data Hand book for Mechanical Engineering by Mahadevan.K and K.Balaveera Reddy.

L	T	P	Cr.
3	-	-	3

B.Tech. (VI Sem.)   20ME20 - COMPUTATIONAL FLUID DYNAMICS

PRE-REQUISITES: Fluid Mechanics and Hydraulic Machinery, Heat Transfer

COURSE EDUCATIONAL OBJECTIVE:

To describe the governing equations, approaches, methodologies and applications used in CFD, distinguishes the importance of parabolic, elliptic and hyperbolic equations used in CFD and grid formations, consistency of CFD problems.

COURSE OUTCOMES: At the end of the course, the student will be able to

CO 1: Classify the mathematical models for FEM, FDM, FVM techniques. **(Remembering – L1)**

CO 2: Apply the mathematical and computational methods for fluid flow simulations. **(Applying - L3)**

CO 3: Analyze the computational problems related to fluid flows and heat transfer **(Analyzing - L4).**

CO 4: Distinguishes the grid sensitivity methods and compute the accuracy of a numerical solution. **(Understanding – L2)**

CO 5: Identify the correct numerical algorithm to solve 1D and 2D problems in steady and transient heat transfer conditions **(Applying – L3).**

UNIT - I

INTRODUCTION: Computational Fluid Dynamics as a Research and Design Tool, Applications of Computational Fluid Dynamics, Need for Computational Fluid Dynamics – Different numerical/CFD techniques – FDM, FEM, FVM, Governing Equations Of Fluid Dynamics**,** Control Volume, Substantial Derivative, Divergence of Velocity, Continuity Equation, Momentum Equation and Energy Equation

UNIT - II

MATHEMATICAL DESCRIPTION OF PHYSICAL PHENOMENON: Introduction, Governing differential equations, Nature of the coordinates, Classification of Quasi-Linear Partial Differential Equations - Hyperbolic Equations, Parabolic Equations, Elliptic Equations, Time dependent methods.

UNIT - III

BASICS ASPECTS OF DISCRETIZATION: Introduction, Explicit and Implicit Approaches, Errors and Stability Analysis, Method of deriving discretization equation – Taylor formulation, Grid Generation- Algebraic Grid Generation, Elliptic Grid Generation, Hyperbolic Grid Generation, Parabolic Grid Generation, Difference between structured and unstructured grids – advantages/disadvantages, Cell Centered and Nodal point Approaches.

UNIT – IV

HEAT CONDUCTION: Finite Difference Applications in conduction and convection heat transfer – Heat conduction, steady and transient heat conduction in a rectangular geometry.

UNIT - V

FLUID FLOW EQUATIONS: Introduction, The fluid-flow equations - Integral/control-volume form of the governing equations and Differential forms of the governing equations - Other differential equations of fluid flow, Compressible and incompressible flow, Non-dimensionalisation, Finite Difference Solutions of 2D Viscous Incompressible flow problems – Vorticity and Stream Function Formulation.

TEXT BOOK

1. John. D. Anderson, Computational fluid dynamics – The basics with Applications - Mc Graw Hill 6th Edition 1995.
2. Dr.Atual Sharma, Introduction to Computational Fluid Dynamics: Developments, Applications and Analysis, Athena Academic and Wiley (UK), 1st Edition 2017.

REFERENCE BOOKS:

1. K.A.Hoffman and Steve T Chiang, Computational Fluid Dynamics, Vol.I, 4th Edition, Engineering Education System Publications.
2. Suhas V Patankar, Numerical heat transfer and Fluid flow, Taylor and Francis, 1st Edition, 1980.

L	T	P	Cr.
3	-	-	3

B.Tech. (VI Sem.)   20ME21 - MODERN MACHINING PROCESSES

PREREQUISITES: Machine Tools and Metrology

COURSE EDUCATIONAL OBJECTIVES:

The main objective of this course is to familiarize with unconventional machining processes and rapid prototyping.

COURSE OUTCOMES: After completion of the course student will be able to

CO 1:   Assort appropriate unconventional machining processes for machining materials and to develop relevant industrial solutions for machining materials. **(Understanding - L2)**

CO 2:   Understand the principles of Electro Chemical Machining Process for machining of materials. **(Understanding - L2)**

CO 3:   Comprehend Electrical Discharge Machining principles for machining intricate components. **(Understanding - L2)**

CO 4:   Differentiate the basic principles and applications of thermal machining processes like EBM, LBM and PAM. **(Understanding - L2)**

CO 5:   Identify the appropriate Rapid Prototyping Processes for manufacturing various components. **(Understanding - L2)**

UNIT - I

INTRODUCTION: Need for unconventional machining methods-Classification of unconventional machining processes – considerations in process selection.

MECHANICAL PROCESSES: Basic principle, equipment, process variable and applications of ultrasonic machining, abrasive jet machining and water jet machining.

UNIT - II

ELECTROCHEMICAL PROCESSES: Introduction, principles, equipment and material removal rate in electrochemical machining, electrochemical grinding, electrochemical deburring and electrochemical honing-Chemical machining: principle, maskants, etchants, advantages and applications.

UNIT - III

ELECTRICAL DISCHARGE MACHINING: Introduction, Principle of Electrical Discharge Machining– Power circuits for EDM, Advantages, Limitations, and applications

PROCESS PARAMETERS OF EDM: Mechanics of metal removal in EDM, Process parameters, selection of tool electrode and dielectric fluids, Electric discharge wire cutting principle and applications.

UNIT - IV

ELECTRON BEAM, LASER BEAM AND PLASMA ARC MACHINING: Introduction, Principle, equipment and applications of electron beam machining, laser beam machining, plasma arc machining and hot machining.

UNIT - V

RAPID PROTOTYPING: Introduction, Prototype fundamentals, historical development, fundamentals of Rapid Prototyping, Advantages of Rapid Prototyping, classification of Rapid prototyping. Rapid Prototyping process chain, types of RP: Liquid based Rapid Prototyping, Stereo Lithography Apparatus (SLA), Solid Ground Curing (SGC), Solid based Rapid Prototyping, Powder based Rapid Prototyping: Selective Laser Sintering (SLS), Applications of Rapid Prototyping.

TEXT BOOKS:

1. Pandey P.C. and Shah H.S, Modern Machining Process / TMH.
2. Chua C.K, Leong K.F and Lim C.S, Rapid Prototyping principles and applications, second edition, world scientific publishers. 2003.

REFERENCES

1. M.K.Singh, Unconventional Manufacturing Processes / New age international.
2. VK Jain, Advanced Machining Processes/ / Allied publishers.
3. N.Hopkinson, R.J.M Haque & P.M.Dickens Rapid Manufacturing, John Wiley & Sons, 2006.

	L	T	P	Cr.
20ME22 - CONDITION MONITORING AND				

B.Tech. (VI Sem.)　　　　**FAULT DIAGNOSIS**

L	T	P	Cr.
3	-	-	3

PRE-REQUISITES　: Theory of Machines

COURSE EDUCATIONAL OBJECTIVE:

　　　The main objective of this course is to understand the mechanical condition monitoring and associated instrumentation for different monitoring areas through fault diagnosis.

COURSE OUTCOMES: At the end of the course, the student will be able to

CO 1:　　Understand basic principles of condition monitoring techniques. **(Understanding – L2)**

CO 2:　　Analyze the vibration characteristics of machinery through condition monitoring. **(Analyzing – L4)**

CO 3:　　Identify the faults through various monitoring techniques. **(Applying – L3)**

CO 4:　　Comprehend the various thermal monitoring methods. **(Understanding – L2)**

CO 5:　　Suggest suitable sensors for condition monitoring in various fields of applications. **(Applying – L3)**

UNIT-I

INTRODUCTION: Introduction to condition monitoring, Maintenance strategies, concept of condition monitoring and methods involved- vibration monitoring, visual monitoring, Oil & debris analysis, signature analysis noise monitoring, temperature monitoring, wear and corrosion monitoring.

UNIT-II

VIBRATION MONITORING: Basic vibration theory, vibration measurement and analysis, Rotational machine faults and vibration characteristics. Vibration monitoring to rotating machines. Vibration monitoring and frequency-based spectrum analysis to detect machine condition and faults in bearings and gears.

UNIT - III

FAULT DIAGNOSIS: Dynamic testing of machines and structures, experimental modal analysis, machine condition monitoring and diagnostics. Condition monitoring and signature analysis applications- noise monitoring, temperature monitoring, wear behavior monitoring, corrosion monitoring, performance trend monitoring.

UNIT –IV

THERMAL MONITORING: Introduction to thermal monitoring, thermal monitoring techniques, application of thermal monitoring to manufacturing processes. Thermal imaging camera tool and its application.

UNIT – V

SENSORS FOR CONDITION MONITORING: Accelerometers, strain gauges, eddy current probes and LVDT for measurement of displacement, velocity, and acceleration. Lock in amplifier for signal conditioning. Thermocouples, thermistors, resistance thermometers and junction semiconductor devices for temperature measurement. Radiation pyrometers for temperature measurement, Thermal imaging devices.

TEXT BOOKS

1. Rao J. S, Vibration Condition Monitoring, Narosa Publishing House, 2000.
2. Mohanty A. R. Machinery Condition Monitoring: Principles and Practices CRC press, 2014.

REFERENCES

1. Ramamurthy, Mechanical Vibrations Practice with Basic Theory, Narosa Publishing House.
2. Collacott, R. A., Mechanical Faults Diagnosis, Chapman and Hall, London, 1990
3. Rao, B., Handbook of condition monitoring, Elsevier advanced technology, Oxford, 1996.
4. P Girdhar – Machinery vibration analysis and predictive maintenance.
5. R G Eisenmann et-al – Machinery malfunction diagnosis and correction Choudhary K, Instrumentation, Measurement and Analysis, Tata McGraw Hill.
6. Collacott R.A.- Mechanical fault diagnosis and condition monitoring.

	L	T	P	Cr.
B.Tech. (VI Sem.) 20ME23 – AUTOMATION IN MANUFACTURING	3	0	0	3

PREREQUISITES: Production Technology

COURSE EDUCATIONAL OBJECTIVES:

The course educational objective is to familiarize the principles of automation in production, material handling and manufacturing systems.

COURSE OUTCOMES: After completion of the course students are able to

 CO 1:   Understand the basic elements in automation and production systems. **(Understanding – L2)**

 CO 2:   Comprehend the techniques of automated material handling and storage equipments. **(Understanding – L2)**

 CO 3:   Identify the types of manufacturing systems and single station manufacturing cells. **(Understanding – L2)**

 CO 4:   Differentiate manual assembly and automated flow lines. **(Understanding – L2)**

 CO 5:   Understand the concepts of automated assembly systems and adaptive control systems. **(Understanding – L2)**

UNIT – I

INTRODUCTION TO AUTOMATION: Basic elements of automated system, advanced automation functions, levels of automation. Production System Facilities, Manufacturing Support systems, Automation in Production systems, Automation principles & Strategies.

UNIT – II

AUTOMATED MATERIAL HANDLING: Types of equipment, considerations in material system design, the ten principles of material handling.

MATERIAL TRANSPORT SYSTEMS: Industrial trucks, automated guided vehicle systems, rail guided vehicles, conveyor systems, cranes and hoists.

STORAGE SYSTEMS: Storage system performance, storage location strategies, conventional storage methods and equipment, automated storage systems.

UNIT – III

INTRODUCTION TO MANUFACTURING SYSTEMS: Components of a Manufacturing system, Classification of Manufacturing Systems, overview of Classification Scheme, manufacturing progress functions.

SINGLE STATION MANUFACTURING CELLS: Single Station Manned Workstations and Single Station Automated Cells, applications, analysis of single station cells.

UNIT – IV

MANUAL ASSEMBLY LINES: fundamentals, alternative assembly systems, design for assembly, analysis of single model assembly lines, line balancing algorithms, mixed model assembly lines.

AUTOMATED FLOW LINES: Fundamentals of automated production lines, applications of automated production lines, analysis of transfer lines with no internal storage, analysis of transfer lines with storage buffers.

UNIT – V

AUTOMATED ASSEMBLY SYSTEMS: Fundamentals, design for automated assembly, quantitative analysis of assembly systems.

ADAPTIVE CONTROL SYSTEMS: Introduction, adaptive control with optimization, Adaptive control with constraints, Application of A.C. in Machining operations. Use of various parameters such as cutting force, Temperatures, vibration and acoustic emission.

TEXT BOOKS

1. Mikell P. Groover, Automation, Production Systems and Computer Integrated Manufacturing, Prentice Hall of India Private Ltd, New Delhi,3rd edition, 2008.
2. Yoramkorem, Computer Control of Manufacturing Systems, Tata McGraw Hill Publishing Company Private Ltd, New Delhi.

REFERENCES

1. P.Radhakrishan, S.Subramanyan, V.Raju,"CAD/CAM/CIM", New age International Publishers, 3rd edition, 2010.
2. Pessan David W, Industrial Automation, I Edition, Wiley Publishers, 2011.
3. W. Buekinsham, "Automation", 3rd ed., PHI Publications, 2011

L	T	P	Cr.
-	-	2	1

B.Tech. (VI Sem.)   **20ME62 - HEAT TRANSFER LAB**

PREREQUISITES: Heat Transfer

COURSE EDUCATIONAL OBJECTIVE:

The objective of this course is to understand the modes of heat transfer in various heat transfer equipments used for different applications by conducting experiments.

COURSE OUTCOMES: After completion of the lab students will be able to

CO 1:   Estimate the thermal conductivity of different materials and powders. **(Applying - L3)**

CO 2:   Estimate the value of heat transfer coefficient in free and forced convection. **(Applying - L3)**

CO 3:   Validate the Stefan Boltzman constant and estimate emissivity of grey body. **(Applying - L3)**

CO 4:   Compare the parallel and counter flow heat exchanger performance characteristics. **(Analyzing - L4).**

LIST OF EXPERIMENTS

(At least 10 Experiments are required to be conducted)

1. Composite Slab Apparatus – Overall heat transfer co-efficient.
2. Heat transfer through lagged pipe.
3. Heat Transfer through a Concentric Sphere
4. Thermal Conductivity of given metal rod.
5. Heat transfer in pin-fin apparatus.
6. Experiment on Transient Heat Conduction
7. Heat transfer in forced convection apparatus.
8. Heat transfer in natural convection
9. Parallel and counter flow heat exchanger.
10. Emissivity apparatus.
11. Stefan Boltzmann Apparatus.
12. Heat transfer in drop and film wise condensation.
13. Critical Heat flux apparatus.
14. Study of heat pipe and its demonstration.
15. Study of Two – Phase flow.

REFERENCES

➢ Lab Manuals

L	T	P	Cr.
0	0	3	1.5

B.Tech. (VI Sem.)   **20ME63 – CAD/CAM LAB**

PRE-REQUISITES: Computer Aided Machine Drawing, CAD/CAM

COURSE EDUCATIONAL OBJECTIVE:

The main objective of this course is to design, assemble, analyze and manufacture engineering components using computer aided tools.

COURSE OUTCOMES: At the end of the course, the student will be able to

CO 1: Design and assemble the mechanical components using CAD Software **(Analyzing - L4)**

CO 2: Apply finite element analysis for components using analysis software. **(Applying - L3)**

CO 3: Develop NC code for different part profiles and perform machining on CNC Machine tools. **(Applying - L3)**

CO 4: Simulate part program to perform various operations on CNC machine (**Applying - L3**)

LIST OF EXPERIMENTS

(At least 10 experiments are to be conducted)

1. Design and Assembly Modeling of Knuckle joint using CAD software
2. Design and Assembly Modeling of Universal Coupling using CAD software
3. Design and Assembly Modeling of Piston, Connecting Rod parts using CAD software
4. Analysis of trusses using ANSYS
5. Analysis of Beams using ANSYS
6. Analysis of 3D solids using ANSYS
7. Steady state heat transfer analysis using ANSYS.
8. Estimation of natural frequencies and mode shapes for simple problems using ANSYS
9. Development of NC code using CAM packages
10. Machining of simple components on CNC Turning by transferring NC Code from CAM package
11. Machining of Simple components on CNC-Mill by transferring NC Code from CAM Package
12. Robot programming, simulation, and execution.
13. Analysis of aero foil wing using computational fluid dynamics using ANSYS

SOFTWARE PACKAGES: CATIA /ANSYS / Iron CAD etc.

REFERENCES:

➢ Lab-Manual

	L	T	P	Cr.
B.Tech. (VI Sem.) **20ME64 - ROBOTICS AND SIMULATION LAB**	1	0	2	2

PRE-REQUISITES: Engineering Mechanics, Theory of Machines, Robotics

COURSE EDUCATIONAL OBJECTIVES:

> The main objective of this course is to demonstrate and analysis of various types of robots.

COURSE OUTCOMES: After completion of the laboratory, students will be able to

CO 1: Simulate forward and inverse kinematic movements of a robot using Robo Analyzer and MATLAB. **(Understanding - L2)**

CO 2: Perform the demo operations on SCARA and PUMA using Robo analyzer software. **(Applying - L3)**

CO 3: Experiment the robot operations like palletizing, gluing, spray painting, polishing, loading and Unloading. **(Applying - L3)**

CO 4: Develop Robot Programmes to use to control commands. **(Analyzing - L4)**

LIST OF EXPERIMENTS

(At least 10 Experiments are required to be conducted)

1. Study the anatomy of robots.
2. Analysis of robot configuration and Simulation of Robot with 2 Dof, to6 Dof using Robo Analyzer.
3. Forward and Inverse Kinematics Analysis of Robot using Robo Analyzer.
4. D-H parametric representation of various robotic arms using Robo Analyzer.
5. Dynamic analysis of robot using Robo Analyzer.
6. Simulation of SCARA, PUMA using Robo Aanlyzer.
7. Program for commands like a line command, circle command.
8. Program for commands SPLINE command (continues path).
9. Program for Point to Point (PTP) command.
10. Palletizing.
11. Loading/Unloading.
12. Gluing.
13. Spray painting.
14. Polishing.
15. Simulate forward and inverse kinematics RR Manipulator using MATLAB.
16. Simulate forward and inverse kinematics RP Manipulator using MATLAB.

SOFTWARE PACKAGES: ARISTO ROBOT, C Prog, Robo Analyzer, MAT Lab
REFERENCES:

➢ Lab Manuals

L	T	P	Cr.
1	-	2	2

B.Tech. (VI Sem.)　　　　**20HSS1- SOFT SKILLS COURSE**

Course Educational Objectives:
The Soft Skills Laboratory course equips students with required behavioral, interpersonal & Intrapersonal skills, communication skills, leadership skills etc. It aims at training undergraduate students on soft skills leading to enhanced self-confidence, esteem, and acceptability in professional circles.

Course Outcomes (COs): At the end of the course, student will be able

CO1: To Develop self-awareness and personality traits for professional growth
(Understand – L2)
CO2: Work effectively in multi-disciplinary and heterogeneous teams through knowledge of teamwork, Inter-personal relationships, conflict management and leadership quality.
(Apply – L3)
CO3: Communicate through verbal/oral communication with good listening skills and empathy
(Apply – L3)
CO4: Apply skills required to qualify in recruitment tests, Interviews & other professional assignments (Apply – L3)

Personality Development Skills
Role of language in Personality – How language reflects, impacts Personality – Using gender-neutral language in MNCs – being culturally-sensitive-Personality Traits - Grooming & Dress code
Activities: Group Discussion/Role play/Presentations (authentic materials: News papers, pamphlets and news clippings)

Impactful Communication
Activities : Extempore / Story Telling/ Group Discussion (Case studies/Current affairs etc.)/ Elocution on Interpretation of given quotes/ Critical Appreciation and Textual Analysis/ Writing reviews on short story/videos/book/Social Media profiling/ Pronunciation Practice

Professional Skills:
Career Planning- job vs. career- goal setting- SWOT analysis-Time management – self-management – stress-management.
Activities: SWOT analysis of the self/Goal setting-Presentation/Writing Report/Listening exercises/Effective Resume-Writing and presentation/ Interview Skills: Mock interviews/Video samples.

REFERENCES :
1. Edward Holffman, "Ace the Corporate Personality", McGraw Hill,2001
2. Adrian Furnham, Personality and Intelligence at Work, Psyc 2. hology Press, 2008.
3. M.Ashraf Rizvi, "Effective Technical Communication", 1 st edition, Tata McGraw Hill, 2005
4. Ace of Soft skills Gopalaswamy Ramesh, Pearson Education India, 2018
5. Soft Skills for the Workplace, Goodheart-Willcox Publisher · 2020.
6. How to Win Friends and Influence People, Dale Carnegie · 2020

	L	T	P	Cr.
B.Tech. (VII Sem.) **20ME24 - REFRIGERATION AND AIR CONDITIONING**	3	-	-	3

PRE-REQUISITES: Thermodynamics.

COURSE EDUCATIONAL OBJECTIVES:

This course provides understanding and analyzing the refrigeration and air conditioning systems. It covers the different refrigeration cycles and its analysis and also the concepts of psychrometry and psychrometry process used for the purpose of air conditioning. Further, the comfort air conditioning and cooling load design and estimation also addressed in this course.

COURSE OUTCOMES: After completion of the course, students will be able to

CO1: Describe the basic concepts of refrigeration and its applications. (**Understanding -L2**).

CO2: Evaluate the performance parameters of refrigeration systems. (**Applying –L3**).

CO3: Identify the desirable refrigerants and its use in various refrigeration systems

   (**Remembering –L1**).

CO4: Analyze the psychometric properties and processes used in air conditioning systems (**Analyzing –L4**).

CO5: Estimate the performance parameters of air conditioning systems. (**Applying –L3**)

UNIT - I

REFRIGERATION: Introduction- Necessity and applications, unit of refrigeration and C.O.P-Heat Engine, Refrigerator and Heat pump-Types of Refrigeration systems, and its Applications.

REFRIGERANTS: Classification of refrigerants- Desirable Properties-Nomenclature-Commonly used refrigerants- Alternate refrigerants –Green house effect, global warming, and Ozone layer depletion and Global warming potential.

AIR REFRIGERATION SYSTEM: Introduction-Air refrigeration system working on Reversed Carnot cycle – Air refrigeration system working on Bell Coleman cycle- COP- Open and Dense air systems, Applications.

UNIT - II

VAPOUR COMPRESSION REFRIGERATION SYSTEM: Working principle-Simple vapour compression refrigeration cycle – COP- Representation of cycle on T-s and P-h charts- Effect of Sub cooling and Super heating --Actual vapour compression cycle and its applications- Compound Compression with Inter cooling, Multiple Evaporator and Cascade System.

VCR SYSTEM COMPONENTS: Compressors-Classification-Working -Condensers – Classification-Working-Evaporators –Classification-Working, Expansion devices –Types-Working.

UNIT - III

VAPOUR ABSORPTION REFRIGERATION SYSTEM: Description and working of Aqua-Ammonia system- Calculation of maximum COP- Lithium Bromide- Water system-Principle of operation of three fluid absorption systems, Applications.

STEAM JET REFRIGERATION SYSTEM: Principle of working – Analysis - Applications.

Non Conventional Refrigeration Systems- Thermo electric Refrigeration, Vortex tube refrigeration, adiabatic demagnetization Refrigeration.

UNIT - IV

PSYCHROMETRY: Introduction - Psychometric properties and relations- Psychometric chart Psychometric processes-Sensible, Latent and Total heat–Sensible Heat Factor and Bypass Factor.

THERMODYNAMICS OF HUMAN COMFORT: Human comfort – Thermoregulatory mechanisms of the human body, Effective temperature, Factors affecting the human comfort, comfort parameters,– Comfort chart.

UNIT - V

AIR CONDITIONING SYSTEMS: Introduction-Components of Air conditioning system-Classification of Air conditioning systems-Central and Unitary systems- Packaged air conditioning systems-summer, winter and Year round systems, AC equipments-Fans and blowers-Types of fans, Ducts-its types and air distribution.

DESIGN OF AIR CONDITION SYSTEMS: Cooling load estimation, summer air conditioning – ADP-System with Ventilated and re-circulated air with and without bypass factor- RSHF, GSHF and ESHF and Infiltration design conditions.

NOTE: M.S.Mathur and F.S.Mehta, Refrigerant and Psychometric properties (Tables and Charts), Jain Brothers, data book will be supplied in the exam.

TEXT BOOKS

1. C. P. Arora. , Refrigeration and air conditioning - TMH, 2nd Edition, 2000. (latest addition)
2. S. C. Arora, Domkundwar, A course in refrigeration and air conditioning-DhanapatRai & sons 9th Edition 2018.

REFERENCES

1. R. Dossat, Principles of Refrigeration - - Pearson 4th Edition 2001
1. Manohar Prasad, Refrigeration and Air conditioning, New Age international, 2003
2. Wilbert F.Stoecker, Jerold W. J.Jones, MGH, 1986.

L	T	P	Cr.
3	-	-	3

B.Tech. (VII Sem.) **20ME25 - ADDITIVE MANUFACTURING**

PRE-REQUISITES: Engineering Drawing, Metallurgy and Material Science, Production Technology, Metrology and Machine Tools.

COURSE EDUCATIONAL OBJECTIVE:

The main objective of the course is to acquaint the students with the knowledge of additive manufacturing process, tooling and applications.

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Understand the working principle of additive manufacturing processes. **(Understanding-L2)**

CO2: Distinguish the essential characteristics of additive manufacturing processes. **(Understanding -L2)**

CO3: Identify high energy based systems and materials for manufacturing components. **(Applying –L3)**

CO4: Describe rapid tooling and relevant processes. **(Understanding -L2)**

CO5: Apply various post processing techniques for additive manufacturing applications. **(Applying-L3)**

UNIT-I

INTRODUCTION TO ADDITIVE MANUFACTURING: Introduction to Additive Manufacturing, Additive Manufacturing evolution, Distinction between Additive Manufacturing& CNC machining, Other Associated Technologies, Classification of Additive Manufacturing processes, Commonly Used Terms, Advantages of Additive Manufacturing, Types of Additive Manufacturing materials, Software's, STL files, Creating STL Files, Slicing and types, problems with STL Files, Additive Manufacturing Applications like Medical, Aerospace and Automotive.

UNIT-II

LOWER ENERGY BASED SYSTEMS: Vat Photo polymerization Processes: Stereo lithography (SL), Materials, Process Modelling, Material Jetting process, Binder Jetting process, Extrusion-Based AM Processes: Fused Deposition Modelling (FDM), Principles, Materials, Process, Benefits and Drawbacks, Applications.

UNIT - III

HIGHER ENERGY BASED SYSTEMS: Sheet Lamination Processes: Bonding Mechanisms, Materials, Laminated Object Manufacturing (LOM), Powder Bed Fusion Processes: Materials,

Powder Fusion Mechanisms, Processes, mechanism of bonding, development of lattice structure through powder bed pressure processes.

DIRECT ENERGY DEPOSITION PROCESSES:

Directed Energy Deposition Processes (DEDM), **Process** Description, Material, DED Systems, process, benefits and drawbacks, Applications.

UNIT –IV

RAPID TOOLING: Rapid Tooling (RT), Conventional Tooling Vs RT, Need for RT, Rapid Tooling Classification: Indirect Rapid Tooling Methods: Arc Spray Metal Deposition, Investment Casting, Sand Casting, 3D Keltool process. Direct Rapid Tooling: Direct AIM, LOM Tools, DTM Rapid Tool Process, EOS Direct Tool Process.

UNIT – V

POST PROCESSING METHODS: Support Material Removal, Surface Texture Improvement, Accuracy Improvement, Aesthetic Improvement, Preparation for use as a Pattern, Property Enhancements using Non-thermal and Thermal Techniques.

TEXT BOOKS

1. Ian Gibson, David Rosen, Brent Stucker, Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, Second Edition, Springer New York Heidelberg Dordrecht London, 2015.
2. Hilton P.D. and Jacobs P.F, Rapid Tooling: Technologies and Industrial Applications‖, CRC press, 2000.

REFERENCES

1. Chua C.K., Leong K.F., and Lim C.S, 3D printing and Additive Manufacturing: Principles and applications, Fifth Edition, World Scientific Publishers, 2017.
2. Andreas Gebhardt Jan-Steffen Hötter, Additive Manufacturing: 3D Printing for Prototyping and Manufacturing, Hanser Publications, 6915 Valley Avenue, Cincinnati, Ohio. 2017.
3. Liou L.W. and Liou F.W, Rapid Prototyping and Engineering applications: A tool box for prototype development, CRC Press, 2007.
4. Frank W.Liou, Rapid Prototyping & Engineering Applications, CRC Press, Taylor & Francis Group, 2011.
5. D.T. Pham and S.S. Dimov, Rapid Manufacturing, Springer, 2001.

L	T	P	Cr.
3	-	-	3

B.Tech. (VII Sem.)   **20ME26 - FINITE ELEMENT METHODS**

PRE-REQUISITES: Mechanics of Solids, Heat Transfer.

COURSE EDUCATIONAL OBJECTIVE:

 The main objective of this course is to understand the principles of finite elements and to develop finite models for engineering applications.

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Formulate the equilibrium equations for solving static engineering problems.**(Applying-L3)**

CO2: Compute the characteristics of flexural elements under different loading conditions. **(Applying-L3)**

CO3: Analyze 2-D structures with iso-parametric elements along with Axi-symmetric problems.**(Analyzing-L4)**

CO4: Apply the finite element techniques for solving thermal problems of different geometries. **(Applying-L3)**

CO5: Compute the Eigen values and vectors for bar and beam elements for dynamic analysis. (**Analyzing-L4)**

UNIT- I

INTRODUCTION TO FINITE ELEMENT METHOD: Stress and Equilibrium-Strain-Displacement relations- Stress – strain relations.

ONE DIMENSIONAL PROBLEM: Finite element modelling coordinates and shape functions-Potential Energy approach - Assembly of Global stiffness matrix and load vector Finite element equations- Treatment of boundary conditions.

UNIT - II

ANALYSIS OF BEAMS: Hermite shape functions - Element stiffness matrix for two nodes, two degrees of freedom per node beam element – Treatment of boundary conditions.

UNIT – III

CONSTANT STRAIN TRAINGLE: Finite element modelling of two-dimensional stress analysis with Constant Strain Triangles and treatment of boundary conditions.

AXISYMMETRIC LOADING: Finite element modelling of Axi-symmetric solids subjected to Axi-symmetric loading with triangular elements. Two dimensional four noded-isoparametric elements, problems on isoperimetric formulation of four noded- quadrilateral element.

UNIT - IV

HEAT TRANSFER ANALYSIS: Heat conduction in plane walls, convection heat transfer in fins. Two-dimensional analysis of thin plate with triangular elements-Element conductivity matrix Convection Matrix-Heat rate vector.

UNIT - V

DYNAMIC ANALYSIS: Formulation of finite element model-Lumped and consistent mass matrices-Evaluation of Eigen values and Eigen vectors for a stepped bar and beams.

TEXT BOOKS:

1. Chandraputla, Ashok and Belegundu, Introduction to Finite Elements in Engineering, 6th edition, Prentice-Hall,2014.
2. S.S Rao, The Finite Element Methods in Engineering 6th edition, B.H.Pergamon.2013.

REFERENCE BOOKS:

1. SS Bhavikatti, Finite Element Analysis, New Age International Publishers 3rd edition 2005.
2. JN. Reddy, An introduction to Finite Element Method, 3rd edition, Mc Graw Hill, 2011.
3. George R. Buchanan and R. Rudra Moorthy, Finite Element Analysis, Tata Mc Graw Hill, 2006.

L	T	P	Cr.
3	-	-	3

B.Tech. (VII Sem.)　　　　**20ME27 - PROJECT MANAGEMENT**

PRE-REQUISITES: Nil

COURSE EDUCATIONAL OBJECTIVE:

　　　　The main objective of this course is to create awareness of project management concepts.

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Describe the principles of project management in managing the product life cycle. **(Understanding-L2)**

CO2: Analyse the feasibility studies for effective implementation of projects. **(Analysing-L4)**

CO3: Evaluate the projects using PERT & CPM techniques. **(Applying-L3)**

CO4: Establish financial planning of the project. **(Applying –L3)**

CO5: Identify and manage risks, while handling the projects. **(Understanding –L2)**

UNIT-I

INTRODUCTION TO PROJECT MANAGEMENT: Definition, functions, evolution of Project Management, classification of projects, Project Management in different environments

UNIT-II

PROJECT FEASIBILITY STUDY: Developing a project plan, market and technical analysis, financial analysis, evaluation of project proposals, risk analysis, sensitivity analysis, social cost benefit analysis

UNIT-III

PROJECT PLANNING: Planning fundamentals, project master plan, work breakdown structure and other tools of project planning, work packages project organization structure and responsibilities.

NETWORK SCHEDULING: Critical Path Method, Project Evaluation & Review Technique – Planning and Scheduling of Activity Networks -Assumptions in PERT Modelling – Time-cost Trade-offs – Linear Programming and Network Flow Formulations – PERT/CPM.

UNIT-IV

COST ESTIMATING & BUDGETING: Cost estimating process elements of budgeting, project cost accounting and management information systems, cost schedules and forecasts.

UNIT-V

MANAGING RISKS IN PROJECTS: Risk concept and identification, risk assessment, risk priority, risk response planning, risk management methods.

PROJECT CONTROL: Information monitoring, internal and external project control, cost accounting systems for project control, control process, performance analysis, variance limits, and issues in project control.

TEXT BOOK

1. Project Management for Business & Technology (Principles & Practice) Nicholas, John M. Pearson Education, 12th edition, 2010.

REFERENCE BOOKS

1. Projects: Planning, Analysis, Selection, Implementation & Review, Prasanna Chandra 7thEdition, Tata McGraw Hill, 3rd edition 2009

2. Shtub, Bard and Globerson, PROJECT MANAGEMENT, Engineering, Technology and Implementation, Prentice Hall, India, 3rd edition 2009

3. P.K.JOY, Total Project Management, the Indian Context, Macmillan India Ltd, 12th edition, 2010.

4. N.J.Smith(Ed), Project Management, Blackwell Publishing,2002.

L	T	P	Cr.
3	-	-	3

B.Tech. (VII Sem.) **20ME28 - ALTERNATIVE FUELS AND POLLUTION CONTROL**

PRE-REQUISITES: Thermodynamic, IC Engines and Gas Turbines.

COURSE EDUCATIONAL OBJECTIVES:

The main objective of this course is to provide the knowledge of various alternative fuels and control of engine pollution. It also covers the viability of alternate fuels and their application to the diesel engines. Further, the course covers the various pollutants formed from the engine exhaust and their possible control techniques.

COURSE OUTCOMES: After completion of the course, student will be able to:

CO1: Comprehend various fuels and basics of combustion principles (**Understanding –L2**).

CO2: Describe the process of making alternative fuels from different vegetable oils (**Understanding –L2**).

CO3: Identify various waste resources for alternative fuels and methods of biomass processing. (**Understanding –L2**).

CO4: Analyze the various pollutants released from the engine exhaust (**Analyzing-L4**).

CO5: Apply different pollution control techniques to reduce the emissions (**Applying-L3**).

UNIT-1

FUELS AND COMBUSTION: Energy sources, Introduction to fuels, Types of fuels, Properties of fuels, Analysis of coal, Principle of combustion, Stoichiometric combustion, Calculation for air-fuel ratio, Enthalpy formation, Heating value of fuel, Adiabatic Flame Temperature, Chemical Equilibrium.

UNIT-II

VEGETABLE OILS AS ALTERNATE FUELS: Need of alternative fuels, Different types of vegetable oils, Vegetable oil properties and their importance, Transesterification process, need of blending of vegetable oils, Performance and emission characteristics of vegetable fuels, Advantages, and drawbacks with usage of vegetable oils, Usage of various fuel additives and their influence on engine characteristics, split injection strategy in Biodiesel fuelled engines.

UNIT-III

ALTERNATE FUELS FROM WASTE RESOURCES: Introduction, Overview of Waste resources around the world, Biomass conversion technologies, Biomass as solar energy, Biomass as an automobile fuel, Primary Biomass energy sources, Secondary Biomass sources.

BIO MASS PROCESSING METHODS: Physical processing of biomass, Thermo chemical and Biochemical processing of Biomass, Environmental considerations of biomass, Economics, and future aspects of biomass.

UNIT-IV

ENGINE POLLUTION: Types of Pollutants- Oxides of Nitrogen, Unburnt hydrocarbon, Carbon monoxide emissions, Particulate Emissions, Measurement of emissions- Oxides of Nitrogen, Unburnt hydrocarbon, Carbon monoxide emissions, Particulate Emissions, Health and environmental effects of pollution,

POLLUTION CONTROL TECHNIQUES: Exhaust Gas recirculation, Thermal reactors, Catalytic Convertors, Selective catalytic reduction, NOx traps, Diesel Particulate filters, Continuously Regenerating Trap (CRT), Oxidation Catalysts, Engine modifications to reduce emissions.

UNIT-V

ELECTRIC AND HYBRID VEHICLES: Introduction, Components of electric vehicles, General layout of electric vehicles, Types of electric vehicles, working principle of electric vehicles, Comparison with Internal combustion engines, Merits and demerits of electric vehicles, Hybrid electric vehicles, General layout of hybrid vehicles, comparison with electric vehicles.

TEXT BOOKS:

1. V.Ganesan, Internal Combustion Engines, 4th edition, Tata McGraw Hill Education Private Limited, 2013.
2. Iqbal Hussai, Electric and Hybrid Vehicles Design Fundamentals, 3rd edition, CRC press, 2021.

REFERENCES:

1. S.S. Thipse, Alternative Fuels- Concepts, Technologies and Developments, 2nd edition, Jaico Publishing House, 2010.
2. Paul Degobert, Automobiles and Pollution, SAE International, 1991.
3. James Larminie and John Lowry, Electric Vehicle Technology Explained, 1st edition, J.Wiley , 2003.
4. John B. Heywood, Internal Combustion Engine Fundamentals, 3rd edition, McGraw-Hill series, 2008.

L	T	P	Cr.
3	-	-	3

B.Tech. (VII Sem.)   **20ME29 - AUTOMOBILE ENGINEERING**

PRE-REQUISITES: Thermodynamics, IC engines and gas turbines

COURSE EDUCATION OBJECTIVES:

The objective of this course is to make students learn about automobile layout, Engine Emissions, working of Transmission system, Steering system, Suspension system, Braking system, Fuel system and different Electrical systems.

COURSE OUTCOMES: After completion of the course, student will be able to:

CO1: List and illustrate the basic components of Automobile (**Remembering –L2**).

CO2: Differentiate the Fuel supply systems in petrol and Diesel Engines (**Understanding –L2**).

CO3: Comprehend the function of various Electrical systems in Automobile (**Understanding –L2**).

CO4: Distinguish various transmission systems, Wheels & Tyres (**Understanding –L2**).

CO5: Compare various types of Steering systems, Braking systems and Suspension systems. (**Understanding –L2**).

UNIT-I

INTRODUCTION: Components of Automobile, Classification of Automobiles, Chassis and Frame, Rear wheel drive- Front wheel drive-Four wheel drive.

ENGINE CONSTRUCTION: Cylinder Block and Crankcase- Cylinder Head- Oil Pan- Manifolds- Gaskets- Cylinder Liners- Piston- Connecting Rod- Engine Valves, Firing Order.

ENGINE EMISSIONS AND CONTROL: Nitrogen oxides, Carbon monoxide, Hydrocarbons, Particulates and Soot, Types of pollutants in SI and CI Engines, Thermal Convertors, Three way catalytic convertor, Exhaust gas recirculation.

UNIT- II

ENGINE SERVICING: Engine Removal, Cylinder Head, Gaskets, Valves, Piston-connecting Rod Assembly.

FUEL SUPPLY SYSTEM IN PETROL& DIESEL ENGINES: Fuel supply systems, Fuel pumps, Fuel Gauge, Simple Carburettor, Defects in simple Carburettor, Zenith Carburettor, SU Carburettor, Petrol Injection- Types, Mechanical Petrol Injection, Electronic Petrol Injection, Types of Injection systems in Diesel Engines, Fuel Filters, Air cleaners, Fuel Injector, Governor- Types of Governors.

UNIT - III

IGNITION SYSTEM: Battery Ignition system- Components of Battery Ignition system, Spark plug construction, Magneto Ignition system, Electronic Ignition system- Capacitive discharge Ignition system, Ignition timing.

CHARGING SYSTEM & STARTING SYTEMS: Batteries- Types, Lead-acid battery, Battery Ratings, Charging system- Introduction- Principle of Generator and constructional details- Generator output control, Starting Motor, Starting drives, Bendix rives, Solenoid switch.

UNIT - IV

TRANSMISSION SYSTEM: Clutches- Introduction, Types- Single plate clutch-Multi plate clutch- Centrifugal clutch, Fluid Fly wheel, Necessity of Transmission, Types of Transmission- Sliding Mesh Gear Box- Constant Mesh gear box, Torque convertor, Propeller shaft, Final drive, Differential.

WHEELS AND TYRES: Types of Wheels, Wheel dimensions, Tyre- Types of Tyres, Carcass types, Tyre Materials, Tyre designations, Sensors-Speed control, Traction Control.

UNIT - V

FRONT AXLE AND STEERING: Front Axle, Types of stub axle, Steering geometry- Camber- Kingpin inclination- Combined angle and scrub radius- Castor- Toe in and Toe out, Under steer and Over steer, Power steering, Types of Steering gears.

SUSPENSION SYSTEM: Introduction, Types of Suspension springs, Leaf springs, Coil springs, Torsion bars, Shock Absorbers, Independent suspension- Types, Air-suspension, Suspension Sensors-Types.

BRAKING SYSTEM: Braking Requirements, Types of Brakes, Drum brakes and Disc Brakes, Hydraulic Brakes, Air brakes, Anti-lock braking systems.

TEXT BOOKS

1. Dr. Kirpal Singh, Automobile Engineering-Vol I& II, 13[th]Edition, Standard Publishers Distributors, 2014.
2. R.B.Gupta, Automobile Engineering, 8th edition, Tech India publication series, 2013.
3. Automotive Mechanics, Vol- 1 & 2, Kripal Singh, Standard Publishers.
4. Automobile Engineering, William Course, TMH Distributors

REFERENCES

1. V.A.W Hillier and David R.Rogers, Hillier's Fundamentals of Motor Vehicle Technology, Book1, 5th Edition- 2007.

2. Heinz Heisler, Advanced Vehicle Technology, 2nd Edition, Butterworth-Heinemann Series, 2002.

3. David A Crolla, Automotive Engineering, 1st Edition, Butterworth-Heinemann series, 2009.

	L	T	P	Cr.
B.Tech. (VII Sem.) **20ME30 - PRODUCTION PLANNING AND CONTROL**	3	-	-	3

PRE-REQUISITES: Nil

COURSE EDUCATIONAL OBJECTIVES:

       The main objective of this course is to provide overview of production planning and control.

COURSE OUTCOMES: After completion of the course student will be able to:

CO1: Describe the production planning and control for operating economy, effectiveness, and cost control. **(Understanding - L2)**

CO2: Apply the forecasting techniques in estimating the number of products. **(Applying - L3)**

CO3: Implement the inventory management techniques to determine the optimum quantity of material. **(Applying - L3)**

CO4: Prepare the route sheet required for a production process / activity. **(Applying - L3)**

CO5: Implement the aggregate planning and prepare the dispatch procedure required for a production process and other activities. **(Applying - L3)**

UNIT - I

INTRODUCTION: Definition – Objectives of Production Planning and Control – Functions of production planning and control – Elements of production control – Types of production – Organization of production planning and control department – Internal organization of department.

UNIT - II

FORECASTING: Objectives and Importance of forecasting – Types of forecasting, forecasting techniques-simple moving average method, weighted moving average method, exponential smoothing method, linear regression and Delphi method. Errors in forecasting-MAD, MSE, MAPE, MFE.

UNIT - III

INVENTORY MANAGEMENT: Introduction, purpose of inventories – relevant inventory costs, EOQ model and assumptions in EOQ. ABC analysis – VED analysis. Inventory control systems – P–Systems and Q-Systems.

MATERIAL REQUIREMENT PLANNING: Introduction to MRP, inputs to MRP, Bill of material, JIT inventory – Kanban system. ERP systems – Components, Modules, Implementation, advantages, and disadvantages.

UNIT - IV

ROUTING: Routing procedure –Route sheets– Factors affecting routing. Scheduling –definition – Difference with loading, Scheduling, and loading guidelines, Standard scheduling methods – forward scheduling and backward scheduling, Johnson's rules.

UNIT - V

AGGREGATE PLANNING: Aggregate planning and aggregate planning strategies, Expediting, controlling aspects. Dispatching– Activities of dispatcher – Dispatching procedure, Documents maintained by dispatching department – follow-up – definition – Reason for existence of functions – types of follow-up, applications of computer in production planning and control.

TEXT BOOKS

1. R.Panneerselvam, Production/Operations Management, Prentice Hall of India Pvt Ltd, 4th edition, 2016.

2. P.Rama Murthy, Production and Operations Management, New Age International, 3rdEdition, 2009.

REFERENCES

1. Production and Operations Management/ S.N.Chary, TMcH, 6thEdition 2019.

2. Elements of Production Planning and Control/ Samuel Eilon, Universal Publishing Corporation, 4th edition, 2017.

3. Modern Production/ Operations Management/ Elwood S.Buffa and Rakesh K.Sarin, Wiley; 8thedition, 2007.

4. Operations Management / Joseph.G.Monks, McGraw-Hill Inc., 6threvised edition, 2020.

L	T	P	Cr.
3	-	-	3

B.Tech. (VII Sem.)   **20ME31- TRIBOLOGY**

PRE-REQUISITES: Mechanical Engineering Design-I.

COURSE EDUCATIONAL OBJECTIVE:

This course provides the knowledge on principles of Tribology (friction, wear, lubrication), with particular emphasis on lubricating system, surface characterization techniques, experimental techniques in Tribology.

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Illustrate the characteristic features of tribology. **(Understanding-L2)**

CO2: Comprehend friction, wear theories and their measurement techniques. **(Understanding-L2)**

CO3: Apply theories of hydrodynamic lubrication for effective lubrication in bearings. (**Applying-L3**)

CO4: Analyze the various design parameters of hydrostatic lubricated bearings under different loading conditions.**(Analyzing-L4)**

CO5: Identify appropriate materials for designing anti frictional bearings. **(Understanding-L2)**

UNIT- I

INTRODUCTION TO TRIBOLOGY: Tribology and their characteristic feature, analysis and assessment of surface, Topography, Deterministic and Stochastic, Tribo models for asperity contacts, Techniques of surface examination, and Technological properties of surfaces. Viscosity, flow of fluids, viscosity, and its variation - absolute and kinematic viscosity, temperature variation, viscosity index determination of viscosity, different viscometers, Viscosity standards.

UNIT - II

FRICTION AND WEAR: Types of friction, Theories of friction, Study of current concepts of boundary friction and dry friction, friction reducing measures. Causes of wear, Types of wear, Mechanism of various types of wear, laws of wear, and effects of wear.

UNIT – III

INTRODUCTION TO LUBRICATION: Boundary lubrication; hydrodynamics, hydrostatic and elasto-hydrodynamic lubrication, Functions of lubricants, Types of lubricants and their physical properties, industrial applications; SAE classification.

THEORY OF HYDRODYNAMIC LUBRICATION: Petroff's equation, Reynolds's equation in two dimensions, bearing modulus, Somerfield number, Effects of side leakage, pressure, flow, load capacity and friction calculations, heat balance, minimum oil film thickness, oil whip and whirl.

UNIT - IV

THEORY OF HYDROSTATIC LUBRICATION: Hydrostatic step bearing, pivoted pad thrust bearing, hydrostatic lifts, hydrostatic squeeze films, pressure, flow, load capacity and friction calculations, oil rings, pressure feed bearing, partial bearings, externally pressurized bearings, Air lubricated bearing, Advantages, and disadvantages.

AIR/GAS LUBRICATED BEARING: Advantages and disadvantages of air/ gas lubrication for Hydrodynamic journal bearings, hydrodynamic thrust bearings. Hydrostatic thrust bearings. Hydrostatic bearing Analysis

UNIT - V

ANTI-FRICTION BEARINGS AND BEARING MATERIALS: Anti-friction bearings, types, Advantages and disadvantages, General requirements of bearing materials, types of bearing materials, General bearing design considerations.

TEXTBOOKS:

1. Basu S.K, Sen Gupta and Ahuja, Fundamentals of Tribology PHI Learning Private Limited, 2010.
2. GwidonWStachowiak and Andrew W Batchelor, Engineering Tribology, 3rd Edition, Elsevier,2011.

REFERENCES:

1. Sushil Kumar Srivastava, Tribology in Industry, S. Chand &Co,2001.
2. B.C. Majumdar, Tribology, S. Chand& Co,2010.
3. Rabinowitz, Friction and Wear of materials, John willey& Sons,2006.
4. Halling. J, Macmillan, Principles of Tribology,1978.
5. Williams. J.A, Engineering Tribology, Oxford University Press,1994.

L	T	P	Cr.
3	-	-	3

B.Tech. (VII Sem.)   **20ME32 - POWER PLANT ENGINEERING**

PRE-REQUISITES: Applied Thermodynamics and Heat Transfer

COURSE EDUCATIONAL OBJECTIVE:

This course provides understanding of the power plant engineering fundamentals which includes the details of steam, hydro, gas nuclear, combined cycle power plants along with solar, wind and geothermal power energy systems in addition to the direct energy conversion systems. The economics of power generation and the environmental aspect of power generation are also being addressed in this course.

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Describe the energy scenario, the energy generation sources and various circuitry systems in power plants. **(Understanding – L2)**

CO2: Draw the layout of different power plants. **(Remembering – L1)**

CO3: Compute the power generation from different power plants. **(Applying – L3)**

CO4: Analyze the input parameters requirement for power generation from various power plant systems. **(Analyzing-L4)**

CO5: Calculate the economics of power generation from various power plants, pollution issues from power plant systems. (**Applying – L3**)

UNIT - I

ENERGY RESOURCES: Introduction, Energy scenario, Various Energy Sources-Types of power plants-Resources and Development of Power in India.

STEAM POWER PLANT: Plant Layout-Working of Different Circuits-Types of Coal-Coal handling systems--Coal storage- Overfeed and Underfeed fuel beds-Pulverized Fuel burning system -Ash handling systems-Dust collection and its disposal-Mechanical type -Electrostatic Precipitator-Cooling Towers and heat rejection.

UNIT - II

DIESEL POWER PLANT: General layout, Components of Diesel power plant, Performance of diesel power plant, fuel system, lubrication system, air intake and admission system, supercharging system, exhaust system, diesel plant operation and efficiency, heat balance, Site selection of diesel power plant, Comparative study of diesel power plant with steam power plant.

GAS TURBINE PLANT: Introduction-Classification-Layout with auxiliaries-Principles of working of Closed and Open cycle gas turbines-introduction to combined cycle power plants and comparison. Numerical problems on closed cycle gas turbines.

UNIT - III

HYDRO ELECTRIC POWER PLANT: Hydrology-Hydrological cycle- Rainfall- Run off Hydrograph- Flow duration curve- Mass curve--Site selection of hydro plant-layout and types of hydro plants. Numerical problems on hydro power generation.

NUCLEAR POWER GENERATION: Nuclear Fission and Fusion - Nuclear Fuels- Breeding-Components of Reactor-Types of Nuclear Reactors-Pressurized water reactor (PWR)-Boiling water reactor (BWR)-CANDU reactor-Gas cooled reactor-Liquid metal cooled reactor-Fast Breeder Reactor-Nuclear waste and its Disposal. Simple problems on nuclear power generation.

UNIT - IV

COMBINED CYCLE POWER GENERATION: Introduction, Working of cogeneration, and combined cycles, Performance of Combined cycle, Future scenario of Combined Cycles. Numerical Problems on combined cycle.

DIRECT ENERGY CONVERSION SYSTEMS: Solar cell- Fuel cell-Thermo Electric and Thermo ionic conversion system-MHD generation. Numerical problems on fuel cell.

UNIT - V

ECONOMICS OF POWER GENERATION: Factors affecting the economics, Load factor, Utilization factor, Performance and operating characteristics of Power Plants-Economic load sharing, Depreciation-Energy Rates-Criteria for optimum loading-Specific economic energy generation problems.

POLLUTION AND CONTROL: Introduction- Particulate and gaseous pollutants-Air and Water pollution by Thermal plants and its control—Acid rains -Methods to control pollution.

TEXTBOOKS

1. P.K.Nag, Power Plant Engineering, 4th Edition ,2020 TMH, New Delhi
2. Arora&Domkundwar, A course in Power Plant Engineering- DhanpatRai&Company 5th Revised Reprint Edition, 2004

REFERENCES

1. R.K.Rajput, A Text book of Power Plant Engineering, Laxmi Publications ,2nd Edition 2001
2. P.C.Sharma, Power Plant Engineering, 9th Revised & Reprint Edition 2012, S.K.Kataria& Sons
3. P.K.Nag, power plant engineering-2020
4. M.M.ElWakil, Power plant technology, 3rd Edition 2010 TMH.
5. G.R.Nagpal, Power plant engineering, Khanna Publishers.14th Edition 2000.

		20ME33 – PRINCIPLES OF ENERGY	**L**	**T**	**P**	**Cr.**
B.Tech. (VII Sem.)		**CONSERVATION AND MANAGEMENT**	3	-	-	3

Pre-requisites: Thermodynamics, Applied Thermodynamics

Course Educational Objective:

To provide the insights on the significance of energy conservation and its management in wide variety of utilities of thermal and electrical systems and estimating the economics of energy systems.

Course Outcomes: At the end of the course, the student will be able to:

CO1: Understand the principles of energy conservation and audit. **(Understanding-L2)**

CO2: Estimate the thermal load for building heating and cooling applications. **(Applying -L3)**

CO3: Apply the energy conservation programme for different utilities. **(Applying-L3)**

CO4: Describe the energy and power management opportunities in electrical industries. **(Understanding -L2)**

CO5: Compute the payback periods for the economic analysis of energy conservation and management. **(Applying -L3)**

UNIT - I

PRINCIPLES OF ENERGY CONSERVATION AND MANAGEMENT: Introduction, Energy scenario, general principles of energy management and energy management planning, energy audit instruments, energy audit report, monitoring, evaluating and following up energy saving measures in utilities, Energy consumption patterns, Resource availability.

UNIT - II

BUILDING ENERGY CONSERVATION: Introduction, Evaluation of thermal performance, calculation of heat loss – heat gain, estimation of annual heating & cooling load factors that influence thermal performance, analysis of existing buildings.

UNIT - III

ORGANIZING ENERGY CONSERVATION PROGRAMME: Introduction, energy audit and energy information system, technology for energy conservation, co-generation of process, steam & electricity.

CASE STUDIES: Case studies of energy conservation, energy conservation opportunity, Energy conservation in I. C. Engine, commercial options in waste heat recovery equipment, Computer controlled energy management.

UNIT - IV

ELECTRICAL ENERGY CONSERVATION: Strategies for electricity and management, setting up an energy management programme, electricity saving technique by category of end use, Electrical end use in industries, energy & power management in industry, energy management strategies for industry, demand management.

UNIT - V

ENERGY ECONOMICS AND MANAGEMENT: Importance and role of energy management, Energy economics, Payback period, Internal rate of return, financial evaluation of energy projects, evaluation of proposals, profitability index, life cycle costing approach, investment decision and uncertainty.

TEXT BOOKS:

1. Craig B. Smith, "Energy Management Principles", Pergamon Press, 2015.
2. Wayne C. Turner, "Energy Management Hand Book", The Fairmount Press, Inc., 2001.
3. Albert Thumann, "Handbook of Energy Audits", Sixth Edition, The Fairmount Press, 2003.

REFERENCE BOOKS:

1. Hamies, Energy Auditing and Conservation, Methods, Measurements, Management and Case Study, Hemisphere, Washington, 1980.
2. Kreith, Economics of Solar Energy and Conservation Systems, Vol -3. 5.
3. W.F.Kenny, Energy Conservation in Process Industry.
4. Trivedi, P.R, Jolka K.R., Energy Management, Commonwealth Publication, New Delhi,1997.
5. Witte, Larry C, Industrial Energy Management and Utilization, Hemisphere Publishers, Washington, 1988.

	L	T	P	Cr.
B.Tech. (VII Sem.) **20ME34 - COMPOSITE MATERIALS**	3	-	-	3

PRE-REQUISITES: Metallurgy and Material Science

COURSE EDUCATIONAL OBJECTIVE:

      To impart the fundamentals of composite materials with different reinforcement, matrix materials and comprehend the types of manufacturing methods for advance composite materials to meet various engineering requirements.

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Identify the behaviour of reinforced composite materials for specific applications **(Understanding-L2)**

CO2: Illustrate various reinforcements and fibre matrices.**(Applying-L3)**

CO3: Comprehend the design process and analysis for composite structures. **(Applying-L3)**

CO4: Describe different manufacturing methods for composite materials. **(Understanding-L2)**

CO5: Distinguish the characteristics of metal matrix, ceramic matrix, and carbon matrix composites **(Understanding-L2).**

UNIT- I

BASICS OF COMPOSITE MATERIALS: Classification and characteristics of composite materials - Mechanical behaviour – Polymer matrix composites – Metal matrix composites – Ceramic matrix composites - Basic terminology and Manufacture of laminated fibre - Reinforced composite materials - Current and potential advantages – Structural and Multifunctional - Applications of composite materials.

UNIT - II

REINFORCEMENT AND MATRICES: Different types of fibres and resins – Glass – Boron – carbon – organic – ceramic – whiskers and other Non oxide Reinforcements - Properties and applications of fibres - Roll of matrix - Matrix materials, Selection of matrix -Thermoset matrix - Thermoplastic matrix, Fibre architecture – Natural Fibre.

UNIT – III

DESIGN OF COMPOSITE STRUCTURE: Elements of Design - Steps in design process – Static, dynamic and stability analysis – Laminated composites plates - inter laminar stresses – stress distribution in fibre and the matrix.

DESIGN ANALYSIS STAGES: Material selection - Configuration selection - Laminate joints - Design requirements and design failure criteria.

UNIT – IV

MANUFACTURING OF COMPOSITES: Fundamentals terms – requirement and selection of constituents - Bagging films - Moulding process - Compression Moulding - Pultrusion – pre-peg layer - Filament winding - Liquid composite Moulding processes - Resin film infusion -Elastic reservoir Moulding -Tube rolling - Forming methods for thermoplastic matrix composites.

UNIT - V

METAL, CERAMIC AND CARBON MATRIX COMPOSITES: Metal matrix composites (MMC) - Characteristics of MMC – Types – reinforcement effects – volume fraction – rule of mixtures – processing of MMC - Ceramic matrix composites (CMC) – types and properties – sintering – cold and hot isostatic pressing - processing of CMC - Carbon matrix composites – Characteristics and constituents - Fabrication methods - Applications.

TEXTBOOKS:

1. Krishnan K., Chawla "Composite Materials Science and Engineering", Springer (India) Private Limited, 2016.

2. P.K. Mallick, "Fibre Reinforced Composite materials, Manufacturing and Design", CRC Press, Taylor and Francis Group, Boca Raton, London, New York, 2014.

3. Ronald F. Gibson "Principles of Composites Materials Mechanics" CRC Press Taylor and Francis Group, Boca Raton, London, New York, 2012.

REFERENCES:

1. A.K. Bhargava, "Engineering Materials: Polymers, ceramics and composites", Pentice Hall of India Limited, 2012.

2. Hyer M., Stress Analysis of Fibre – "Reinforced Composite Materials", Tata McGraw Hill, 2010.

3. Madhujit Mukhopadhyay, "Mechanics of Composite Materials and Structures", Universities Press (India) Private Limited, 2009.

4. Robert M. Jones, "Mechanics of Composite Materials", Taylor & Francis Group, 2012.

5. Web Portal: Composite Materials {NPTEL. Mechanical Engineering}

L	T	P	Cr.
3	-	-	3

B.Tech. (VII Sem.)   **20ME35 - TOTAL QUALITY MANAGEMENT**

PRE-REQUISITES: Nil

COURSE EDUCATIONAL OBJECTIVE:

The main objective of this course is to familiarize the concepts of quality management techniques in industries.

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Comprehend the principles and strategies of quality control. **(Understanding - L2)**

CO2: Apply the principles of total quality management to improve the quality of the product. **(Applying - L3)**

CO3: Choose the appropriate statistical quality control tool to check the process capability. **(Applying - L3)**

CO4: Examine various TQM techniques for industrial applications. **(Applying - L3)**

CO5: Interpret ISO quality standards in an organization. **(Understanding - L2)**

UNIT - I

INTRODUCTION: Evolution of total quality management, Definition of Quality, Quality costs, Quality Council, Strategic Planning, Deming Philosophy, Barriers to TQM Implementation.

UNIT - II

TQM PRINCIPLES: Customer satisfaction- Types of Customers, customer supply chain, customer perception of quality, customer feedback, customer retention, Service quality. Employee Involvement, Motivation, Maslow's hierarchy of needs, Herzberg theory, Empowerment and Team work, Performance appraisal, Benefits.

CONTINUOUS PROCESS IMPROVEMENT: Continuous process improvement- Juran Trilogy, PDSA cycle, 5S, Kaizen, Supplier Partnership- Partnering, sourcing, supplier selection, Performance Measures-Basic Concepts, Strategy, Performance Measure.

UNIT - III

STATISTICAL PROCESS CONTROL: The seven tools of quality, Statistical Fundamentals, Population and Sample, Normal curve, Control charts for variables and attributes, Process Capability.

SIX SIGMA:

Introduction to six sigma, indicators of six sigma, principle, elements, process, advantages, limitations, applications.

UNIT - IV

TQM TOOLS: Benchmarking, Benchmarking Process, Quality Function Deployment (QFD), House of Quality, QFD Process, Taguchi Quality Loss Function, Total Productive Maintenance- Concept, improvement needs, FMEA- Stages of FMEA.

UNIT - V

QUALITY SYSTEMS: Need for ISO 9000 and other Quality systems, ISO 9000:2000 Quality System, Implementation of Quality system, Documentation, Quality Auditing, TS 16949, ISO 14000- concepts.

TEXT BOOK

1. Dale H. Besterfiled, et al., Total Quality Management, Pearson Education, 3rd Edition 2010.

REFERENCES

1. James R. Evans & William M. Lidsay, The Management and Control of Quality, South-Western (Thomson Learning), 2002.
2. Feigenbaum.A.V, Total Quality Management, MCGraw-Hill, 2005.
3. Narayana V. and Sreenivasan, N.S, Quality Management- Concepts and Tasks, New Age International, 2006.
4. Zeiri, Total Quality Management for Engineers, Wood Head Publishers, 2009.

	L	T	P	Cr.
B.Tech. (VII Sem.) **20HS03 - INDUSTRIAL ECONOMICS AND MANAGEMENT**	3	-	-	3

PRE-REQUISITES: Nil

COURSE EDUCATIONAL OBJECTIVE:

The main objective of this course is to familiarize the concepts of quality management techniques in industries.

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Comprehend the principles of Management. **(Understanding-L2)**

CO2: Estimate the budget requirements considering break even analysis for industrial applications.**(Applying-L3)**

CO3: Implement work study techniques to identify the effective method of production. **(Applying-L3)**

CO4: Apply the principles of quality control to check the process capability and quality of the product. **(Applying-L3)**

CO5: Describe the functions of human resource management. **(Understanding-L2)**

UNIT-I

INTRODUCTION: Management - Definition, Nature, Importance of management Functions of Management - Taylor's scientific management theory, Fayal's principles of management, Contribution of Elton mayo, Maslow, Herzberg, Douglas Mc Gregor Theories, basic concepts of Organization- Authority, Responsibility Delegation of Authority, Span of control, Departmentation and Decentralization.

ORGANIZATIONAL STRUCTURE: - Organization structures: Line organization, Line and staff organization, Functional organization, Committee organization, Matrix organization, Advantages, Limitations, Applications

UNIT-II

COST ANALYSIS: Cost concepts. Break-even Analysis (BEA)-Determination of Break-Even Point (simple problems) - Managerial Significance.

CAPITAL BUDGETING: Capital and its significance, Types of Capital, Estimation of Fixed and Working capital requirements, Methods and sources of raising capital - Trading Forecast, Capital Budget, Cash Budget.

UNIT-III

OPERATONS MANAGEMENT: Plant location, Factors influencing location, Principles and types of plant layouts - Methods of production: job, batch and mass production, Applications

WORK STUDY: Work study - Basic procedure involved in method study and Work measurement, advantages, limitations, applications.

UNIT-IV

QUALITY AND MATERIALS MANAGEMENT: Statistical quality control - Meaning Variables and attributes - X chart, R Chart, C Chart, P Chart, simple Problems, Acceptance sampling, Sampling plans, Deming's contribution to quality.

UNIT-V

HUMAN RESOURCE MANAGEMENT (HRM): Concepts of HRM, Personal management and industrial relations,

FUNCTIONS OF HR MANAGER: Manpower planning, Recruitment, Selection, Training and development, Placement, Wage and salary administration, Promotion, Transfers Separation, performance appraisal, Job evaluation and merit rating.

TEXT BOOK

1. Dr A.R.Aryasri, Management Science; TMH, 4th Edition 2009.

REFERENCES

1. Neville Stanton et al., Handbook of Human Factors and Ergonomics Methods; CRC press, 2009
2. Khan MI; Industrial Ergonomics; PHI Learning

	L	T	P	Cr.
B.Tech. (VIII Sem.) **20PI03 -PROJECT WORK**	-	-	-	12

Pre-Requisites: Knowledge gained in all the theory, practical courses, industrial training, mini project and internship.

Course Educational Objective: The main objective of this course is to make the student to plan and execute a project as an individual and team using the available recourses within and outside the institute.

Course Outcomes: After completion of the course students will be able to:

CO1: Apply the engineering knowledge to prepare the prototype and experimental setup layouts. **(Applying –L3)**

CO2: Analyze the complex engineering problems relevant to society, industry, environment and sustainability. **(Analyzing -L4)**

CO3: Design and develop a prototype models and experimental setups with the knowledge of mathematics, science and engineering. **(Designing –L6)**

CO4: Implement the project management and modern IT Tools to make a project reports with results and discussions. **(Analyzing -L4)**

CO5: Exhibit the individual and team work skills with professional and ethical values and communicate the project works effectively with society. **(Applying- L3)**