COURSE STRUCTURE

I SEMESTER

S. No	Course code	Course Title	Contact hours/week				Credits	Scheme of Valuation		
			L	T	P	Total		CIE	SEE	Total
1	17FE01	Professional Communication - I	3	-	-	3	3	40	60	100
2	17FE04	Differential Equations and Linear Algebra	3	2	-	5	4	40	60	100
3	17FE13	Engineering Physics	3	2	-	5	4	40	60	100
4	17CI01	Computer Programming	2	2	-	4	3	40	60	100
5	17ME01	Engineering Graphics	2	2	-	4	3	40	60	100
6	17FE60	English Communication Skills Lab	-	-	2	2	1	40	60	100
7	17FE63	Engineering Physics Lab	-	-	2	2	1	40	60	100
8	17CI60	Computer Programming Lab	-	-	2	2	1	40	60	100
9	17ME60	Engineering Workshop	1	-	2	3	2	40	60	100
		Total	**14**	**8**	**8**	**30**	**22**	**360**	**540**	**900**

II SEMESTER

S. No	Course code	Course Title	Contact hours/week				Credits	Scheme of Valuation		
			L	T	P	Total		CIE	SEE	Total
1	17FE02	Professional Communication - II	3	-	-	3	3	40	60	100
2	17FE06	Transformation Techniques and Vector Calculus	3	2	-	5	4	40	60	100
3	17FE14	Applied Chemistry	4	-	-	4	4	40	60	100
4	17EE52	Basic Electrical Engineering	2	2	-	4	3	40	60	100
5	17ME02	Engineering Mechanics	2	2	-	4	3	40	60	100
6	17FE64	Applied Chemistry Lab	-	-	2	2	1	40	60	100
7	17EE71	Basic Electrical Engineering Lab	-	-	2	2	1	40	60	100
8	17ME61	Engineering Mechanics and Fuel Testing Lab	-	-	2	2	1	40	60	100
9	17ME62	Computer Aided Engineering Graphics Lab	1	-	2	3	2	40	60	100
		Total	**15**	**6**	**8**	**29**	**22**	**360**	**540**	**900**

III SEMESTER

S.No	Course code	Course Title	Contact hours/week				Credits	Scheme of Valuation		
			L	T	P	Total		CIE	SEE	Total
1	17FE03	Environmental Science	3	-	-	3	3	40	60	100
2	17FE07	Numerical Methods and Fourier Analysis	3	2	-	5	4	40	60	100
3	17EC50	Basic Electronics Engineering	2	2	-	4	3	40	60	100
4	17ME03	Thermodynamics	2	2	-	4	3	40	60	100
5	17ME04	Mechanics of Solids	2	2	-	4	3	40	60	100
6	17ME05	Metallurgy and Material Science	3		-	3	3	40	60	100
7	17EC75	Basic Electronics Engineering Lab	-	-	2	2	1	40	60	100
8	17ME63	Metallurgy and Material Science Lab	-	-	2	2	1	40	60	100
9	17ME64	Materials Testing Lab	-	-	2	2	1	40	60	100
10	17PD01	Problem Assisted Learning	-	-	1	1	0	100	-	100
		Total	**15**	**08**	**07**	**30**	**22**	**460**	**540**	**1000**

IV SEMESTER

S.No	Course code	Course Title	Contact hours/week				Credits	Scheme of Valuation		
			L	T	P	Total		CIE	SEE	Total
1	17FE08	Probability and Statistics	3	2	-	5	4	40	60	100
2	17ME06	Operations Research	3	-	-	3	3	40	60	100
3	17ME07	Fluid Mechanics and Hydraulic Machinery	3	-	-	3	3	40	60	100
4	17ME08	Production Technology	3	-	-	3	3	40	60	100
5	17ME09	Applied Thermodynamics	2	2	-	4	3	40	60	100
6	17ME10	Kinematics of Machines	3	-	-	3	3	40	60	100
7	17ME65	Production Technology Lab	-	-	2	2	1	40	60	100
8	17ME66	Computer Aided Machine Drawing Lab	-	-	2	2	1	40	60	100
9	17ME67	Fluid Mechanics and Hydraulic Machinery Lab	-	-	2	2	1	40	60	100
10	17PD02	Problem Based Learning	-	-	1	1	0	100	-	100
11	17PD03	Professional Ethics and Human Values	3	-	-	3	0	40	60	100
		Total	**20**	**04**	**07**	**31**	**22**	**500**	**600**	**1100**

V SEMESTER

S.No	Course code	Course Title	Contact hours/week				Credits	Scheme of Valuation		
			L	T	P	Total		CIE	SEE	Total
1	17ME11	Industrial Management	3	-	-	3	3	40	60	100
2	17ME12	IC Engines and Gas Turbines	3	-	-	3	3	40	60	100
3	17ME13	Mechanical Engineering Design - I	2	2	-	4	3	40	60	100
4	17ME14	Dynamics of Machines	2	2	-	4	3	40	60	100
5	17ME15	Metal Cutting and Machine Tools	2	2	-	4	3	40	60	100
6	**PROGRAMME ELECTIVE - I**		3	-	-	3	3	40	60	100
	17ME16	Non-Conventional Energy Sources								
	17ME17	Mechanical Vibrations								
	17ME18	Non Destructive Evaluation and Testing								
	17ME19	Optimization Techniques for Engineers								
7	17ME68	Machine Tools and Dynamics Lab	-	-	2	2	1	40	60	100
8	17ME69	Thermal Engineering Lab	-	-	2	2	1	40	60	100
9	17PD04	Mini Project	-	-	4	4	2	100	-	100
10	17ME90	Energy, Environment and Pollution **(*Add on course – I)**	3	-	-	3	3	40	60	100
11	17PD05	Employability Enhancement Skills - I	1	-	-	1	0	100	-	100
12	17PD06	Industrial Training/In-house Training	-	-	-	-	-	-	-	-
		Total	**19**	**6**	**8**	**33**	**22/25***	**560**	**540**	**1100**

VI SEMESTER

S.No	Course code	Course Title	Contact hours/week				Credits	Scheme of Valuation		
			L	T	P	Total		CIE	SEE	Total
1	17ME20	Heat Transfer	2	2	-	4	3	40	60	100
2	17ME21	Mechanical Engineering Design - II	2	2	-	4	3	40	60	100
3	17ME22	CAD/CAM	3	-	-	3	3	40	60	100
4	17ME23	Finite Element Analysis	3	-	-	3	3	40	60	100
5	**PROGRAMME ELECTIVE - II**		3	-	-	3	3	40	60	100
	17ME24	Automobile Engineering								
	17ME25	Conditional Monitoring								
	17ME26	Modern Machining Processes								
	17ME27	Managing Innovation and Entrepreneurship								
6	**OPEN ELECTIVE – I**		3	-	-	3	3	40	60	100
7	17FE61	Presentation Skills Lab	-	-	2	2	1	40	60	100
8	17ME70	CAD/CAM Lab	-	-	2	2	1	40	60	100
9	17ME71	Heat Transfer Lab	-	-	2	2	1	40	60	100
10	17PD07	Seminar	-	-	2	2	1	100	-	100
11	17ME91	Design of Experiments **(*Add on course – II)**	3	-	-	3	3	40	60	100
12	17PD08	Employability Enhancement Skills - II	1	-	-	1	0	100	-	100
		Total	**20**	**04**	**08**	**32**	**22/25***	**600**	**600**	**1200**

VII SEMESTER

S.No	Course code	Course Title	Contact hours/week				Credits	Scheme of Valuation		
			L	T	P	Total		CIE	SEE	Total
1	17ME28	Refrigeration and Air Conditioning	2	2	-	4	3	40	60	100
2	17ME29	Robotics	2	2	-	4	3	40	60	100
3	17ME30	Metrology and Instrumentation	2	2	-	4	3	40	60	100
4	**PROGRAMME ELECTIVE - III**		3	-	-	3	3	40	60	100
	17AE25	Computational Fluid Dynamics								
	17ME31	Fundamentals of Tribology								
	17ME32	Mechatronics								
	17ME33	Production Planning and Control								
5	**PROGRAMME ELECTIVE – IV**		3	-	-	3	3	40	60	100
	17ME34	Power Plant Engineering								
	17AE29	Theory of Elasticity								
	17ME35	Additive Manufacturing								
	17ME36	Total Quality Management								
6	**OPEN ELECTIVE – II**		3	-	-	3	3	40	60	100
7	17ME72	Robotics and Simulation Lab	-	-	2	2	1	40	60	100
8	17ME73	Metrology and Instrumentation Lab	-	-	2	2	1	40	60	100
9	17PD09	Internship	-	-	1	1	2	100	-	100
10	17PD10	Extra-curricular/Co-curricular Activities	-	-	1	1	-	-	-	-
11	17ME92	Computer Integrated Manufacturing **(*Add on course – III)**	3	-		3	3	40	60	100
		Total	**18**	**6**	**6**	**30**	**22/25***	**460**	**540**	**1000**

VIII SEMESTER

S.No	Course code	Course Title	Contact hours/week				Credits	Scheme of Valuation		
			L	T	P	Total		CIE	SEE	Total
1	**PROGRAMME ELECTIVE - V**		3	-	-	3	3	40	60	100
	17ME37	Energy Conservation and Management								
	17ME38	Mechanics of Composite Materials								
	17ME39	Automation in Manufacturing								
	17ME40	Project Planning andManagement								
2	**PROGRAMME ELECTIVE - VI**		3	-	-	3	3	40	60	100
	17ME41	Nuclear Science and Engineering								
	17ME42	Fracture Mechanics								
	17ME43	Estimation, Costing and Engineering Economics								
	17ME44	Plant Layout and Material Handling								
3	**OPEN ELECTIVE - III**		3	-	-	3	3	40	60	100
4	17PD11	Project Work	-	-	24	24	12	40	60	100
5	17PD12	Comprehensive Viva-Voce	-	-	2	2	1	100	-	100
		Total	**09**	**-**	**26**	**35**	**22**	**260**	**240**	**500**

OPEN ELECTIVE – I (VI Semester)

S.No.	Course Code	Title of the Course	Offered by	Chosen by
1	17MB80	Industrial Engineering and Management	MBA	AE, CE, CSE, ECE, EEE, EIE & IT
2	17MB81	Project Management	MBA	AE, CE, CSE, ECE, EEE, EIE, IT & ME
3	17MB82	Logistics and SupplyManagement	MBA	AE, CE, CSE, ECE, EEE, EIE, IT & ME
4	17MB83	Banking and InsuranceManagement	MBA	AE, CE, CSE, ECE, EEE, EIE, IT & ME

OPEN ELECTIVE – II (VII Semester)

S.No.	Course Code	Title of the Course	Offered by	Chosen by
1	17AE80	Principles of Flight	AE	CE, CSE, ECE, EEE, EIE, IT & ME
2	17CE80	Basic Civil Engineering	CE	AE, CSE, ECE, EEE, EIE, IT & ME
3	17CS80	Java Programming	CSE	AE, CE, ECE, EEE, EIE & ME
4	17CS81	Introduction to Operating Systems	CSE	AE, CE, ECE, EEE, EIE & ME
5	17EC80	Satellite Technology	ECE	AE, CE, CSE, EEE, EIE, IT & ME
6	17EC81	Analog and Digital Communications	ECE	AE, CE, CSE, EEE, IT & ME
7	17EE80	Basic Control Systems	EEE	AE, CE, CSE, IT & ME
8	17EE81	Utilization of Electrical Energy	EEE	AE, CE, CSE, ECE, EIE, IT & ME
9	17EI80	Instrumentation Technology	EIE	AE, CE, CSE, ECE, EEE, IT & ME
10	17IT80	Introduction to Database	IT	AE, CE, ECE, EEE, EIE & ME
11	17ME80	Optimization Techniques	ME	AE, CE, CSE, ECE, EIE & IT
12	17ME81	Elements of AutomobileEngineering	ME	AE, CE, CSE, ECE, EEE, EIE, & IT

OPEN ELECTIVE – III (VIII Semester)

S.No.	Course Code	Title of the Course	Offered by	Chosen by
1	17AE81	Space Technology	AE	CE, CSE, ECE, EEE, EIE, IT & ME
2	17CE81	Disaster Management	CE	AE, CSE, ECE, EEE, EIE, IT & ME
3	17CS82	Internet Technologies	CSE	AE, CE, ECE, EEE, EIE & ME
4	17CS83	Shell Programming	CSE	AE, CE, ECE, EEE, EIE & ME
5	17EC82	Elements of Communication Systems	ECE	AE, CE, CSE, IT & ME
6	17EC83	Systems and Signal Processing	ECE	AE, CE, CSE, IT & ME
7	17EE82	Energy Auditing	EEE	AE, CE, CSE, ECE, EIE, IT & ME
8	17EE83	Renewable Energy Sources	EEE	AE, CE, CSE, ECE, EIE & IT
9	17EI81	Nano Technology	EIE	AE, CE, CSE, ECE, EEE, IT & ME
10	17IT81	Computer Networks	IT	AE, CE, EEE & ME
11	17ME82	Robotics and Automation	ME	AE, CE, CSE, ECE, EEE & IT
12	17ME83	Mechanical Handling Systems and Equipments	ME	AE, CE, CSE, ECE, EEE, EIE & IT

B.Tech. (I Sem.)	17FE01 - PROFESSIONAL COMMUNICATION – I	L	T	P	Cr.
		3	-	-	3

Pre-requisites : Basics in English Grammar & Vocabulary

Course Educational Objective:
To improve the proficiency of students in English with an emphasis on Vocabulary& Grammar for better communication in formal and informal situations;Develop listening skills required for thorough understanding and analysis to face interviews with confidence.

Course Outcomes: At the end of the course, the student will be able to
CO1: Use English vocabulary & grammar effectively while speaking and writing.
CO2: Comprehend the given text and Communicate confidently in formal and informal contexts.
CO3: Draft E-mails & Memos
CO4: Understand the written and spoken information thoroughly.
CO5: Face interviews with confidence.

UNIT – I
Presidential Address – Dr. A.P.J. Abdul Kalam
Vocabulary: Word formation: Prefixes, suffixes & Compound Collocations
Grammar: Punctuation; Parts of Speech
Reading: Double Angels, David Scott
Writing: Sentence structure; Paragraph writing& Dialogue writing

UNIT – II
SatyaNadella's E-Mail to his Employees
Vocabulary: Homonyms, Homophones, Homographs (Words often confused)
Grammar: Types of verbs; Types of sentences
Reading: The Road Not Taken – Robert Frost
Writing: Letter Writing: Official Letters

UNIT – III
Technology with a Human Face – E.F.Schumacher
Vocabulary: Synonyms & Antonyms, commonly misspelt words
Grammar: Tenses: Types & Uses
Reading: Extract from 'Preface' to Lyrical Ballads – William Wordsworth
Writing:E-mails; Memo drafting

UNIT – IV
Listening Skills: The boy who broke the bank – Ruskin Bond; Importance of active listening; understanding the people; understanding places & events;expanding the proverbs on listening& listening at work place.

UNIT – V
Interview Skills: The lighthouse keeper of Aspinwall – Henryk Sienkiewicz; Interview skills from the story; expanding proverbs on Interview skills; Tips for attending an Interview -
Covering letters for job applications & Writing a CV/Résumé

TEXT BOOKS

1. Board of Editors, "Fluency in English – A Course book for Engineering Students", Orient Black Swan, Hyderabad, 2016
2. Dhanavel S.P, "English and Soft Skills", Orient Black Swan, Hyderabad, 2010.

REFERENCE

1. Murphy, "English Grammar with CD", Cambridge University Press, New Delhi, 2004.
2. Rizvi Ashraf M., "Effective Technical Communication", Tata McGraw Hill, New Delhi, 2008
3. BaradwajKumkum, "Professional Communication", I.K.International Publishing House Pvt.Lt., New Delhi, 2008.
4. Raman, Meenakshi and Sharma, Sangeeta, . "Technical Communication -Principles and Practice".Third Edition. New Delhi: Oxford University Press. 2015.

B.Tech.(I Sem.) **17FE04- DIFFERENTIAL EQUATIONS AND LINEAR ALGEBRA**

L	T	P	Cr.
3	2	-	4

Pre-requisites : Basics of Differential Calculus and Matrix Algebra

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 will also learn Matrix Algebra.

Course Outcomes : At the end of the course, the student will be able to :
CO1: Apply first order and first degree differential equations to find Orthogonal trajectories and to calculate current flow in a simple LCR circuit.
CO2: Discriminate among the structure and procedure of solving a higher order differential equations with constant coefficients and variable coefficients.
CO3: Developing continuous functions as an infinite series and compute the Jacobian to determine the functional dependence.
CO4: Distinguish among the pros and cons between the Row operation methods and Iterative methods in solving system of linear equations.
CO5: Compute the Eigen values and Eigen vectors and powers, Inverse of a square matrix through Cayley – Hamilton theorem.

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 to Orthogonal trajectories, Newton's Law of Cooling and Law of Growth and Decay.

UNIT –II
Higher Order Differential Equations
Linear differential equations of second and higher order with constant coefficients, method of variation of parameters.

UNIT – III
Functions of Several variables
Generalized Mean Value Theorem (without proof), Maclaurin's series, Functions of several variables, Jacobians (polar, cylindrical, spherical coordinates), Functional dependence.
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.

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

TEXT BOOKS

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

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 and sons, New Delhi, 2001.

B.Tech. (I Sem.)	17FE13 - ENGINEERING PHYSICS	L	T	P	Cr.
		3	2	-	4

Pre-requisites : Basics in Light, Crystals, Magnetism, Conductivity etc.,

Course Educational Objective : To make students learn the basic concepts of Optics such as Interference, Diffraction, Polarization and Lasers; the principle of quantum mechanics, different types of crystals, magnetic materials and the concept of super conductivity.

Course Outcomes : At the end of the course, the student will be able to :
CO1:Define the nature of Interference and Diffraction.
CO2: Describe the polarization and LASER, types of lasers and their applications.
CO3: Analyze the dual nature of matter waves and the crystal structures.
CO4: Identify the different types of magnetic materials and their applications.
CO5: Propose the different superconducting materials.

UNIT – I
INTERFERENCE AND DIFFRACTION
INTERFERENCE: Introduction, coherence, Conditions for Interference, Interference in thin film by reflection, Newton's rings (reflection), Working principle of Interferometer.
DIFFRACTION: Introduction, Diffraction, Fraunhofer diffraction at single slit- Diffraction due to circular aperture –Diffraction due to N- slits- Diffraction Grating- Resolving power of Grating, Telescope.

UNIT – II
POLARIZATION AND LASERS
POLARIZATION: Introduction – Polarization of light, Brewster's law–Double refraction, Quarter wave plate – Half wave plate - Polarimeter.
LASERS: Introduction- Characteristics of Lasers – Principle of laser (Absorption, Spontaneous and stimulated emission of Radiation), Einstein Coefficients - Nd-YAG laser, Helium Neon Laser.

UNIT – III
PRINCIPLES OF QUANTUM MECHANICS , CRYSTALLOGRAPHY AND X-RAY DIFFRACTION
PRINCIPLES OF QUANTUM MECHANICS
De Broglie waves, Experimental verification- Schrodinger wave equation-time independent wave equation, physical significance of the wave function – particle in a box.
CRYSTALLOGRAPHY AND X-RAY DIFFRACTION
Fundamental terms of crystallography, Types of crystals, Miller Indices, Relation between Interplanar and atomic distance, simple cubic crystal structure, Body centred cubic structure, Face centred cubic structure, Bragg's law, Laue's method .

UNIT – IV
MAGNETIC MATERIALS
Magnetic parameters, Classification of magnetic materials-Diamagnetic materials, paramagnetic materials, ferromagnetic materials, Antiferromagnetic materials and Ferri magnetic materials, Weiss theory of ferro magnetism, soft and hard magnetic materials, Applications of magnetic materials.

UNIT – V
SUPER CONDUCTIVITY
Introduction- General properties of super conducting material, Meissner effect, Effect of electric current, Types of super conductors- Type I super conductors, Type II super conductors, DC and AC Josephson Effect, London Equations Applications of super conductors- SQUID , Cryotron, Magnetic levitation.

TEXT BOOKS

1. V. Rajendran, "*Engineering Physics*", TMH, New Delhi, 6th Edition ,2013.
2. D.K.Bhattacharya, Poonam Tandon, "*Engineering Physics*", Oxford press, New Delhi, 5th Edition, 2015.

REFERENCE

1. M. N. Avadhanulu , TVS Arun Murthy "*Engineering Physics*", S Chand & Co, New Delhi, 2017.
2. P K Palaniswamy, "*Engineering Physics*" Sci. Publ. Chennai, 2016.
3. P. Sreenivasa Rao, K. Muralidhar, "*Engineering Physics*", Himalaya Publishing House, Hyderabad, 2016.

B.Tech. (I Sem.) **17CI01 - COMPUTER PROGRAMMING**

L	T	P	Cr.
2	-	2	3

Pre-requisites : NIL

Course Educational Objective: In this course student will learn about
The basic elements of C programming structures like data types, expressions, control statements, various I/O functions and how to solve simple mathematical problems using control structures.The derived data types like arrays, strings, various operations on them. Modular programming using functions and Memory management using pointers.User defined structures and various operations on it.The basics of files and its I/O operations.

Course Outcomes: At the end of the course, the student shall be able to:
CO1: Identify basic elements of C programming structures like data types, expressions,control statements, various simple functions and inview of using them in problem solving.
CO2: Apply various operations on derived data types like arrays and strings in problem solving.
CO3: Design and Implement Modular Programming and memory management using pointers.
CO4: Implement user defined data structures used in specific applications.
CO5: Compare different file I/O operations on text andbinary files.

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: arithmetic, relational and logical operators, increment and decrement operators, conditional operator, bit-wise operators, assignment operators, expressions, type conversions, conditional expressions, precedence of operators and order of evaluation.
Conditional statements: if, if else, else if ladder and switch statements, continue, goto. Loops: while, do-while and for statements, break, programming examples.

UNIT – II
Arrays- one dimensional arrays-concept, declaration, definition, accessing elements, storing elements, two dimensional and multi-dimensional arrays.
Character Strings: declaration, initialization, reading, writing strings, arithmetic operations on characters, string handling functions, programming examples

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

UNIT –IV

Derived types- structures- declaration, definition and initialization of structures, accessing structures, nested structures, array of structures, structures and functions, pointer to structure, self-referential structures, unions, typedef, programming examples.

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, and programming examples.

TEXT BOOKS

Jeri R.Hanly, Elliot B.Koffman, Problem Solving and Program Design in C, Pearson Publishers, 7th Edition, 2013

REFERENCE

1. N.B.Venkateswarlu and E.V.Prasad, C and Data Structures, S.Chand Publishing, 1st Edition, 2010,
2. ReemaThareja, Programming in C, Oxford University Press, 2nd Edition, 2015
3. Stephen G.Kochan, Programming in C, Pearson Education, 3rd Edition, 2005
4. **PradeepDey, Manas Ghosh, Programming in C, Oxford University Press, 2nd Edition, 2011**
5. E Balagurusamy, Computer Programming, McGraw Hill Education, 1st Edition

B.Tech. (I Sem.) **17ME01 - ENGINEERING GRAPHICS**

L	T	P	Cr.
2	2	-	3

PRE-REQUISITES : Mathematics, Physics

COURSE EDUCATIONAL OBJECTIVE:
The main objective of the course is to recognize the BI Standards of Engineering Drawing and develop an ability to get familiarized with orthographic projections and isometric views

COURSE OUTCOMES: At the end of the course, the student will be able to:
CO 1: Represent the geometrical objects considering BIS standards.
CO2: Comprehend the basics of orthographic projections and deduce orthographic projections of a point and a line at different orientations.
CO3: Visualize geometrical planes of different positions in real life environment
CO4: Imagine orthographic views of various solid objects at different orientations
CO5: Recognize the significance of isometric drawing to relate 2D environment with 3D environment.

UNIT – I
INTRODUCTION TO ENGINEERING DRAWING:
Introduction: Principles of Engineering Graphics 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:
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: Planes parallel to one of the reference planes-Inclined to one reference plane and perpendicular to other-Oblique planes.

UNIT – IV
PROJECTIONS OF SOLIDS: Projection of solids in simple position - Axis inclined to one of the reference planes and parallel to the other-Axis inclined to both H.P and V.P.

UNIT – V
ISOMETRIC VIEWS: Introduction-theory of isometric projection, isometric views, isometric axes, scale, lines & planes-Isometric view of prism, pyramid, cylinder & 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 BOOK
N. D. Bhatt, Engineering Drawing, 51th Revised and Enlarged Edition, Charotar publishers, 2012

REFERENCE
1. Narayana K L, Kannaiah P, Textbook on Engineering Drawing, 2nd Edition, SciTech publishers, 2012.
2. R.K.Dhawan, Engineering Drawing, S.Chand Company LTD, 2014.
3. Venugopal, Engineering Drawing and Graphics, New Age publishers, 2014.
4. Dhananjay A. Jolhe, Engineering Drawing, Tata McGraw Hill Publishers, 2012.
5. N.S.Parthasarathy, Vela Murali, Engineering Drawing, Oxford Higher Education, 2016.

B.Tech. (I Sem.) **17FE60 - ENGLISH COMMUNICATION SKILLS LAB**

L	T	P	Cr.
-	-	2	1

Pre-requisites: Students should have fundamental knowledge in making sentences and be with readiness to speak

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 the course, the student will be able to
CO1 : Articulate English with good pronunciation.
CO2 : Manage skilfully through group discussions.
CO3 : Communicate with the people effectively.
CO4 : Collect and interpret data aptly.

Syllabus: English Communication Skills Lab (ELCS) 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, written language.
ICS Lab:
Practice: Introduction to English Phonetics – Speech Sounds – Vowels and Consonants – Minimal Pairs - Phonetic Transcription.

Exercise – II
CALL Lab:
Understand:Usage of various words in different parts of speech.
ICS Lab:
Practice: Ice-Breaking Activity and JAM Session – Introducing Oneself.

Exercise – III
CALL Lab:
Understand:Features of Good Conversation – Strategies for Effective Communication
ICS Lab:
Practice: Situational Dialogues – Role-Play – Expressions in various situations – Making Requests and seeking permissions.

Exercise – IV
CALL Lab:
Understand:Data collection strategies – Interpretation of collected data.
ICS Lab:
Practice: Data interpretation – Information transfer from flow charts, pie charts, bar graphs, pictograms etc.

Exercise – V
CALL Lab:
Understand:Features of Good Conversation – Strategies for Effective Communication.
ICS Lab:
Practice: Introduction to Group Discussions

Lab Manual:
Board of Editors, "ELCS Lab Manual – A Workbook of CALL and ICS Lab Activities", Orient Black Swan Pvt. Ltd., Hyderabad, 2016.

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.

B.Tech. (I Sem.) **17FE63 – ENGINEERING PHYSICS LAB**

L	T	P	Cr.
-	-	2	1

Pre-requisites : Awareness about the usage of Vernier callipers, Screw Gauge etc.,

Course Educational Objective:
To make students learn the theoretical concepts, Analytical techniques and graphical analysis through completing a host of experiments with the procedures and observational skills using 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.
CO2: Estimate the wave length and width of the slit with Laser light source.
CO3: Evaluate the specific parameters in electrical circuits.
CO4: Analyze the characteristics of Torsional Pendulum, Thermister, Stewart and Gee's.

List of Experiments
(ANY 8 EXPERIMENTS)

GENERAL EXPERIMENTS:
1. Determine the frequency of AC supply by using Sonometer.
2. Determine the frequency of a tuning fork by using Melde's arrangement.
3. Study the characteristics of L.C.R Circuit.
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. Study the characteristics of Thermister.
7. Determination of time constant of a RC Circuit.

OPTICS LAB EXPERIMENTS:
8. Determine the wavelength and divergence of a laser radiation.
9. Determine the width of a single slit by forming diffraction pattern.
10. Determine the Radius of Curvature of a Plano - Convex lens by forming Newton's Rings.
11. Find the specific rotation of sugar solution by using a polarimeter.
12. Determine the Refractive index of a material of the given prism.
13. Determine the Wavelengths of various spectral lines by using diffraction grating.
14. Determination of a thickness of thin wire by using wedge shaped film.

TEXT BOOKS
Lab Manual Prepared by the LBRCE.

B.Tech. (I Sem.) **17CI60 - COMPUTER PROGRAMMING LAB**

L	T	P	Cr.
-	-	2	1

Pre-requisites : NIL

Course Educational Objective: In this course student will learn about
Software development tools like algorithm, Pseudo codes and programming structure. Basic elements C programming structures like data types, expressions, Control statements, various I/O functions and how to solve simple mathematical Problems using control structures. Design and implementation of various software components which solve real world problems.

Course Outcomes: At the end of the course the student will be able to
CO1: Apply and practice logical formulations to solve some simple problems leading to specific applications.
CO2: Demonstrate C programming development environment, compiling, debugging, linking and executing a program using the development environment.
CO3: Design effectively the required programming components that efficiently solve computing problems in real world.
Mandatory: All Programs must have Algorithms and Flow Charts

LAB CYCLESSYLLABUS

I) Exercise Programs on Basics of C-Program
Write a program in 'C' language to cover the following problems.
a) Example program which shows the usage of various preliminary Data types available in C Language.
b) Example program which shows the usage of various Operators available in C Language.
c) Example programs to illustrate the *order of evaluation*.

II) Exercise Programs on Control Structures:
a) To check whether the given year is leap year (or) not
b) Roots of Quadratic Equation.
c) Finding smallest& biggest number from the given set of 4 numbers using 'if' statement.
d) Calculate the student grade in the examination – assume suitable Constraints.
e) Prepare electricity bill for the consumed units – assume suitable Constraints.
f) Converting given two digit number into words using switch statement
g) To illustrate the usage of 'goto' statement.

III) Exercise Programs on Loops:
a) To Display first N natural numbers
b) To find whether the given number is Armstrong (or) not
c) To find reverse of the given number and to check whether it is palindrome (or) not.
d) To find whether given number is strong number (or) not.
e) To check whether given number is Prime (or) not
f) To display prime numbers with in the given range (Nesting of Loops).
g) To display the following structure (Nesting of Loops)

i)
```
        1
      1   2
    1   2   3
  1   2   3   4
1   2   3   4   5
```

ii)
```
5 4 3 2 1
  4 3 2 1
    3 2 1
      2 1
        1
```

IV) Exercise Programs on Arrays& Strings:

Write example programs in C Language to perform following operations:

a) Finding the sum and average of given numbers using Arrays.
b) To display elements of array in reverse order
c) To search whether the given element is in the array (or) not using linear search &binary search.
d) Write a C program to perform the following operations
   i) Addition, subtraction and multiplication of Matrices
   ii) Transpose of given matrix

   (The above operations are to be exercised using functions also bypassing arguments)
e) Write a C program to find whether the given string is palindrome (or) not.
f) To accept line of text and find the number of characters, number of vowels and number of blank spaces in it.
g) Write an example program to illustrate the use of any 5 string handling functions.

V) Exercise Programs on Functions &Pointers:

a) Example program to bring clarity on pointer declaration & initialization and Pointer arithmetic.
b) Write an example program to describe the usage of *call by reference*.
c) Write a program to find sum of the elements of the array using functions.

VI) Exercise Programs on Functions:

Write example programs in C Language:

a) To find factorial of a given number using functions.
b) Swap two numbers using functions.
c) To find GCD of two numbers using recursion
d) Write a recursive function to solve Towers of Hanoi problem.
e) Write an example program to illustrate use of external &static storage classes.
f) Write an example program to illustrate the usage of command line arguments.
g) Program to illustrate the usage of dynamic memory management functions.

VII) Exercise Programs on Derived data types:

a) Write an example program using structures to process the student record. Assume suitable fields for student structures (Different kinds of initialization of structure variables are to be exercised)
b) Write a program to read records of 10 employees and find their average salary (Exercise array of structures & Nested structures concepts through this program).
c) Write a program to handle a structure variable using pointers and implement self referential structure(i.e. A structure variable having a pointer to itself)

VIII) Exercise Programs on Files:

Write an example program on file to perform following operations:

a) Accessing content from files and writing content in to it.
(Exercise different file operation modes)
b) Copy the contents of one file into another.
(Exercise different file operation modes)

B.Tech. (I Sem.) **17ME60 - ENGINEERING WORKSHOP**

L	T	P	Cr.
1	-	2	2

PRE-REQUISITES: Knowledge in dimensions and units, Usage of geometricalinstruments andanalyticalability

COURSE EDUCATIONAL OBJECTIVE:

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

COURSE OUTCOMES: After completion of the course students are the able to:

CO1 : Design and model different prototypes in the carpentry trade such as Cross lap joint, Dove tail joint.

CO2 : Fabricateandmodelvariousbasicprototypesinthetradeoffitting suchasStraightfit, V- fit.

CO3 : Producevariousbasicprototypesinthetradeof Tin smithysuchasrectangular tray, and openCylinder.

CO4 : Perform various basic House Wiring techniques.

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

Trade –1: CARPENTRY SHOP

1.1. Introduction to various types of wood such as Teak, Mango, Sheesham, etc. (Demonstration and their identification).

1.2. Demonstration, function and use of commonly used hand tools.

1.3. Introduction to various types of wooden joints, their relative advantages and uses.

1.4. Care maintenance of tools and safety precautions in carpentry shop.

Job I- Marking, sawing, planning and chiselling& their practice

Job II -Preparation of half lap joint

JobIII -PreparationofMortiseand Tenon Joint

Trade –2: FITTING SHOP

2.1. Introduction to fitting shop tools, common materials used in fitting shop.

2.2. Description and demonstration of simple operation of hack-sawing, various types of blades and their specifications, uses and method of fitting the blade.

2.3. Care and maintenance of tools & safety precautions in fitting shop.

Job I-Making a L-Fit from a rectangular piece of MS

Job II-Making a T-Fit from a rectangular piece of MS

Job III-Making a V-Fit from a rectangular piece of MS

Job IV-Making a Half round Fit from a rectangular piece of MS

Trade -3: TIN- SMITHY SHOP

3.1. Introduction to tin -smithy shop, use of hand tools and accessories e.g. different types of hammers, hard and soft mallet, sheet and wire gauge, necessary allowance required during job fabrication, selection of material and specifications.

3.2. Introduction and demonstration of various raw materials used in sheet metal shop e.g. M.S. sheet, galvanized-iron plain sheet, galvanized corrugated sheet, aluminium sheets etc.

3.3. Care and maintenance of tools & safety precautions in Tin-Smithy shop.

Job I - Preparation of a rectangular tray.

Job II- Preparation of a open scoop/ funnel.

Job III - Preparation of a Single Seam Joint and Double Seam Joint.

Job IV - Preparation of a Corner Seam Joint.

Trade –4: PLUMBING SHOP

4.1. Introduction to plumbing –use of hand tools and accessories e.g. pipe vice, Die sets, adjustable spanners, pipe wrench, pipe cutter and pipes and pipe fittings -various raw materials used in plumbing such as PVC Pipes, CI Pipes, MS pipes, Brass Pipes, Copper Pipes, Aluminium Pipes.

4.2. Demonstration of hand tools used in plumbing – preparation of pipe layout and pipe threading.

4.3. Care and maintenance of tools & safety precautions in Plumbing.

Job I – preparation of pipe layout.

Job II – Pipe threading.

Trade -5: BLACK SMITHY

5.1. Introduction to Black smithy –use of tools and equipments e.g.

5.2. Demonstration of forging operations.

5.3. Care and maintenance of tools & safety precautions in Black smithy.

Job I – preparation of S –Hook.

Job II – preparation of Chisel

Trade -6: HOUSE WIRING

6.1.Study, demonstration and identification of common electrical materials such as wires, cables, switches, fuses, PVC Conduits.

6.2.Study of electrical safety measures and demonstration about use of protective devices such as fuses, and relays including earthing.

Job I - Two lamps in series and parallel connection with one way switch

Job II – Florescent lamp and calling bell circuit.

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

Job IV – House wiring circuit.

REFERENCE

1. LBRCE Workshop Lab Manual
2. S.K.Hajra Choudary & A.K.Choudary, "Workshop Technology-I", Media Promoters and Publishers Pvt.Ltd., Mumbai, 2012.
3. B.S.Raghuvamsi, "Workshop Technology-I", Dhanpatrai and company, New Delhi, 2014.
4. P.Khannaiah, K.L.Narayana, "Workshop Mnaual", Scitech Publications India Pvt.Ltd, 2015.

B.Tech. (II Sem.)	17FE02 - PROFESSIONAL COMMUNICATION - II	L	T	P	Cr.
		3	-	-	3

Pre-requisites: Students should have basics in English vocabulary andGrammar & they should write error free sentences

Course Educational Objective : To Improve vocabulary, Grammar, Verbal – Non verbal Communication; to develop adaptability, assertive skills and Team spirit for skillful management in work place; and to Interpret technical data given in the form of charts, graphs & pictograms for writing technical reports.

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

CO1 : Use appropriate vocabulary to interpret data thoroughly and to write reports effectively.
CO2 : Face any situation with confidence and voice opinions/decisions assertively.
CO3 : Use English Language effectively in spoken and written forms.
CO4 : Work effectively in teams for better result.
CO5 : Communicate effectively using verbal and non-verbal dimensions aptly.

UNIT – I

Good Manners – J.C. Hill

Vocabulary: Idioms; One-word substitutes

Grammar: Subject-Verb agreement (Concord)

Reading: If – Rudyard Kipling

Writing: Information transfer: Tables, Bar graphs, Line graphs, Pie charts, Flow charts, Tree Diagrams, Pictograms; Note-making& Abstract/Summary writing

UNIT – II

Assertive Skills: Verger – Somerset Maugham; Assertive skills from the story; Assertive skills at personal level & at workplace; Expanding proverbs & their Significance

Team work skills: White washing the fence – Mark Twain; Teamwork skills from the story; Teamwork at work place & its Importance

UNIT – III

Oh Father, Dear Father – Raj Kinger

Vocabulary: Foreign Languages and their Influence on English

Grammar: Conditional Sentences; Degrees of Comparison; Question Tags

Reading: Basic Education – M.K. Gandhi

Writing: Report Writing: Nature, Significance & Types of Reports

UNIT – IV

Adaptability: Sen˜or Payroll – W E Barrett; Understanding the Organizational Communication; Adaptability skills from the story; Expanding proverbs on Adaptability skills; Importance at work place & Real life - Active & Passive Voice; Direct & Indirect Speech.

UNIT – V

Non-Verbal Communication Skills: A real good smile – Bill Naughton; 'Wh' & 'Yes' or 'No' questions; Working on articulation and gestures; Non-Verbal Communication Skills from the story; Expanding the proverbs on Non-Verbal Communication; enhancing skills through real life experiences - Common Errors.

TEXT BOOKS

1. Board of Editors, "Fluency in English – A Course book for Engineering Students", Orient Black Swan, Hyderabad, 2016
2. Dhanavel S.P, "English and Soft Skills", Orient Black Swan, Hyderabad, 2010.

REFERENCES

1. Murphy, "English Grammar with CD", Cambridge University Press, New Delhi, 2004.
2. Rizvi Ashraf M., "Effective Technical Communication", Tata McGraw Hill, New Delhi, 2008
3. BaradwajKumkum, "Professional Communication", I.K.International Publishing House Pvt.Lt., New Delhi, 2008.
4. Raman, Meenakshi and Sharma, Sangeeta, . "Technical Communication -Principles and Practice".Third Edition. New Delhi: Oxford University Press. 2015.

B.Tech. (II Sem.)	17FE06 - TRANSFORMATION TECHNIQUES AND VECTOR CALCULUS	L	T	P	Cr.
		3	2	-	4

Pre-requisites: Basics of Integral Calculus and Vector Calculus

Course Educational Objective : In this course the students are introduced to Integral transformations which includes Laplace Transforms and Z – Transforms. They will also learn Multiple Integrals in different coordinate systems and Vector Calculus.

Course Outcomes : At the end of the course, the student will be able to :
CO1: Apply the concepts of Laplace Transforms to solve ordinary differential equations.
CO2: Apply Z - Transforms to solve difference equations
CO3: Discriminate among Cartesian, Polar and Spherical coordinates in multiple integrals and their respective applications to areas and volumes.
CO4: Evaluate the directional derivative, divergence and angular velocity of a vector function.
CO5: Apply Vector Integration for curves, surfaces and volumes and relationship among themselves.

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

UNIT – II
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.

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

UNIT – IV
Vector Differentiation
Vector Differentiation: Gradient- Directional Derivatives -Divergence – Solenoidal fields- Curl – Irrotational fields-potential surfaces - Laplacian and second order operators and related properties of sums and products

UNIT – V
Vector Integration
Vector Integration - Line integral – work done –area - surface and volume integrals. Vector integral theorems: Greens, Stokes and Gauss Divergence Theorems (Without proof) and related problems

TEXT BOOKS

1. Dr. B.S. Grewal, "*Higher Engineering Mathematics*", 42nd Edition, Khanna Publishers, New Delhi, 2012.
2. Dr. B. V. Ramana, "*Higher Engineering Mathematics*", 1st Edition, TMH, New Delhi, 2010.

REFERNCES

1. Michael D. Greenberg , "*Advanced Engineering Mathematics*", 2nd Edition, TMH, New Delhi, 2011.
2. Erwin Krezig, "*Advanced Engineering Mathematics*", 8th Edition, John Wiley & Sons, New Delhi, 2011.

B.Tech. (II Sem.)	17FE14 - APPLIED CHEMISTRY	L	T	P	Cr.
		4	-	-	4

Pre-requisites: Knowledge of atomic weights, molecular weights, equivalent weights, galvanic cell, working principle of battery, concept of polymerization.

Course Educational Objectives

In this course, students will learn the concepts and applications of chemistry in engineering. It aims at strengtheningthe students with the fundamental concepts of chemistry. It provides them with the knowledge of water specification for different industries along with solutions to the problems that arise due to hardness of water.

It enables the students to know analysis of fuels and alternate fuels used in diverse fields. It makes the students to effectively use the knowledge of electrochemistry, battery technology, and corrosion science in engineering applicationsIt enables the students to identify the role of polymers and lubricants in various fields.

Course Outcomes: After completion of course, students will be able to

CO1: Identify the troubles due to hardness of water and its maintenance in industrial applications.

CO2: Analyze issues related to conventional fuels and apply the concepts of advanced fuels like bio, nuclear and rocket fuels in energy production.

CO3: Analyze different types of electrodes and batteries for technological applications..

CO4: Apply principles of corrosion for design and effective maintenance of various equipments.

CO5: Identify the important applications of engineering materials like plastics, rubbers and lubricants.

UNIT – I : WATER TECHNOLOGY

Introduction: Sources of water and quality.

Hardness: Hardness of Water - Temporary and permanent hardness, units and their inter relation, problems on hardness and disadvantagesof hard water in industries.

Boiler troubles: Reasons, disadvantages and methods of prevention for scale and sludge formation, caustic embrittlement, boiler corrosion and carryover(priming and foaming).

Water softening: Ion- Exchange Process, merits and demerits.

Desalination of brackish water: Electro dialysis and reverse osmosis.

UNIT – II : CONVENTIONAL FUELS

Introduction: Definition and classification of fuels(solid,liquid and gaseoues 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.

ADVANCED FUELS

Bio fuels: Characteristics of bio fuels, sources of bio mass and advantages, - Production of bio diesel from rape seed oil.

Nuclear fuels: Nuclear fission, fusion, differences between chemical and nuclear fuel, Charecterstics of fuel elements.

Rocket propellants: Characteristics of good propellants, classification, examples and mechanism of propulsion.

UNIT – III : ELECTRO CHEMISTRY & BATTERIES

Introduction: Electrode potential, standard reduction and oxidation potentials (S.R.P and S.O.P), E.M.F/cell potential of a cell.

Nernst equation: Derivation and problems.
Reference Electrode: Standard hydrogen electrode (S.H.E), calomel electrode, measurement of electrode potential, electro chemical series and applications.
Types of batteries: Primary, secondary and reserve batteries, dry battery(Leclanche cell), Nickel-Cadmium battery, Magnesium - Copper reserve battery.
Fuel Cells: Hydrogen- Oxygen fuel cells.

UNIT – IV : SCIENCE OF CORROSION
Introduction: Definition, examples.
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, galvanic series.
Factors Influencing Corrosion: Nature of metal (purity, position in galvanic series, relative area of cathode and 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: Definition, basic terminology, differences between thermosets & thermoplasts, types of polymerization(addition, condensation and co-polymerisation), preparation, properties and engineering applications of Teflon and bakelite, conducting polymers-extrensic and intrensic conducting polymers.
Rubbers: Definition, processing of natural rubber, draw backs, vulcanization and advantages, preparation, properties and applications of BUNA-S and thiokol.
Lubricants: Characteristicsofa good lubricant and properties of lubricants (viscosity, flash and fire points, cloud and pour points, aniline point) and applications.

TEXT BOOKS

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

REFERENCES

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. Bharathi Kumari, Jyotsna Cherukuri, "A Text book of Engineering Chemistry", VGS Publications, Vijayawada, 1st Edition, 2009.

B.Tech. (II Sem.)	17EE52 - BASIC ELECTRICAL ENGINEERING	L	T	P	Cr.
		2	2	-	3

Pre-requisites : NIL

Course Educational Objective: This course enables the studentto illustrate the basics of circuits and AC electrical machines. It also deals with basic principles of measuring instruments.

Course Outcomes: At the end of the course, the student will be able to :
CO1: Analyse AC and DC circuits
CO2: Enumerate the working of static& rotating electrical machines
CO3: Analyze the performance of electrical machines
CO4: Interpret the working of various electrical measuring instruments

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 transformations. Numerical problems.

UNIT – II: Network Theorems without proofs (DC Networks)
Mesh Analysis, Nodal Analysis, Theorems -Superposition, Thevenin's, Norton's theorems, Maximum Power Transfer theorem. Numerical problems.

UNIT – III : AC Fundamentals
Peak, R.M.S, average and instantaneous values, Form factor and Peak factor for periodic waveforms – Phase and Phase difference –Concepts of Reactance, Impedance, Susceptance and Admittance, Real , Reactive and apparent Powers, Power Factor- Resonance. Numerical problems.

UNIT–IV: Generalised Treatment of Electrical Machines
Introduction-Dynamo, Generator and Motor-basic Electro-Magnetic Laws-EMF induced in a coil rotating in a magnetic field-physical concept of production of torque-elementary concept of an electrical machine-Common features of rotating electrical machines-Types of rotating electrical machines. Numerical problems.

UNIT – V : Single Phase Transformers & 3-Phase Induction Motor
Single Phase Transformers: Constructional details- principle and operation of single phase transformers-Emf equation-Losses- efficiency and regulation calculations -O.C and S.C tests. Numerical problems.
Induction Motor: Principle and operation of Induction Motors- Types of rotors Slip ring and Squirrel cage motors –Slip- rotor emf and current-torque-starting torque-condition for Maximum Torque –Slip-Torque characteristics. Numerical problems.
Electrical Measuring Instruments: Qualitative treatment

TEXT BOOKS
1. M.S Naidu and S. Kamakshaiah,"Introduction to Electrical Engineering", TMH Publication, 3rd Edition
2. A.Sudhakar and Shyammohan S Palli,"Electrical Circuits" Tata McGraw-Hill, 3rd Edition.

REFERENCES
1. Kothari and Nagarath, "Basic Electrical Engineering" ,TMH Publications, 3rd Edition.
2. V.K.Mehta, "Principles of Electrical Engineering" , S.Chand Publications.

B.Tech. (II Sem.) **17ME02 – ENGINEERING MECHANICS**

L	T	P	Cr.
2	2	--	3

PRE-REQUISITES : Engineering Physics, Applied Mathematics

COURSE EDUCATIONAL OBJECTIVE:

The main objective of this course is to develop the capacity to predict the behaviour of rigid 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 :Analyse the coplanar force systems using free body diagram.
CO2 :Analyse the rigid bodies associated with frictional forces using conditions of equilibrium
CO3 : Locate the centroid/center of gravity and determine the moment of inertia of plane sections/solids
CO4 :Examine the behaviour of moving bodies in rectilinear and trajectory motion using kinematic equations or motion curves.
CO5 :Examine the behaviour of moving bodies using dynamic equilibrium/workenergy methods

UNIT-I

INTRODUCTION TO ENGINEERING MECHANICS: Basic Concepts of mechanics .
RESULTANT OF SYSTEM OF FORCES: Resultant of Coplanar ConcurrentForceSystem - Moment of a Force,Couple,Varignon's Theorem,Resultant of Coplanar Non-Concurrent Force System.
EQUILIBRIUM OF SYSTEM OF FORCES:Equilibrium of a Body Subjected toConcurrent Forces and Non-concurrent Forces, Free Body Diagrams,Lami's Theorem, Equilibrium of Connected Bodies.

UNIT-II

FRICTION: Introduction, Types of Friction, Laws of Friction, Angle of Friction, Angle of Repose, Problems on blocks resting on horizontal and inclined planes -Ladder friction.

UNIT - III

CENTROID AND CENTRE OF GRAVITY: Concept of Centroid and Centre of gravity, Centroid of simple figures from basic principles, Centre of gravity of simple bodies.
AREA MOMENT OF INERTIA: Theorems of Moment of Inertia, Determination of Moment of Inertia of Circle, Rectangle, Hollow Circle, Semi Circle, Triangle from basic principles.
MASS MOMENT OF INERTIA: Radius of gyration, Determination of Mass Moment of Inertia of Uniform Rod, Rectangular Plate, Circular Plate, Solid Cone, Solid Sphere, Solid Cylinder.

UNIT –IV

KINEMATICS:
Rectilinear Motion, Motion Curves, Motion with Uniform Velocity, Motion with Uniform Acceleration.
PROJECTILES: Definitions, Motion of a Body Projected Horizontally, Inclined projection on Level Ground, Inclined Projection with Point of Projection and Point of Strike at Different Levels.

UNIT – V

KINETICS:
Bodies in Rectilinear Translation, Bodies in Curvilinear Translation, Kinetics of Bodies Rotating about Fixed Axis.
WORK ENERGY METHOD:
Equation for Translation, Motion of Connected Bodies, Kinetic Energy of Bodies in Fixed Axis Rotation.

TEXT BOOKS

1. S.S. Bhavikatti, Engineering Mechanics, 4thedition, New Age International (P) Ltd, 2012.
2. N.H.Dubey, Engineering Mechanics, McGraw Hill, 2013.

REFERENCES

1 Ferdinand. L. Singer, Engineering Mechanics, 3rd edition, Harper – Collins, 1994
2. B.Bhattacharya, Engineering Mechanics, 1stedition, Oxford University Press, 2008
3. A.K.Tayal, Engineering Mechanics, 14thedition, 2ndreprint, Umesh Publications, 2012.
4. R.K.Bansal, Engineering Mechanics, 3rd edition, Laxmi Publications, 1996.
5. Manoj K Harbola, Engineering Mechanics, 2nd edition, CEng age Learning, 2012.

B.Tech. (II Sem.)	17FE64 - APPLIED CHEMISTRY LAB	L	T	P	Cr.
		-	-	2	1

Pre-requisites : Knowledge of volumetric titration.

Course Educational Objectives:

The primary objective of Applied Chemistry is to make the students analyze water sample for hardness and alkalinity. It makes the students to perform and distinguish different types of volumetric titrations. It also provides them with an overview of preparation of polymers. It makes the students to find important properties of fuels and lubricants for their effective use.

Course Outcomes: After completion of the course, the students will be able to

CO1: Assess quality of water based on the procedures given.
CO2: Distinguish different types of titrations in volumetric analysis after performing the experiments listed in the syllabus.
CO3: Acquire practical knowledge related to preparation of polymers.
CO4: Exhibit skills in performing experiments based on theoretical fundamentals.

Introduction

1. Introduction to Chemistry laboratory – Molarity, Normality, Primary, secondary standard solutions, Volumetric titrations, Quantitative analysis, Qualitative analysis, etc.
2. Preparation of standard solutions, concept of standardisation of solutions, dilution to get solution of required normality.
3. Model experiment - Determination of amount of HCl using standard Na_2CO_3 solution.

Water analysis

4. Determination of alkalinity of water sample**.**
5. Determination of total hardness of water by EDTA method.
6. Determination of permanent hardness of water by EDTA method.

Preparation of polymers

7. Preparation of Urea Formaldehyde resin.
8. Preparation of Phenol Formaldehyde resin.

Redox titrations

9. Estimation of Mohr's salt by using potassium permanganate.
10. Estimation of Mohr's salt by using potassium dichromate.
11. Estimation of $KMnO_4$ by using Oxalic acid.

Demonstration Experiments

12. Determination of pH of the given sample solution/ soil using pH meter.
13. Determination of turbidity of the given sample water.

Fuels

14. Determination of flash and fire points of a given fuel/lubricant.
15. Determination of cloud and pour point of a given fuel/lubricant.
16. Determination of Aniline point of a given lubricant.

REFERENCES

Lab manual

B.Tech. (II Sem.) **17EE71 - BASIC ELECTRICAL ENGINEERING LAB**

L	T	P	Cr.
-	-	2	1

Pre-requisites: Basic Electrical Engineering(17EE52)

Course Educational Objective : This laboratory course enables the student to demonstrate the knowledge of electrical equipment and analysis of electric circuits.

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

CO1: Demonstrate the use various electrical components

CO2: Analyze the performance of AC machines

CO3:Evaluate the responses for the given circuit

CO4: Interpret the concept of electrical resonance

List of Experiments

1. Identify and test different types of passive elements(R, L, C).
2. Study of electrical and electronic measuring devices (voltmeter, ammeter, wattmeter, multimeter, megger).
3. Study of windings used in home appliances.
4. Verification of Kirchhoff's Laws (KCL and KVL).
5. Verification of Superposition theorem.
6. Measurement of active and reactive powers in a single phase series R-L/R-C circuits.
7. Experimental determination of resonant frequency, Bandwidth and Q-factor for an RLC network (Series & Parallel).
8. Pre-determination of single phase transformer performance using OC and SC tests.
9. Study of fluorescent lamp and determination of parameters.
10. Plot the slip-torque characteristics of 3-phase Induction motor.

Additional experiments

11. Verification of Thevenin's theorem.
12. Verification of Norton's theorem.
13. Verification of Maximum Power Transfer theorem.
14. Measurement of peak, average, rms values, frequency and time period of a sinusoidal waveform

B.Tech. (II Sem.)	17ME61 - ENGINEERING MECHANICS AND FUEL TESTING LAB	L	T	P	Cr.
		-	-	2	1

PRE-REQUISITES: Engineering Mechanics, Applied Chemistry

COURSE EDUCATIONAL OBJECTIVE:
The main objective of this course is to demonstrate the concepts of engineering mechanics & fuels through experiments.

COURSE OUTCOMES: At the end of the course, the student will be able to :
CO1 : Verify the laws of Mechanics.
CO2 : Evaluate the force in the mechanical systems.
CO3 : Estimate the dynamic characteristics of fuel using Viscosity and Flash & Fire point data.
CO4 : Determinecalorific-value of fuels.

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) Verification of principle of moment with the help of Bell crank lever Apparatus.
5) Evaluation of the forces in the members of Truss Apparatus.
6) Determination of coefficient of friction between the two materials using Tilting-plane method.
7) Verification of Newton's second law.
8) Determination of viscosity of given oil using Saybolt Viscometer.
9) Determination of Calorific value of given fuel using Junkers Gas Calorimeter.
10) Determination of viscosity of given oil using Red-wood-II Viscometer.
11) Determination of viscosity of given oil using Englers Viscometer.
12) Determination of Flash and Fire point of given oil using ABELS Apparatus.
13) Determination of Calorific value of given fuel using BOMB Calorimeter.

REFERENCES:

Lab-Manual

B.Tech. (II Sem.)	17ME62 - COMPUTER AIDED ENGINEERING GRAPHICS LAB	L	T	P	Cr.
		1	-	2	2

PRE-REQUISITES : Engineering Graphics, Mathematics, Physics

COURSE EDUCATIONAL OBJECTIVE:

The main objectives of this course are to familiarize various commands used in Auto-CAD and to visualize the isometric and orthographic views of any solid object.

COURSE OUTCOMES: After completion of the course students are the able to:

CO1: Understand the Auto-CAD basics and apply to solve practical problems used in industries where the speed and accuracy can be achieved.
CO2: Understand the principle of Orthographic projections of points, lines, planes and solids.
CO3: Familiarize with the sectioning of solids and development of surfaces.
CO4: Convert orthographic to isometric vice versa.

At least 10 Exercises are to be conducted using Auto Cad software:

BASIC AUTO CAD COMMANDS:

1. Basic drawing commands (line, circle, arc, ellipse, polygon, and rectangle).
2. Edit commands (copy, move, erase, zoom).
3. Array commands (polar array, rectangular array, P-edit, divide a line, offset).
4. Hatching &line commands (hatching with different angles& different types of lines).
5. Mirror & trim commands (mirror an object, trim, extend a line, chamfer& fillet, explode).
6. Dimensioning & text commands (linear, angular, radius, diameter& text).

PROJECTION OF POINTS AND LINES:

1. Projection of points (I, II, III, & IV quadrants).
2. Projection of lines parallel to both reference planes.
3. Projection of lines parallel to one reference plane & inclined to other reference plane.

PROJECTION OF PLANES AND SOLIDS:

1. Projection of planes parallel to one reference plane & perpendicular to other reference plane.
2. Projection of planes inclined to one reference plane& perpendicular to other reference plane.
3. Projection of solids in simple position.
4. Projection of solids with axes inclined to one reference plane & parallel to other.

SECTION OF SOLIDS & DEVELOPMENT OF SURFACES

1. Sectioning of simple solids like prisms, pyramids, cylinder and cone in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section
2. Development of lateral surfaces of simple solids – Prisms, pyramids, cylinders, cube and cones

ORTHOGRAPHIC PROJECTIONS:

1. Conversion of plane objects.
2. Conversion of circular objects.
3. Conversion of both combination of plane figures and circular objects.

ISOMETRIC PROJECTIONS:

- Conversion of plane objects.
- Conversion of circular objects.
- Conversion of both combination of plane figures and circular objects.

REFERENCES

1. M. Kulkarni, A.P Rastogi, and A.K. Sarkar, Engineering Graphics with AutoCAD, PHI Learning Private Limited, New Delhi, 2009.
2. Bethune, Engineering Graphics with AutoCAD, PHI Learning Private Limited, New Delhi, 2009.
3. N. D. Bhatt, Engineering Drawing, 51th Revised and Enlarged Edition, Charotar Publishers, 2012.

B.Tech. (III Sem.)	17FE03 - ENVIRONMENTAL SCIENCE	L	T	P	Cr.
		3	-	-	3

Pre-requisites : None

Course Educational Objective :

To provide a general background on developing an understanding of systems and cycles on the earth and how individual organisms live together in complex communities.

To enable the students in understanding how human activities influence our air, water and soil and it also helps in developing a right attitude about our use of fossil fuels and effect on climate and sustainable management of natural resources.

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

CO1: Identify environmental problems arising due to engineering and technological activities that help to be the part of sustainable solutions.

CO2: Evaluate local, regional and global environmental issues related to resources and their sustainable management.

CO3: Identify the importance of ecosystem and biodiversity for maintaining ecological balance.

CO4: Acknowledge and prevent the problems related to pollution of air, water and soil.

CO5: Interpret the significance of implementing environmental laws and abatement devices for environmental management.

UNIT – I

Nature and scope of Environmental Problems

- Introduction, components of Environment
- Scope and importance of environmental studies
- Population explosion, variations among nations
- Resettlement and Rehabilitation - Issues and possible solutions
- Environment and human health
- HIV-AIDS
- Environmental ethics
- 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, floods, drought, conflicts over water, interlinking of rivers, dams-benefits and problems. Rain water harvesting, watershed management
- 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

- Definition, structure and functions of an ecosystem
- Food chains and Food webs, Ecological succession, Ecological pyramids
- Biogeochemical cycles, Major Types of Ecosystems – Forest, Grassland, Desert Land & aquatic Ecosystem, Ecological Niche and Keystone Species
- Definition and levels of measuring biodiversity - genetic, species, community and ecosystem diversity

- Bio geographical classification of India
- India as a mega diversity nation
- Values of biodiversity- Direct and Indirect values
- Threats to biodiversity; Man and wild life conflicts
- Endangered and endemic species of India
- 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
- Soil pollution
- Noise pollution
- Nuclear hazards
- Solid Waste Management – Sources, Classification, effects and control measures of Municipal solid waste, Biomedical waste & Hazardous and e-waste
- Environmental Issues relating to Climate change, global warming, acid rain, ozone layer depletion
- Disaster Management- Floods, Cyclones, Earthquakes, Landslides and Tsunamis.

UNIT – V

Environmental Management

- Sustainable development and unsustainability
- Stockholm and Rio Summit
- Environmental Impact Assessment (EIA)
- Green building
- Consumerism and Waste products
- Carbon credits and carbon trading
- Environmental Law- Air, Water, Wild life, Forest, and Environmental protection act

TEXT BOOKS

1. Anubha Kaushik, C.P.Kaushik, "Perspectives in Environmental Studies", New age international publishers, Delhi, 5nd edition,2016.
2. Mahua Basu, S.Xavier, "Fundamentals of Environmental Studies", Cambridge University Press, Delhi, 1st edition, 2016.

REFERENCES

1. S.Deswal, A. Deswal, "A Basic course in Environmental Studies", Educational & Technical Publishers, Delhi, 2nd Edition, 2014.
2. R. Rajagopalan, "Environmental Studies (From Crisis to Cure)", Oxford University Press, New Delhi, 3rd Edition, 2012.
3. De, A.K, "Environmental Chemistry", New Age International (P) Limited, New Delhi,5th Edition, 2003.
4. Dr.K.V.S.G. Murali Krishna, "Environmental Studies", VGS Techno Series, Vijayawada, 1st Edition,2010.
5. G. Tyler Miller, Scott Spoolman, "Introduction to Environmental Studies", Cengage Learning, New Delhi, 13th Edition, 2009.

B.Tech. (III Sem.)	17FE07 - NUMERICAL METHODS AND FOURIER ANALYSIS	L	T	P	Cr.
		3	2	-	4

Pre-requisites : None

Course Educational Objective : The main objective of this course is to enable the students learn Numerical Techniques for solving the equations, interpolation, differential equations and fitting of various cuves. They will also learn about the Fourier analysis of single valued functions.

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

CO1: Compare the rate of accuracy between various methods in approximating the root of the equation and Distinguish among the criteria ofselection and procedures of various Numerical Integration Rules.

CO2: Estimate the best fit polynomial for the given tabulataed data using the methods of Newton's Interpolation formulae and Lagrange's Interpolation.

CO3: Apply various Numerical methods in solving the initial value problem involving the ordinary differential equation.

CO4: Estimate the unknown dependent variables using curve fitting methods..

CO5: Generate the single valued functions in the form of Fourier series and obtain the Fourier Transforms

UNIT – I

Solution of Algebraic and Transcendental 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 – II

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 – 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

CURVE FITTING

Curve fitting by the principle of Least Squares: Fitting of a straight line – Second degree parabola-other polynomial curves-Fitting of exponential curves –Fitting of a power curve

UNIT – V

Fourier Series and Fourier Transforms

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

Fourier Transforms

Fourier integral theorem (only statement) – Fourier transform – sine and cosine transforms – properties.

TEXT BOOKS

1. S. S. Sastry, "*Introductory Methods of Numerical Analysis*", 5th Edition, PHI, New Delhi, 2005.
2. B. V. Ramana, "*Higher Engineering Mathematics*", 1st Edition, TMH, New Delhi, 2010.

REFERENCES

1. B.S. Grewal , "*Higher Engineering Mathematics*", 42ndEdition, Khanna Publishers, New Delhi, 2012.
2. Steven. C. Chopra, Ra. P. Canale, "*Numerical Methods for Engineers with programming and software application*",4th Edition, TMH, New Delhi, 2002.
3. M. K. Jain, S. R. K. Iyengar, R.K. Jain, "*Numerical Methods for Scientific and Engineering Computation*", 5th Edition, New Age International Publishers, New Delhi, 2007.

B.Tech. (III Sem.) **17EC50 - BASIC ELECTRONICS ENGINEERING**

L	T	P	Cr.
2	2	-	3

Pre-requisites: Engineering Physics

Course Educational Objectives: The course will provide introduction to semiconductor materials, operation of electronic devices like diodes, transistors and their applications. This course further provides knowledge about logic gates, implementation of digital circuits using logic gates and understand the constraints of operational amplifier.

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

CO1: Know the basics of semiconductor materials and operation of electronic devices.

CO2: Use of junction diode and transistor for different applications.

CO3: Design amplifier circuits using transistor

CO4: Analyze the digital circuits using logic gates

CO5: Design the combinational & sequential circuits using logic gates and Examine the characteristics related to OP-AMP.

UNIT-I:

Semiconductor Physics: Energy band theory of crystals, types of materials, mobility, conductivity, semiconductor definition, types of semiconductors, majority and minority carriers in semiconductors, Fermi level in semiconductors, mass action law.

Electronic Devices: P-N junction diode, Biasing conditions of P-N junction diode, V-I characteristics of junction diode, Zener diode and its applications.

UNIT-II:

Applications of junction diode: Rectifier definition, types of rectifiers, Half wave, full wave rectifier and bridge rectifier, rectifier circuits operation and parameters, comparison of rectifier circuits, need of filter in rectifier, rectifier circuits with capacitor, inductor, L- section and π section filters

Introduction to three terminal devices : Introduction to Transistor, transistor terminals, operation of Bipolar Junction Transistor (BJT), Field Effect Transistor (FET) and Metal Oxide Semiconductor Field Effect Transistor (MOSFET).

UNIT-III:

Transistor Biasing: Need for biasing, operating point, DC load line, AC load line, Stability, types of biasing circuits -fixed bias, collector to base bias and voltage divider bias circuits operation and design. Stability factors S, S^I and S^{II} for different basing circuits.

UNIT-IV:

Number System & Boolean Algebra: Number systems (binary, octal, decimal and hexadecimal), compliments (1s and 2s compliments), Boolean algebra, K-map and its minimization (up to four variables), Binary codes and code converters.

Logic Gates: Basic logic gates (AND, OR, NOT), universal logic gates (NAND, NOR), and special logic gates (XOR, XNOR), implementation of digital circuits using logic gates.

UNIT-V:

Combinational & Sequential Circuits: Half adder, full adder, half Subtractor, full Subtractor, decoder and encoder, Multiplexer and de-multiplexer, sequential circuits, difference between combinational and sequential circuits, latches and flip-flops (SR, JK, D and T), flip-flop conversions

Operational Amplifiers: Introduction to operational amplifier (OP-AMP), block diagram of OP-AMP, 741 OP-AMP parameters, 741 Op-Amp applications- adder, subtractor, 741 OP-AMP as integrator and differentiator.

TEXT BOOKS:

1. R.L.Boylested and Louis Nashelsky, "Electronic Devices and Circuits" , Pearson/ prentice Hall Publishers.
2. Morris Mano, "Digital Design", PHI Publishers, 4th Edition.

REFERENCES:

1. Jacob Millman, Christos C Halkies, " Electronic Devices and Circuits", Tata McGraw Hill, Publishers, New Delhi.
2. "Electronic Devices and Circuits" by G.S.N.Raju, I.K.International.

B.Tech. (III Sem.) **17ME03 - THERMODYNAMICS**

L	T	P	Cr.
2	2	-	3

Pre-requisites: Engineering Physics

Course Educational Objective:
To provide insights on laws of thermodynamics and its applications, gas mixtures, pure substances and thermodynamic cycles.

Course Outcomes: At the end of the course, the student will be able to:
CO1: Comprehend the concepts of heat, work, forms of energy, laws of thermodynamics, mixture of gases, pure substances and thermodynamics cycles.
CO2: Describe various thermal systems using thermodynamic laws and principles.
CO3: Apply the laws of thermodynamics to solve problems on various thermodynamic systems.
CO4: Analysethermodynamic cycles, properties of pure substances and mixtures of gases using Thermodynamic concepts
CO5: Evaluate the performance parameters of thermodynamic cycles, pure substances and gas mixtures.

UNIT – I
BASIC CONCEPTS AND DEFINITIONS: Introduction, Macroscopic and Microscopic approaches, System, Control Volume, Properties of System, State, Path, and Process, path and Point Functions. Cycle and Equilibrium-Thermodynamic Equilibrium, Quasi static process-Applications, Internal Energy, Specific Heat, Enthalpy.
ZEROTH LAW OF THERMODYNAMICS: Temperature Scales, Temperature measurement, Constant Volume Gas Thermometer, Advantages of gas thermometers over liquid thermometers.

UNIT – II
FIRST LAW OF THERMODYNAMICS : Introduction, Internal Energy - Property of System Closed System and Open system, First Law Analysis of Closed System, Thermodynamic processes, Different forms of stored energy, Energy-Forms of Energy, Heat, Work, Mechanical forms of Work and its applications, PMM1.
THERMODYNAMIC ANALYSIS OF CONTROL VOLUME: Conservation of Energy Principle-Flow work, The Steady Flow Process-Steady Flow Energy Equation, Steady Flow Engineering Devices-Nozzles, Diffusers, Turbine, Compressors, Throttling Valves, Heat Exchangers, Limitations of first law of thermodynamics

UNIT – III
SECOND LAW OF THERMODYNAMICS: Introduction, Thermal Energy Reservoirs, Heat Engines, Refrigerators, Heat Pumps, Kelvin-Planck & Clausius Statements of Second law of Thermodynamics, , Equivalence of Kelvin-Plank and Clausius Statements, PMM II, Differences between reversible and Irreversible Process, Carnot Cycle, Carnot Theorem,
ENTROPY: Introduction, temperature - entropy Plot, Principle of increase of entropy, Entropy Change for Ideal gases, Applications of Entropy.

UNIT – IV
NON REACTIVE GAS MIXTURES: Introduction, Composition of Gas Mixture, Mass Fraction, Mole Fraction, Daltons Law of Additive Pressures, Amagat`s Law of Additive Volumes, Ideal Gas Mixtures.
PROPERTIES OF PURESUBSTANCE: Introduction, Phases of Pure Substance, Properties of steam, dryness fraction, Phase Change Processes, Property Diagrams of (*p-v, p-t, t-s.*) Pure Substance, *p-v-t* Surface, h-s Diagram or Mollier Diagram for a Pure Substance.

UNIT – V

VAPOUR POWER CYCLES: Carnot Vapour Cycle, Working of simple Rankine Cycle.

GAS POWER CYCLES: Introduction, Analysis of Power Cycles- Carnot, Otto, Diesel, Dual, Brayton Cycle and Atkinson cycle

REFRIGERATION CYCLES: Reversed Carnot Cycle, Bell-Coleman Cycle, Simple Vapour Compression Cycle.

TEXT BOOKS

1. P.K.Nag ,"Engineering Thermodynamics"- McGraw-Hill. 5th Edition, 2013
2. Y.A. Cengel, and M.A.Boles, "Thermodynamics : An Engineering Approach", McGraw-Hill,7th Edition, 2011.

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.

B.Tech. (III Sem.) **17ME04 - MECHANICS OF SOLIDS**

L	T	P	Cr.
2	2	-	3

PRE-REQUISITES: Engineering Mechanics

COURSE EDUCATIONAL OBJECTIVE:
The objective of the course is to analyze the stresses & deformations in mechanical members due to various loads.

COURSE OUTCOMES: After completion of the course students will be able to
CO1: Compute the stresses & deformations of a member due to axial loading under uniform and non uniform conditions.
CO2: Analyze the variation of SF & BM in determinate beams.
CO3: Analyze the structural members subjected to flexural and torsional loads.
CO4: Analyze the biaxial stresses developed at a point of stressed member and identify shear stresses across the cross section of a beam.
CO5: Evaluate deflections for statically determinate beams and analyze the thin and thick pressure vessels.

UNIT - I
SIMPLE STRESSES AND STRAINS: Stress and strain due to axial force. Hooke's law, Factor of safety, Stepped bars – Uniformly varying sections - Stresses in composite bars due to axial force and temperature - Strain energy due to axial force– stresses due to sudden and impact loads - Lateral strain - Poisson's ratio - Change in volume – Shear stress - Shear strain -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 and Overhanging beams subjected to concentrated loads and uniformly distributed loads - 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.
TORSION: Theory of Torsion - Assumptions - Derivation of torsion equation – Polar modulus, Power transmitted by a shaft, Stresses in solid and hollow circular shafts.

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 - Mohr's circle of stresses.
SHEAR STRESSES: Derivation of formula – Shear stress distribution across various beam cross sections like Rectangular, Circular.

UNIT - V
DEFLECTION OF BEAMS: Differential equation of elastic line - Deflection in statically determinate beams - Macaulay's method for prismatic members.
THIN AND THICK CYLINDRICAL SHELLS: Hoop and longitudinal stress- Thin and Thick cylinders -Changes in dimensions and volume.

TEXT BOOK

1. Popov, E.P., "Engineering Mechanics of Solids", PHI, 2nd Edition, 2009
2. Sadhu Singh, "Strength of Materials", Khanna Publishers, 10th Edition, 2013.

REFERENCES

1. S.Ramamrutham, "Strength of Materials", 14th Edition, 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", 2nd Edition, Oxford University Press, 2010.
5. R.K.Bansal, "Strength of Materials", 15th Edition, Laxmi Publishers, 2013.
6. James M.Gere, Barry J.Goodno, "Mechanics of Materials", 7th Edition, CEngage Learning, 2009.

B.Tech. (III Sem.) **17ME05 - METALLURGY AND MATERIAL SCIENCE**

L	T	P	Cr.
3	-	-	3

PRE-REQUISITES: Applied Mathematics, Engineering Physics, Engineering Chemistry

COURSE EDUCATIONAL OBJECTIVE: The objectives of this course are to acquire knowledge on structure of metals and alloys, understand the concept of alloys and equilibrium diagrams; demonstrate the concept of heat treatment process.

COURSE OUTCOMES: After completion of the course students will be able to:
CO1: Estimate the properties of the metals and alloys based on structures.
CO2: Classify, construct and analyze equilibrium diagrams.
CO3: Analyze and distinguish various ferrous, non-ferrousmetals and alloys.
CO4: Identify the influence of mechanical working and heat treatment principles on materials.
CO5: Classify, analyze and suggest the suitable manufacturing method for composite materials.

UNIT – I
STRUCTURE OF METALS: Crystal structures-Body centred 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 rules.

UNIT – II
EQUILIBRIUM DIAGRAMS: Experimental methods of construction of equilibrium diagrams, Classification of equilibrium diagrams- isomorphous, eutectic, partial eutectic equilibrium diagrams.
EQUILIBRIUM DIAGRAMS FOR TRANSFORMATIONS: 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.
FERROUS METALS AND ALLOYS: Study of Iron-Iron carbide equilibrium diagram.

UNIT – III
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. Harden ability-determination of harden ability by 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.

METAL MATRIX COMPOSITES: Introduction to metal ceramic mixtures, Metal – Matrix composites and C – C composites and applications.

TEXT BOOKS:

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

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

B.Tech. (III Sem.) 17EC75 - BASIC ELECTRONICS ENGINEERING LAB

L	T	P	Cr.
1	-	2	2

Course Educational Objectives:
In this course student will learn about

- The PN junction Diode and its characteristics.
- Applications of a diode as a Rectifier and Filter circuits.
- Characteristics of BJT.
- Op-amp applications.

Course Outcomes: At the end of this course student will be able to
CO1: Calculate the static & dynamic resistances of Diodes.
CO2: Differentiate Rectifiers and Filters parameter characteristics
CO3: Calculate the input & output impedances of Transistors from its characteristics.
CO4: Explore the applications of op-amp.

LIST OF EXPERIMENTS:

1) V-I characteristics of P-N junction diode.
2) V-I characteristics of Zener diode.
3) Half wave rectifier without filter.
4) Half wave rectifier with filter.
5) Full wave rectifier without filter.
6) Full wave rectifier with filter.
7) Input & Output characteristics of Transistor in Common Emitter mode.
8) Frequency response of Common Emitter Amplifier.
9) 741 op-amp as a inverting amplifier.
10) 741 op-amp as an non-inverting amplifier.
11) 741 op-amp as a adder.
12) 741 op-amp as a Subtractor.

Note:
A student will do Minimum 10 experiments in hardware lab.

B.Tech. (III Sem.)	17ME63 - METALLURGY AND MATERIAL SCIENCE LAB	L	T	P	Cr.
		-	-	2	1

PRE-REQUISITES: Engineering Physics, Applied Chemistry

COURSE EDUCATIONAL OBJECTIVE: The main objectives of the course are to determine the various mechanical properties of materials under different loading conditions and study the microstructure of alloys.

COURSE OUTCOMES: After completion of the course students will be able to
CO1: Prepare the specimens as per standards
CO2: Observe microstructure of different materials.
CO3: Analyze the properties of materials based on microstructure.
CO4: Perform hardness test and heat treatment of steels.

LIST OF EXPERIMENTS: Conduct a minimum of 10 experiments

1. Preparation and study of the microstructure of Cu.
2. Preparation and study of the microstructure of Al.
3. Preparation and study of the microstructure of low carbon steels.
4. Preparation and study of the microstructure of medium carbon steels.
5. Preparation and study of the microstructure of high carbon steels.
6. Preparation and study of the microstructures of gray cast iron, malleable cast iron and nodular cast iron.
7. Preparation and study of the microstructures of brass.
8. Hardenability of steels by Jominy end quench test.
9. Hardness of various treated and untreated steels.
10. Fabrication of FRP Composite by Hand lay-up method.
11. Fabrication of FRP Composite by Vacuum bag moulding
12. Study of the microstructuresof heat treated steels.
13. Study of Age hardening of Al-Cu alloy.
14. Study of Fe-Fe_3C equilibrium diagram.
15. Study of TTT diagram for eutectoid steel.

REFERENCES
Lab Manual

B.Tech. (III Sem.) **17ME64 - MATERIALS TESTING LAB**

L	T	P	Cr.
-	-	2	1

PRE-REQUISITES **:** Engineering Mechanics

COURSE EDUCATIONAL OBJECTIVE:

The objective of this course is to make the students observe the response of the materials under different loads and measure various mechanical properties.

COURSE OUTCOMES: After completion of the course students will be able to
CO1: Observe the behaviour of materials by conducting Tension, Compression & Shear tests.
CO2: Evaluate the impact strength of material.
CO3: Determine the hardness of a given material.
CO4: Determine Elastic constants of a given material using flexural and torsion tests.

LIST OF EXPERIMENTS

NOTE: Conduct a minimum of 10 experiments

1. Determination of strength of different materials under tensile load by using UTM and to study stress strain characteristics.
2. Determination of shear strength of material by using UTM.
3. Determination of stiffness and modulus of rigidity by conducting compression tests on springs.
4. Determination of hardness number by using Brinell Hardness Tester.
5. Determination of hardness number by using Rockwell Hardness Tester.
6. Determination of hardness number by using Vickers Hardness Tester.
7. Determination of Impact strength on Izod Impact Testing Machine.
8. Determination of Impact strength on Charpy Impact Testing Machine.
9. Determination of Rigidity Modulus by conducting Torsion test on circular shafts.
10. Determination of Young's Modulus for materials on simply supported beam.
11. Determination of Young's Modulus for materials on Cantilever beam.

REFERENCE
Lab Manual

B.Tech. (IV Sem.)	17FE08 - PROBABILITY AND STATISTICS	L	T	P	Cr.
		3	2	-	4

Pre-requisites : None

Course Educational Objective : The objective of this course is to intoduce the probability and its distributions, sampling methods and estimation. They also learn various tests of hypothesis and evaluation of correlation and regression analysis.

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

CO1: Predict various probabilistic situations based on the laws of probability and random variables.

CO2: Distinguish among the criteria of selection and application of Binomial, Poisson, Normal and Exponential distributions.

CO3: Estimate the point and interval estimators of mean and proportion for the given Sample data.

CO4: Apply various sample tests like Z-test, t-test, F-test and χ2-test for decision making regarding the population based on sample data.

CO5: Estimate the level of correlation, the linear relationship using the regression lines for the given bivariate data.

UNIT - I :

PROBABILITY AND RANDOM VARIABLES

Conditional probability – Multiplication theorem-Baye's theorem.

Random variables – Discrete and continuous Random Variables, distribution function. Mathematical Expectation of Univariate Random Variable.

UNIT –II

PROBABILITY DISTRIBUTIONS

Discrete Probability Distributions: Binomial distribution and Poisson distribution. Continuous Probability Distributions: Normal distribution and Exponential distribution. Related properties, simple applications.

UNIT –III

SAMPLING DISRIBUTION AND ESTIMATION

Population and sample, Sampling distribution of mean (with known and unknown variance), and variances. Sampling distribution of sums and differences. Point estimation and interval estimation for mean and proportions.

UNIT –IV

TESTS OF HYPOTHESIS

Null and Alternative Hypothesis, One tail and two tailed tests,Type I and Type II errors. Testing of hypothesis concerning means, proportions and their differences using Z-test. Tests of hypothesis using Student's t-test, F-test and χ^2-test.

Applications of decision making using the above tests.

UNIT –V

CORRELATION AND REGRESSION

Simple Bivariate Correlation: Karl Pearson's coefficient of correlation, Spearman's Rank correlation coefficient. Linear Regression: Regression lines, Regression coefficients, properties of Regression coefficients.

TEXT BOOKS

1. Miller, Freund, "*Probability and Statistics for Engineers*", 8th edition, PHI, New Delhi, 2011.
2. S.C.Gupta, V.K.Kapoor, "*Fundamentals of Mathematical Statistics*", 11th Edition, Sultan Chand and sons, New Delhi, , 2014.

REFERENCES

1. Jay L. Devore, "*Probability and Statistics for engineering and the sciences*", 8th Edition, Cengage Learning India, New Delhi, 2012.
2. William W. Hines, "*Probability and Statistics in Engineering*", 4th edition, John Wiley and Sons, New Delhi, 2003.
3. T.K.V. Iyangar, "*Probability and Statistics*", 4th revised Edition, S. Chand and Company, New Delhi, 2012.
4. B.V. Ramana, "*Higher Engineering Mathematics*", 1stEdition, TMH, New Delhi, 2010.

B.Tech. (IV Sem.) **17ME06 - OPERATIONS RESEARCH**

L	T	P	Cr.
3	-	-	3

PRE-REQUISITES : Applied Mathematics

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

CO 1: Apply linear programming approach for optimizing the objectives of industrial oriented problems.
CO 2: Formulate and solve Transportation Models and assignment Models
CO 3: Implement the strategies in competitive situations and Identify the replacement period of the equipment.
CO 4: Analyze the waiting situations in an organization.
CO 5: Determine the optimum inventory level and resolve the complex problem into simple problems by dynamic programming approach and apply optimum strategies.

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 – m X 2 & 2 X n games and 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.

TEXTBOOKS

1. Kantiswarup. P.K.Gupta, Man Mohan, Operations Research, Sultan Chand& Sons, Educational Publications, New Delhi, 14th Edition, 2008.
2. S.D Sharma, "Operation Research", Kedar Nath and RamNath - Meerut , 2008

REFERENCES

1. Singiresu S Rao, Engineering Optimization: Theory and Practice, A Wiley- Interscience Publication, 4th edition,2009.
2. Hiller &Libermann, Introduction to O.R (TMH), 9TH EDITION, 2009
3. A.M.Natarajan, P.Balasubramani, A. Tamilarasi,Operations Research, Pearson Education, 2nd edition, 2014.
4. Taha, Introduction to O.R .PHI, 9th edition, 2010.

B.Tech. (IV Sem.)	17ME07 - FLUID MECHANICS AND HYDRAULIC MACHINERY	L	T	P	Cr.
		3	-	-	3

PRE-REQUISITES : Basic principles of Engineering Physics and Mathematics

COURSE EDUCATIONAL OBJECTIVE:

To learn fundamentals of fluids, flow measuring devices, losses in pipes, performance of turbines and pumps.

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

CO1: Apply fundamentals of fluid mechanics and its applicable laws to solve problems in engineering applications
CO2: Formulate and solve different Types of Fluid Flows and its Velocity Potential
CO3: Analyze surface forces and losses in pipe flows
CO4: Compute drag & lift forces using the boundary layer concepts
CO5: Design& formulate the working parameters of Hydraulic machines

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,

FLUID KINEMATICS: Stream Line, Path Line, Streak Line, Stream Tube, Classification of Flows-Steady & Un Steady, Uniform and Non Uniform, Laminar, Turbulent, Rotational and Irrotational Flows-Equation of Continuity For One Dimensional Flows.

UNIT-II

FLUID DYNAMICS: Surface and Body Forces-Euler's Equation, Bernoulli's Equations For Flow along a Stream Line, Momentum Equation and Its Application of 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 & Turbulent Boundary Layer, Boundary Layer Thickness, Displacement Thickness, Energy Thickness, Momentum Thickness, Boundary Layer Separation, Methods to control separation of Boundary layer.

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.

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 and efficiencies of Francis Turbine, Working proportions of Francis Turbine, Kaplan Turbine, work done, heads& efficiencies, Draft Tube, Draft Tube Theory, Types Of Draft Tubes, Governing of Turbines, Unit Quantities and Specific Quantities, Geometric Similarity, Cavitation in Turbines, Performance Characteristic Curves.

UNIT-V

CENTRIFUGAL PUMPS: Working of Centrifugal Pumps, Types of Centrifugal Pumps, Velocity triangles, Work done by The Impeller - Losses and Efficiencies, Specific Speed, Pumps in Series, Parallel-Performance Characteristics Curves, NPSH

RECIPROCATING PUMPS: Main components and working of a Reciprocating Pumps, Types of Reciprocating Pumps, work done by Reciprocating Pump, Single, Double, Co Efficient of Discharge, Percentage of Slip and Negative slip of pump.

TEXT BOOKS

1. Introduction to Fluid Mechanics, Robert W. Fax, Philip J. Pritchard, Alan T. McDonald. John Wiley &sons, 7th edition, 2010. India Edition.
2. Fluid Mechanics Franck .M White Tata Mc GrawHill Publication 2011.
3. Shames, "*Mechanics of Fluids*", McGraw Hill Book Co., New Delhi, 1988
4. Streeter V.L., Benjamin Wylie, "*Fluid Mechanics*", Mc Graw Hill Book Co., New Delhi, 1999
5. P.N. Modi and S.M. Seth, "Hydraulics & Fluid Mechanics", Standard Book House, Delhi, 20thEdition, 2015

REFERENCES

1. R.K.Bansal, "Fluid Mechanics and Hydraulic Machines",laxmi publications, 9th Edition, 2012
2. Banga& Sharma, "Hydraulic Machine's, Khanna publishers, 6th Edition, 1999
3. RamaDurgaiah, "Fluid Mechanics and Machinery", New Age International, 1stedition, 2006
4. D.S. Kumar, "Fluid Mechanics and Fluid power engineering", S.K. Kataria& Sons6th Edition, 1998

B.Tech. (IV Sem.)	17ME08 - PRODUCTION TECHNOLOGY	L	T	P	Cr.
		3	-	-	3

PRE-REQUISITES: Work Shop

COURSE EDUCATIONAL OBJECTIVE: The main objective of the course is to understand the various production or manufacturing processes which could be done in real time, appreciate the importance of basic principles of Manufacturing Technology.

COURSE OUTCOMES: After completion of the course students are the able to

CO1: Identify the primary manufacturing concepts like casting, welding, forming, forging and extrusion
CO2: Distinguish various manufacturing processes such as casting and welding, welding and forming, forming and forging
CO3: Apply the working principles of primary manufacturing processes
CO4: Design and fabrication of engineering components using different manufacturing processes
CO5: Evaluate the manufacturing processes being utilized in the present industrial scenario.

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 & brazing processes and applications, welding defects, causes and remedies, arc blow, 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.

PLASTICE ENGINEERING: Introduction, extrusion of plastics, Injection moulding, blow moulding, thermoforming and thermosetting of materials, applications.

TEXT BOOKS

1) P.N. Rao ,Manufacturing Technology, TMH, 2ndEdition, 2004.
2) Richard W Heine, Philp Rosenthal& Karl R.Loper, Principles of metal casting, TMH Edition, 2000.

REFERENCES:

1) S. Kalpakjain, S.R.Schmid, Manufacturing Engineering and Technology, Pearson Edu., 4thEdition, 2001.
2) R.K. Jain , Production Technology /Khanna Publishers, 17thEdition, 2012.
3) Lindberg, Process and materials of manufacturing, PE.
4) Sarma P C, Production Technology, S Chand & Company Ltd, 3rdEdition, 2012.
5) B.S. Raghuvamsi, Workshop Technology, Dhanapatirai and co. 10thEdition, 2011.

B.Tech. (IV Sem.) **17ME09 - APPLIED THERMODYNAMICS**

L	T	P	Cr.
2	2	-	3

Pre-requisites:Thermodynamics

Course Educational Objective : To provide insights on components of thermal power plant and various types of compressors.

Course Outcomes: At the end of the course, the student will be able to
CO1.Describe the components and functioning of a Rankine cycle and compressors.
CO2.Apply thermodynamic analysis to study the behavior of steam nozzles.
CO3.Analyze the need of various boiler draught systems for a vapor power cycle.
CO4.Evaluate the performance of impulse, reaction turbines and reciprocating compressors.
CO5.Estimate the parametric performance of Rankine cycle with reheat and regeneration concepts.

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 turbine- 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. Methods to reduce rotor 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, Free Air Delivery, 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

1. Mahesh.M. Rathore, Thermal Engineering,TMH,1st Edition, 2012.
2. R.K.Rajput, Thermal Engineering, Laxmi publications, 5th Edition, 2005.

REFERENCES

1. T.D Eastop and A. McConkey, Applied Thermodynamics, Pearson 5th Edition 2013.
2. R. Yadav ,Thermodynamics and Heat Engines,Vol-II,Central Book Depot,5th Edtn,1999.
3. R.S.Khurmi ,Thermal Engineering , S.Chand & Company, 1st Edition , 2012.
4. P.K Nag, Power Plant Engineering, TMH, 3rd Edition 2012.

B.Tech. (IV Sem.) **17ME10 - KINEMATICS OF MACHINES**

L	T	P	Cr.
3	-	-	3

PRE-REQUISITES: Engineering Mechanics

COURSE EDUCATIONAL OBJECTIVE: The main objective of this course is to identify the basic components & layout of mechanisms and understand the kinematics of linkages in the machines.

COURSE OUTCOMES: After completion of the course students are able to:
CO1: Develop the mechanisms from the basic concepts for path and function generation
CO2: Evaluate the velocity and accelerations of various kinematic links in a mechanism.
CO3: Analyse cams for producing a desired motion and cams with specified contours.
CO4: Design belt and rope derives for the rated conditions of the machines.
CO5: Calculate the speeds of gears for automobile and machine tools.

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.
Exact and approximate copiers and generated types –Peaucellier, Hart and Scott Russell – Grasshopper – Watt - Chebicheff and Robert Mechanisms.

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 - Klein's construction-Coriolis acceleration.
MECHANISMS WITH LOWER PAIRS:
Conditions for correct steering – Davis Steering gear- Ackerman steering gear, Single Hooke's joint –Limitation - Double Hooke's joint – Problems.

UNIT - III
CAMS: Classification of Cam and Follower mechanism-Terminology - Types of follower motion - Uniform velocity – Simple harmonic motion and Uniform acceleration& deceleration - Graphical layouts of cam profiles -Displacement diagrams- Derivations of follower motion for tangent cams.

UNIT - IV
BELT AND ROPE DRIVES: Introduction - Selection of belt drive- Types of belt drives-materials- Velocity ratio- Slip -Creep - Tensions for flat belt drive& V-belt drive -Angle of contact-Centrifugal tension- Maximum tension – Rope drives.

UNIT - V
GEARS: Terminology – Law of gearing- Profile for gears- Involute action- Path of contact, Arc of contact, Contact ratio- Velocity of sliding –Interference and Undercutting.
GEAR TRAINS: Speed ratio- Train value- Types of Gear trains – Applications – Epicyclic gear trains-Automobile differential.

TEXT BOOKS

1. Thomas Bevan, "Theory of Machines", 3rd Edition, CBS Publishers and Distributors, 2013.
2. Rattan S.S, “Theory of Machines”, 3rd Edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2011.

REFERENCES

1. Shigley J.E. and Uicker J.J., "Theory of Machines and Mechanisms", 2nd Edition,McGraw-Hill, Inc., 1995.
2. Rao J.S and Dukkipati R.V, “Mechanism and Machine Theory”, 2nd Edition, New AgeInternational, New Delhi, 2007.
3. Sadhu Singh “Theory of Machines”, 3rd Edition, Pearson Education, 1997.
4. Ballaney.P.L “Theory of Machines”, 20th Edition, Khanna Publishers, 1996.
5. Ambekar A. G., “Mechanism and Machine Theory”, Prentice Hall of India, New Delhi, 2009.

B.Tech. (IV Sem.) **17ME65 - PRODUCTION TECHNOLOGY LAB**

L	T	P	Cr.
-	-	2	1

PRE-REQUISITES : Engineering Workshop

COURSE EDUCATIONAL OBJECTIVE:

The objectives of the course are to provide hands-on laboratory experience in the area of production, provide basic knowledge about casting and tools used in casting; get familiarized with welding equipment and various welding processes; acquire practical knowledge in mechanical press working and get equip with moulding processes.

COURSE OUTCOMES: After completion of the course students are able to:
CO1: Design and develop a product using various metal casting methods.
CO2: Fabricate machine components with suitable welding technique.
CO3: Choose a suitable mechanical press working process to obtain the required shape of metal.
CO4: Manufacture a plastic component using various plastic processing techniques.

I. METAL CASTING

1. Pattern Design and making - for one casting drawing – 1 Exercise.
2. Sand properties testing - Exercise -for strengths and Permeability
3. Moulding, Melting and Casting - 1 Exercise

II WELDING

1. ARC Welding Lap & Butt Joint - 2 Exercises.
2. Spot Welding - 2 Exercises.
3. TIG Welding - 1 Exercise.

III MECHANICAL PRESS WORKING

1. Blanking & Piercing operation and study of simple, compound and progressive press tool.
2. Hydraulic Press: Deep drawing and extrusion operation.
3. Bending and other operations

IV PROCESSING OF PLASTICS

1. Injection Moulding
2. Blow Moulding

Ref: Production Technology Manual

B.Tech. (IV Sem.)	17ME66 - COMPUTER AIDED MACHINE DRAWING LAB	L	T	P	Cr.
		-	-	2	1

PRE-REQUISITES: Engineering Graphics, CAEG.

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: After completion of the course students are able to:
CO1: Develop and/or comprehend basic conventions needed for machine drawing
CO2: Apply the conventions of machine elements while designing standardized parts
CO3: Apply the ideas and make design calculations correctly.
CO4: Design the drawings of mechanical components and their assemblies

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 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, cottered 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.

List of Tasks:

S. No	Name of the task	No. of Periods
1	Drawing commands	3
2	Editing commands	3
3	Dimensioning commands, Layers	3
4	*Principles of Drawing: Title block, Borders, scales and their specifications*	*3*
5	*Lines and sections and Dimensioning principle*	*3*
6	*Conventional Representation of Materials*	*3*
7	*Conventional Representation of Machine components-I*	*3*
8	*Conventional Representation of Machine components-II*	*3*
9	*Thread Profiles*	*3*
10	*single and multi-start threads, left and right hand threads*	*3*
11	*Bolts and Nuts: Hexagonal and square headed nuts and bolts;*	*3*
12	*Flanged Nut, Dome Nut, Ring Nut, Washer, Lock Nut, Castle Nut, Eye Foundation Bolt*	*3*
13	*Cotter Joint with socket and Spigot Ends*	*3*
14	*Cotter Joint with Gib*	*3*
15	*Riveted Joints: Rivet heads; Double strap diamond butt Joint*	*3*
16	*Double riveted chain Lap joint; double riveted double strap zigzag butt joint*	*3*
17	*Keys: Taper Key, Sunk Taper Key, Round Key, Saddle Key, Feather Key, Splined Shaft, Woodruff Key*	*3*
18	*Shaft Couplings: Bushed pin type flange coupling*	*3*
19	*Universal Coupling*	*3*
20	*Assembly Drawings: Any four of the following: Stuffing Box of Steam Engine, Eccentric of Steam Engine, Connecting Rod of an IC Engine, Screw Jack, Plumber Block, Tool Post of Lathe Machine*	*12*

TEXT BOOKS

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

B.Tech. (IV Sem.)	17ME67 - FLUID MECHANICS AND HYDRAULIC MACHINERY LAB	L	T	P	Cr.
		-	-	2	1

PRE-REQUISITES: Engineering Mechanics Lab

COURSE EDUCATIONAL OBJECTIVE:
In this course student will learn about the insights of calculating the discharge in various flow measuring devices, performance parameters of hydraulic machines.

COURSE OUTCOMES: After completion of the course students are able to:
CO1: Tuning flow discharge measuring devices used in pipes channels and tanks.
CO2: Compute flow equations to solve control volume analysis problems in fluid mechanics.
CO3: Determine the laminar and turbulent boundary layer fundamentals in fluid flow problems.
CO4: Develop capability to apply conservation principles to hydraulic machines.

LIST OF EXPERIMENTS
At least 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 pipeline
6. Determine Co-Efficient of 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 Reciprocating Pump.
11. Determination Of Co-Efficient of flow using Turbine flow meter.
12. Flow visualization using Reynolds experiment.
13. Flow Visualization study using Water Flow Channel

REFERENCE: Lab Manual

B.Tech. (IV Sem.)	17PD03 - PROFESSIONAL ETHICS AND HUMAN VALUES	L	T	P	Cr.
		3	-	-	0

Pre requisite: Basic Sciences and Humanities

COURSE EDUCATIONAL OBJECTIVES:

1. To create an awareness on engineering ethics and human values.
2. To adumbrate the inevitability of different intellectual property rights like patents, copyrights, trademarks, and trade secret.
3. To give an impetus on achieving higher positions in profession, with ethical and human values as a base and support for the growth.
4. To explicate the professional and societal responsibilities of the engineers.
5. To make the student realize the sensitiveness associated with experimentation process

COURSE OUTCOMES: At the end of the course, the student

CO1 : Acquires the basic concepts of human values & also gain the connotations of ethical theories.
CO2: Knows the basic concepts of Professional ethics and handling Dilemma in decision making.
CO3: Knows the duties and rights towards the society in an engineering profession
CO4: Would realize the importance and necessity of intellectual property rights.
CO5: Can take all the necessary precautions while conducting the experiments, which may reduce the risk.

UNIT –I: **ETHICS**

Senses of 'Engineering Ethics' -Variety of moral issues - Types of inquiry -Moral dilemmas Moral autonomy -Kohlberg's theory Gilligan's theory -Consensus and controversy – Models of Professional Roles -Theories about right action- Self interest - Customs and religion -Uses of Ethical theories.

UNIT - II: HUMAN VALUES

Morals, Values and Ethics – Integrity – Work Ethic – Service Learning - Civic Virtue –Respect for Others–Living Peacefully – Caring – Sharing - Honesty – Courage– Valuing Time - Cooperation – Commitment – Empathy – Self Confidence – Character – Spirituality

UNIT – III: ENGINEERING AS SOCIAL EXPERIMENTATION

Engineering as experimentation- Engineering Projects VS. Standard Experiments - Engineers as responsible experimenters – Codes of ethics - Industrial Standards - Abalanced outlook on law- The challenger case study.

UNIT – IV: SAFETYAND RESPONSIBILITIES

Safety and risk- Assessment of safety and risk- Risk benefit analysis and reducing risk- Three Mile Island and Chernobyl case study - Collegiality and loyalty -Respect for authority- Collective bargaining – Confidentiality- Conflicts of interest- Occupational crime-Professional Rights- Employee Rights –Intellectual Property Rights(IPR) discrimination.

UNIT – V: GLOBAL ISSUES

Multinational Corporation’s -Environmental ethics-computer ethics -weapons development Engineers as managers - consulting engineers-engineers as expert witnesses and advisors, Moral leadership - sample code of Ethics (Specific to a particular Engineering Discipline).

TEXT BOOKS

1. R.S.Nagarajan, a Textbook on "Professional Ethics and Human Values", New Age Publishers – 2016.
2. Mike Martin and Roland Schinzinger, "Ethics in engineering", McGraw Hill, New York 1996.
3. "Professional Ethics and Human Values" by A.Alavudeen, R.Kalil Rahman and M. Jayakumaran- Laxmi Publications.
4. "Ethics in Engineering" by Mike W. Martin and Roland Schinzinger – Tata McGraw-Hill – 2003.

REFERENCES

1. Govindarajan M, Natarajan S, Senthil Kumar V. S, " Engineering Ethics", Prentice Hall of India, New Delhi, 2004.
2. Charles D. Fleddermann, "Engineering Ethics", Pearson Education/ Prentice Hall, New Jersey,2004 (Indian Reprint now available)
3. Charles E Harris, Michael S. Protchard and Michael J Rabins, "Engineering Ethics – Concepts and Cases", Wadsworth Thompson Leatning, United States, 2000 (Indian Reprint now available).
4. John R Boatright, "Ethics and the conduct of business", Pearson Education, New Delhi,2003.
5. Edmund G Seebauer and Robert L Barry, "Fundamentals of ethics for scientists and engineers", Oxford University Press, Oxford, 2001.
6. "Fundamentals of ethics for scientists and engineers" Edmund G Cseebauer and Robert L Barey,Oxford University Press, 2001.
7. "Text book on Intellectual Property rights", N K Acahrya, Asian Law House, 7th edition,2014.
8. "An Introduction to Intellectual Property Rights", Dr.J.P.Mishra,Central law House, 3rd edition,2012.

B.Tech. (V Sem.) **17ME11 - INDUSTRIAL MANAGEMENT**

L	T	P	Cr.
3	-	-	3

Prerequisite Subjects: Basic Sciences, Mathematics

Course Educational Objectives:The main objective of this course is to underline the importance of human factors in engineering design.

Course Outcomes:**After completion of this course, students will be able to:**

CO1: Understand the importance of human factors in work study and decide the best method using method study techniques

CO2: Select appropriate work measurement technique for work standardization.

CO3: Design an efficient man machine system using principles of ergonomics.

CO4: Apply principles of physical ergonomics and anthropometry for designing of equipment and work place.

CO5: Develop an effective human centered machining system and manage human resources efficiently with best HR practices.

UNIT- I

MANAGEMENT: Definition, Importance of Management, Functions of Management, Taylor's Scientific management theory, Fayal's principles of management, Contribution of Elton Mayo, Maslow, Herzberg, basic concepts of organization, organization structures.

OPERATIONS MANAGEMENT: Plant location, principles and types of plant layouts.

UNIT -II

WORK STUDY: Definition, Objective and Scope of work study, Human factor in work study. Work study and management, work study and supervision, work study and worker.

METHOD STUDY: Definition, objective and scope of method study, activity recording and exam aids. Charts to record moments in shop operation – process charts, flow process charts, travel chart and multiple activity charts.

UNIT- III

QUALITY AND MATERIALS MANAGEMENT: Statistical quality control-Variables and attributes, X chart, R chart, C Chart, P Chart

WORK MEASUREMENT: Definition, objective and benefit of work measurement. Work measurement techniques. Work sampling: need, confidence levels, sample size determinations, random observation, conducting study with the simple problems

UNIT- IV

METHODS OF ANALYSIS: Introduction to Physical Methods, Musculoskeletal Discomfort Surveys Used at NIOSH, the Dutch Musculoskeletal Questionnaire (DMQ), Rapid Upper Limb Assessment (RULA), Rapid Entire Body Assessment,

ANTHROPOMETRIC PRINCIPLES IN WORKSPACE AND EQUIPMENT DESIGN: Designing for a population of users Sources of human variability, Anthropometry and its uses in ergonomics, Principles of applied anthropometry in ergonomics, Application of anthropometry in design

UNIT- V

HUMAN RESOURCE MANAGEMENT: Concepts of HRM, Basic functions of HR manager, Man power planning, Wage and salary administration, job evaluation and merit rating.

HUMAN FACTOR ENGINEERING: Definition, history and development of human factors engineering, types &characteristics of man-machine-system, relative capabilities of human being and machines; development and use of human factor data; information input and processing.

TEXT BOOK

1. R.S.Bridger, Introduction to Ergonomics; Taylor & Francis group, 3rd Edition 2008
2. Dr A.R. Aryasri, Management Science, TMH, 4th Edition, 2009

REFERENCES

1. Neville Stanton at al., Handbook of Human Factors and Ergonomics Methods; CRC Press,2009
2. Khan MI; Industrial Ergonomics; PHI Learning
3. ILO; work-study; International Labour Organization

B.Tech. (V Sem.) **17ME12-IC ENGINES AND GAS TURBINES**

L	T	P	Cr.
3	-	-	3

Prerequisite Subject: Thermodynamics

Course Education Objectives: To provide an insight of fundamentals and salient features of internal combustion engines & systems, performance analysis, gas turbines, jet and rocket propulsion systems.

Course Outcomes: After completion of the course students are able to

CO1: Understanding the working of various internal combustion engine components and their working.
CO2: Comprehend the air standard, fuel air and actual cycles.
CO3: Analyze the combustion phenomenon of SI engines and CI engines.
CO4: Compute the two stroke and four stroke engine performance characteristics.
CO5: Apply the gas turbines and jet propulsion systems and its applications.

UNIT-I

INTRODUCTION: Heat engine, Classification of IC Engines, Basic Engine Components and Nomenclature, Working principles of 4-Stroke and 2-Stroke Spark Ignition and Compression Ignition Engines, Valve and Port timing diagrams, Applications of I.C.Engines.

ENGINE SYSTEMS: Introduction, Layout of Fuel supply system for SI Engine-Simple Carburetor, Fuel supply system for CI Engine-Solid Injection-Individual pump type, Common rail type only. Super charging and turbo charging of IC engines.

UNIT- II

ENGINE SYSTEMS: Cooling systems, Air cooling, Water cooling, Comparison, Radiators and cooling fans, Lubricating systems, Mist lubrication, Wet sump lubrication, and Dry sump lubrication system, Ignition systems, Battery, Magneto and Electronic ignition system.

AIR-STANDARD CYCLES AND THEIR ANALYSIS: Otto, Diesel, Dual, and Brayton cycles.

FUEL-AIR CYCLES AND THEIR ANALYSIS: Introduction, Fuel-air cycles and their significance, composition of cylinder gases, dissociation, comparison of air-standard and fuel-air cycles.

ACTUAL CYCLES AND THEIR ANALYSIS: Introduction, comparison of air-standard and actual cycles, time loss factor, heat loss factor, exhaust blow down, loss due to rubbing friction, actual and fuel-air cycles of engines.

UNIT - III

COMBUSTION IN SI ENGINES: Introduction, Homogeneous and Heterogeneous mixture, stages of combustion in SI engines, flame front propagation, factors influencing the flame speed, Abnormal combustion, phenomenon of knock in SI engines, effect of engine variables on knock, combustion chambers for SI engines- Fuel requirement and fuel rating.

COMBUSTION IN CI ENGINES: Introduction, stages of combustion in CI engines, factors affecting the delay period, phenomenon of knock in CI engines, comparison of knock in SI and CI engines, Combustion Chambers for CI engines, Fuel requirement and fuel rating.

UNIT - IV

ENGINE TESTING AND PERFORMANCE: Introduction, Parameters of performance Measurement of Fuel consumption, Air intake, Brake power, Determination of Frictional power and Indicated power, Performance tests, Performance Characteristic Curves, Heat Balance sheet. Engines exhaust emissions- CO, NO_x, SO_x, HC, and Soot.

UNIT - V

GAS TURBINES: Introduction, Gas turbine plant and Its Components, Classification, Analysis of Closed and Open cycle Gas Turbine plants-Methods of improving performance, Intercooler, Regeneration and Reheating, Applications.

JET PROPULSION SYSTEMS: Introduction- Working of Turbojet, Turbo Fan, Turboprop, Ramjet, applications.

TEXT BOOKS

1. V.Ganesan, Internal Combustion Engines – Tata McGraw-Hill, 3rd Edition 2008.
2. V.Ganesan, Gas Turbines – Tata McGraw-Hill, 2007.
3. P.W.Gill ,J.H.Smith&Ziurys ,Fundamentals of I.C.Engines - IBH & Oxford publications, 4th Edition 1959.
4. Mahesh M. Rathode, Thermal Engineering, Tata McGraw-Hill, 5th Edition 2010.

REFERENCES

1. John B.Heywwod, Internal Combustion Engine Fundamentals ,Tata McGraw- Hill,2012.
2. M.L.Mathur&R.P.Sharma, A Course in I.C. Engines ,DhanpatRai New Delhi, 7th Edition 2000.
3. Cohen ,Rogers and Sarvanamuttu, Gas Turbine Theory, Longman Group limited, England,4th Edition 1996.
4. Vasandhani& Kumar, Treatise on Heat Engineering - Metropolitan Book Company, Delhi,4th Edition 2001.
5. Pulkrabek, Engineering Fundamentals of I.C.Engines – PHI 2nd Edition 2004.

B.Tech. (V Sem.) 17ME13 - MECHANICAL ENGINEERING DESIGN - I

L	T	P	Cr.
2	2	-	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: Apply the stresses, strains in machine elements subjected to static loads.
CO2: Analyze the failure criteria of mechanical parts under fatigue loadings.
CO3: Design the riveted and welded joints.
CO4: Apply the principles of design for different types of temporary joints.
CO5: Design shafts and shaft couplings for various engineering applications.

UNIT – I
INTRODUCTION:
Basic procedure of machine design– Basic requirements of machine elements – Design of machine elements – Design analysis-Design synthesis – Introduction to Indian standards-Selection of Preferred sizes
DESIGN FOR STATIC STRENGTH: Modes of failure – Factor of safety – Stress-strain relationship – Shear stress and shear strain – Stresses due to bending moment – Stresses due to torsional moment – Eccentric axial loading - Theories of elastic failure-Maximum principal stress theory-Maximum shear stress theory-Distortion energy theory

UNIT – II
DESIGN FOR FATIGUE STRENGTH: Stress concentration – Stress concentration factors - Reduction of stress concentration- Fluctuating stresses Fatigue failure – Endurance limit – Notch sensitivity - Endurance limit - Approximate estimation – Soderberg and Goodman lines – Design for infinite life.

UNIT – III
RIVETED JOINTS: Types of riveted joints - efficiency of riveted joint - eccentrically loaded riveted joints
WELDED JOINTS: Butt joints-Fillet joints-Strength of butt welds - Strength of parallel fillet welds-Strength of transverse fillet welds-Maximum shear stress in parallel fillet and transverse fillet welds-Axially loaded unsymmetrical welded joints-Welded joint subjected to bending moment.

UNIT – IV
THREADED JOINTS: Threaded joints-Terminology of screw threads- Bolted joint eccentrically loaded bolted joints in shear - Eccentric load perpendicular to axis of bolt - Bolts of uniform strength
KEYS, COTTER AND KNUCKLE JOINTS: Types of keys- Design of square and flat keys-Cotter joints-Socket and Spigot cotter joint-Knuckle joint-Failures.

UNIT – V
SHAFTS: Transmission shafts-Shaft design on strength basis-Shaft design on torsional rigidity basis-ASME code for shaft design-Design of hollow shaft on strength and torsional rigidity basis
SHAFT COUPLINGS: Requirements – Rigid couplings-Muff coupling-Clamp coupling Flange coupling-Bushed pin flexible coupling.

TEXT BOOKS

1. Bhandari V.B, Design of Machine Elements, 3rdEdition, Tata McGraw Hill 2010
2. Shigley J.E and Mischke C. R., Mechanical Engineering Design, 6th Edition, Tata McGraw-Hill, 2003.

REFERENCES

1. Norton R.L, "Design of Machinery", 2nd edition, Tata McGraw-Hill Book Co,2001.
2. Orthwein W, "Machine Component Design", 1st edition, Jaico Publishing Co, 1999.
3. Ugural A.C, "Mechanical Design – An Integral Approach, McGraw-Hill BookCo, 2004.
4. Spotts M.F., Shoup T.E "Design and Machine Elements" Pearson Education,2004.
5. Juvinall R. C., Marshek K.M., "Fundamentals of Machine component Design", John Wiley & Sons, 3rd Edition, 2002.

B.Tech. (V Sem.) **17ME14 - DYNAMICS OF MACHINES**

L	T	P	Cr.
2	2	-	3

PRE-REQUISITES: Engineering Mechanics, Kinematics of Machines

COURSE EDUCATIONAL OBJECTIVE:
The main objective of this course is to familiarize the standard mechanisms used for speed and stability control under the effects of vibrations.

COURSE OUTCOMES: At the end of the course, the student will be able to
CO1: Characterize the clutches, brakes and dynamometers & analyze the gyroscopic effects on different vehicles.
CO2: Draw the turning moment diagram for different engines and energy storage in the flywheels.
CO3: Analyzethe speed regulations in various types of governors.
CO4: Comprehend the balancing of the moving parts (rotating & reciprocating) statically and dynamically.
CO5: Understand the concepts of various types of vibrations for mechanical systems.

UNIT - I
CLUTCHES, BRAKES AND DYNAMOMETERS:
Friction clutches- Single plate clutch-Multiple plate clutch- Cone clutch-Centrifugal Clutch - Block brake- Band brake - Block & band brake - Internal expanding shoe brake- Dynamometers – Absorption and Transmission types- General description and method of operations
PRECESSION: Gyroscopes- Effect of precession – Aeroplanes and Ships - Motion on the stability of moving vehicles - Motor car and Motor cycle

UNIT - II
TURNING MOMENT DIAGRAMS AND FLY WHEELS: Turning moment – Angular velocity and acceleration of connecting rod – Crank effort and torque diagrams – Inertia torque of connecting rod - Fluctuation of energy – Fly wheels and their design.

UNIT - III
GOVERNORS: Watt, Porter and Proell governors- Spring loaded governors – Hartnell governor- Sensitiveness- Isochronism - Hunting.

UNIT - IV
BALANCING : Introduction – Balancing of Rotating Masses – Single and Multiple – Single and different planes - Primary and Secondary balancing of reciprocating masses -Analytical method - Unbalanced forces and couples - Locomotive balancing – Hammer blow- Variation of Tractive efforts - Swaying couple

UNIT - V
VIBRATIONS: Types of vibrations-Degrees of freedom-Free longitudinal vibrations-Displacement, velocity and acceleration-Inertia effect of the mass of spring-Damped vibrations-Forced vibrations- Forced damped vibrations-Vibration isolation and transmissibility-Whirling of shafts.

TEXT BOOK

1. Rattan S.S, “Theory of Machines”, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2007
2. Shigley J.E. and Uicker J.J., "Theory of Machines and Mechanisms", McGraw-Hill, Inc., 1995.

REFERENCES

1. Rao J.S and Dukkipati R.V, “Mechanism and Machine Theory”, New AgeInternational, NewDelhi, 2007.
2. Thomas Bevan, "Theory of Machines", CBS Publishers and Distributors, 1984.
3. Sadhu Singh “Theory of Machines”, Pearson Education, 2002.
4. Ballaney.P.L“Theory of Machines”, Khanna Publishers,1990.
5. Ghosh A. and Mallick A.K., "Theory of Mechanisms and Machines", Affiliated East-West Press Pvt. Ltd., New Delhi, 1988.

B.Tech. (V Sem.) 17ME15 - METAL CUTTING AND MACHINE TOOLS

L	T	P	Cr.
2	2	-	3

Prerequisite: Engineering Workshop, Engineering Drawing, Production Technology

COURSE EDUCATIONAL OBJECTIVES:
The main objective of this course is to provide overview of metal cutting theory and machine tools.

COURSE OUTCOMES: After completion of the course student will be able to:
CO1: Analyze the concepts of metal cutting, tool life, cutting force and chip characteristics.
CO2: Apply the knowledge of various machine tools in manufacturing of a product.
CO3: Selection of suitable machining processes for the production of different components.
CO4: Understand the principles of finishing processes.
CO5: Design Jigs and Fixtures for work and tool holding in machining a given product.

UNIT - I
ELEMENTARY TREATMENT OF METAL CUTTING THEORY: Elements of cutting process – Methods of Metal Cutting – Classification of Cutting Tools- Geometry of Single Point Cutting Tool. Chip formation, mechanism and types of chips- chip breakers. Merchant's Force diagram, measurement of cutting forces, work done in cutting. Metal cutting theories. Machining parameters-Tool Life, Tool Failure-Cutting Tool Materials, Cutting Fluids

UNIT - II
ENGINE LATHE: Principle of working and specification of lathe – Types of lathes – Work holders and tool holders –Lathe accessories- Operations on Lathe- -Taper turning-Thread turning and lathe attachments.
TURRET AND CAPSTAN LATHES: Principle of working -Collet chucks – Other work and tool holding devices – Box and tool layout.

UNIT - III
SHAPING, SLOTTING AND PLANING MACHINES: Principles of working – Principal parts – Specification, classification, operations performed, machining time calculations.
DRILLING AND BORING MACHINES: Principles of working, specifications, types, operations performed – tool holding devices – twist drill – Boring machines – Fine boring machines – Jig Boring machine. Deep hole drilling machine.

UNIT - IV
MILLING MACHINES:– Principle of working – Specifications – Classifications of milling machines – Principal features of horizontal, vertical and universal milling machines – Machining operations-Types -Geometry of milling cutters –Milling cutters – Methods of indexing – Accessories to milling machines.
GRINDING MACHINES – Fundamentals – Theory of grinding –Classification of grinding machine – Cylindrical and surface grinding machine – Tool and cutter grinding machine – special types of grinding machines.

UNIT - V
LAPPING, HONING AND BROACHING MACHINES: Comparison to grinding – lapping and honing. Constructional features of speed and feed units, machining time calculations
JIGS AND FIXTURES: Principles of design of Jigs and fixtures and uses. Classification of Jigs & Fixtures – Principles of location and clamping – Types of clamping & work holding devices.
Typical examples of jigs and fixtures.

TEXT BOOK

1. R.K. Jain and S.C. Gupta, Production Technology, Khanna publication, 17th edition, 2012**.**
2. B.S.Raghu Vamshi ,Workshop Technology, Dhanpat Rai & Co, 10th edition, 2009.

REFERENCES

1. Gosh and Malik , Manufacturing Science, East west press Pv.t Ltd., 2nd EDITION, 2011.
2. Kalpakjain S, Manufacturing Engineering & Technology, Pearson Education, 4TH edition 2001.
3. J.P.Kaushish, Manufacturing Processes, PHI, Second Edition, 2010.
4. H.M.T. (Hindustan Machine Tools), Production Technology, Tata MeGraw Hill, 2009.

B.Tech. (V Sem.) 17ME16 - NON-CONVENTIONAL ENERGY SOURCES

L	T	P	Cr.
3	-	-	3

Prerequisite Subject: Thermodynamics, Thermal Engineering

Course Educational Objectives: 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.
CO2: Apply the principles of energy conversion to study wind and Geothermal energy plants.
CO3: Analyze the power generating capacities of wave energy and ocean thermal energy plants.
CO4: Describe the biomass production system technologies and their capacities for generating power.
CO5: Comprehend the direct energy conversion principles, systems and potential for power generation.

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 – photovoltaic generation.

UNIT - II

WIND ENERGY: Wind – characteristics – wind energy conversion systems – types – Betz model – Interference Factor – Power Coefficient – Torque Coefficient and thrust coefficient – Lift machines and drag machines – matching – electricity generation..

GEOTHERMAL ENERGY: Structure of Earth – Geothermal Regions – Hot springs – Hot Rocks – Hot Aquifers – Analytical Methods to estimate Thermal Potential – Electricity Generation Systems.

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: 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 – The Energetic and Economics of Biomass systems – Biomass gasification

UNIT - V

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

TEXTBOOK

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, McGraw-Hill, 1978.

REFERENCES

1. John Twidell &Tony Weir, Renewable Energy Resources – 2nd Edition ,Taylor & Francis
2. Malcolm Flesher & Chrris Lawis Biological Energy Resources – Routledge Publishers
3. G.N.Tiwari, Solar Energy – Fundamentals, Design, Modelling and Applications – Narosa Publication Ltd.,2000.
4. Ashok V Desai, Non-Conventional Energy- Wiley Eastern, 2000.
5. Godfrey Boyle, Renewable Energy, Power for a Sustainable Future, Oxford University Press, U.K, 1996.
6. Veziroglu, T.N., Alternative Energy Sources, Vol 5 and 6, McGraw-Hill, 1990
7. Khandelwal K.C, Mahdi S.S., Biogas Technology - A Practical Handbook, Tata McGraw Hill

B.Tech. (V Sem.) **17ME17 - MECHANICAL VIBRATIONS**

L	T	P	Cr.
3	-	-	3

PRE-REQUISITES: Engineering Mechanics, Mechanics of solids

COURSE EDUCATIONAL OBJECTIVE:
The main objective of this course is to provide the knowledge on the sources of vibrations and make modifications to improves the life of components.

COURSE OUTCOMES: At the end of the course, the student will be able to
CO1: Formulate governing equations for un- damped free vibrations of single degree of freedom systems and its solutions.
CO2: Solve the damped free vibrations equations for of single degree of freedom systems.
CO3: Evaluate the response of various mechanical systems under harmonic excitation conditions.
CO4: Apply two degree of freedom systems to get their response of a mechanical system in terms of natural frequencies.
CO5: Analyze the multi degree of freedom systems to find the response by using different methods.

UNIT - I
UNDAMPED FREE VIBRATIONS OF SINGLE DEGREE OF FREEDOM SYSTEMS: Introduction- Differential equation – Solution of differential equation -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

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,7th edition, Nemchand& Bros.2003.
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.

B.Tech. (V Sem.)	17ME18 - NON DESTRUCTIVE EVALUATION AND TESTING	L	T	P	Cr.
		3	-	-	3

Prerequisite Subject: Engineering Physics, Metallurgy and Material Science

Course Educational Objectives: To provide an overview of Non Destructive Testing Methods.
Course Outcomes:After completion of the course students are the able to

CO1: Comprehend the basics of Non Destructive Testing methods
CO2: Apply the knowledge of Liquid and Magnetic penetrate testing techniques in manufacturing arena
CO3: Testthe materials using thermography and eddy current testing techniques in manufacturing industry
CO4: Understand the basic principles of Ultrasonic testing and Acoustic Emission Techniques
CO5: Locate and recognise radiographic images of defects with a high probability of detection

UNIT I: INTRODUCTION

NDT Versus Mechanical testing, Overview of the Non Destructive Testing Methods for the detection of manufacturing defects as well as material characterization. Relative merits and limitations, Various physical characteristics of materials and their applications in NDT, Visual inspection – Unaided and aided. Basics of Visual Testing - Principles, Techniques, Applications, Limitations, Codes, standards and Specifications related to Visual Testing

UNIT II: SURFACE NDE METHODS

Liquid Penetrant Testing – Principles, types and properties of liquid penetrants, developers, advantages and limitations of various methods, Testing Procedure, Interpretation of results. Magnetic Particle Testing- Theory of magnetism, inspection materials Magnetization methods, Interpretation and evaluation of test indications, Principles and methods of demagnetization, Residual magnetism.

UNIT III: THERMOGRAPHY AND EDDY CURRENT TESTING (ET)

Thermography- Principles, Contact and non contact inspection methods, Techniques for applying liquid crystals, Advantages and limitation – infrared radiation and infrared detectors, Instrumentations and methods, applications. Eddy Current Testing-Generation of eddy currents, Properties of eddy currents, Eddy current sensing elements, Probes, Instrumentation, Types of arrangement, Applications, advantages, Limitations, Interpretation/Evaluation.

UNIT IV: ULTRASONIC TESTING (UT) AND ACOUSTIC EMISSION (AE)

Ultrasonic Testing-Principle, Transducers, transmission and pulse-echo method, straight beam and angle beam, instrumentation, data representation, A/Scan, B-scan, C-scan. Phased Array Ultrasound, Time of Flight Diffraction. Acoustic Emission Technique –Principle, AE parameters, Applications

UNIT V: RADIOGRAPHY (RT)

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

TEXT BOOKS

1. Baldev Raj, T.Jayakumar, M.Thavasimuthu "Practical Non-Destructive Testing", Narosa Publishing House, 2009.
2. Ravi Prakash, "Non-Destructive Testing Techniques", 1st revised edition, New Age International Publishers, 2010.

REFERENCES

1) Nondestructive Testing, Louis Cartz, ASM International
2) ASM Metals Handbook,"Non-Destructive Evaluation and Quality Control", American Society of Metals, Metals Park, Ohio, USA, 200, Volume-17.
3) Paul E Mix, "Introduction to Non-destructive testing: a training guide", Wiley, 2nd Edition New Jersey, 2005
4) Charles, J. Hellier," Handbook of Nondestructive evaluation", McGraw Hill, New York 2001.
5) ASNT, American Society for Non Destructive Testing, Columbus, Ohio, NDT Handbook,Vol. 1, Leak Testing, Vol. 2, Liquid Penetrant Testing, Vol. 3, Infrared and Thermal Testing Vol. 4, Radiographic Testing, Vol.5, Electromagnetic Testing, Vol. 6, Acoustic Emission Testing, Vol.7, Ultrasonic Testing

B.Tech. (V Sem.)	17ME19 - OPTIMIZATION TECHNIQUES FOR ENGINEERS	L	T	P	Cr.
		3	-	-	3

Pre-requisite Course: Operation Research

Course Educational Objectives (CEOs):
The main objective of this course is to solve engineering problems using optimization techniques.

Course Outcomes (COs): After completion of the course students are able to:
CO1: Understand the impact of optimization techniques in engineering applications
CO2: Develop mathematical models for various optimization problems.
CO3: Apply non-linear programming approach for optimizing various parameters.
CO4: Formulate large-scale Linear and Integer Programming problems.
CO5:Resolve a complex problem into a sequence of simple problems using dynamic programming.

UNIT – I
INTRODUCTION: Optimization – Historical Development – Engineering applications of optimization – Statement of an Optimization problem – classification of optimization problems.

UNIT –II
CLASSIC OPTIMIZATION TECHNIQUES: Linear programming - duality in Linear Programming, Revised simplex method, Sensitivity Analysis, Goal Programming, Applications.

UNIT -III
NON-LINEAR PROGRAMMING: Introduction – Lagrangeon Method – Kuhn-Tucker conditions – Quadratic programming – Separable programming – Stochastic programming – Geometric programming

UNIT -IV
INTEGER PROGRAMMING: Integer programming - Branch and bound technique, Zero-one implicit enumeration, Sequential Linear Discrete Programming, Generalized Penalty Function Method.

UNIT -V
ADVANCES IN SIMULATION: Introduction, Simulations Models, Monte-Carlo Simulation, Simulation of Inventory Problems.Genetic algorithms – simulated annealing – Neural Network and Fuzzy systems,Applications

TEXT BOOKS
1. KalyanmoyDeb, Optimization for Engineering Design, PHI publishers, 2nd edition, 2012
2. Hamdy A. Taha, Operations Research – An Introduction, Prentice Hall of India, 9th edition, 2010.
3. Engineering optimization-theory practice-fourth edition- Singiresu S. Rao, Published by John Wiley & Sons, Inc., Hoboken, New Jersey.

REFERENCES
1. Ravindran, Philips and Solberg, Operations Research Principles and Practice, John, Wiley & Sons, Singapore, 2nd edition, 2007.
2. J.K.Sharma, Operations Research – Theory and Applications – Macmillan India Ltd. 4th edition, 1997. 4. P.K. Guptha and Man-Mohan, Problems in Operations Research – Sultan Chand&Sons, 3rd edition, 2009.

B.Tech. (V Sem.) 17ME68 - MACHINE TOOLS AND DYNAMICS LAB

L	T	P	Cr.
-	-	2	1

Prerequisite Subjects: Metal cutting & Machine Tools, Dynamics of Machinery, Production Technology Lab

COURSE EDUCATIONAL OBJECTIVES: The main objective of this course is to impart practical exposure on various machine tools and to understand the concepts of machine dynamics.

COURSE OUTCOMES: After completion of the course students are the able to:

CO1: Exhibit the ability in developing sequence of machining operations required for industry.
CO2: Capable of manufacturing components according to given drawings using various machine tools
CO3: Analyze speed regulations of governors and observe the gyroscopic effect and cam jump phenomena.
CO4: Analyze the effects of various vibrations.

PART-A (MACHINE TOOLS LAB)

LIST OF EXPERIMENTS:

1. To perform the step turning operation and taper turning operation.
2. To perform knurling operation and threading operations
3. To form and grind the given work piece (square rod) into single point cutting tool
4. To cut spur gear on a given M.S.Round blank using milling machine.
5. To cut a rectangular groove (or key way) with given dimensions on work piece using Shaping machine, Planar Machine and Slotter.
6. To perform drilling and tapping operations on a given M.S. plate using universal drilling machine.
7. To prepare a smooth flat surface on M.S.flat using surface Grinding machine.
8. Study various machine tools

REFERENCE BOOKS

Lab Manual

PART-B (DYNAMICS LAB)

LIST OF EXPERIMENTS

Any of the 6 Experiments are required to be conducted

1.a) To determine gyroscopic couple on Motorized Gyroscope
b) Determination of transmission efficiency of gear reducers
2.a) To find the stability and sensitivity of Watt governor
b) To find the stability and sensitivity of Porter governor
3. To find the transverse vibrations of free-free beam
4.a) Balancing of rotating masses
b) Balancing of reciprocating masses
5. Determination of damping coefficient of single degree of freedom system using spring mass system
6. Determination of critical speed of shaft with concentration loads
7.a) Determine the moment of inertia of connecting rod by compound pendulum method
b) Determine the moment of inertia of flywheel by oscillation

REFERENCE BOOKS

Lab Manual

B.Tech. (V Sem.) **17ME69 - THERMAL ENGINEERING LAB**

L	T	P	Cr.
-	-	2	1

Prerequisite: ICGT, Thermal Engineering

Course Objectives: The main objective of this course is to familiarize the principles and its evaluation of various performance parameters of mechanical systems and its impact on global environment.

Course Outcomes: After the completion of the course, students should be able to

CO1: Estimate various fuel characteristics through experimental testing.
CO2: Analyze the performance characteristics of Internal Combustion Engines
CO3: Evaluate the performance parameters of refrigeration and air conditioning systems
CO4: Draw the characteristic curves for the air compressors

LIST OF EXPERIMENTS (Any 10 experiments):

1. I.C. Engines Valve & Port Timing Diagrams
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 4-Stroke Petrol 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 I.C Engines.
13. Solar parabolic concentrator apparatus
14. Determination of calorific value of fuel using bomb calorimeter.

References:

Thermal engineering lab manuals.

B.Tech. (V Sem.)	17PD04 - MINI PROJECT	L	T	P	Cr.
		-	-	4	2

PRE-REQUISITES: Knowledge acquired in the theory and practical courses during the first two years.

COURSE EDUCATIONAL OBJECTIVE:
The main objectives of this course are to prepare the students to plan and implement a mini project independently using the limited resources available within the institute.

COURSE OUTCOMES: After completion of the course students are the able to:
CO1: Understand the concepts of basic Mechanical Engineering.
CO2: Identify, formulate and solve practical engineering problems of simple nature.
CO3: Analyze the Mechanical Engineering concepts by practical observations.
CO4: write the technical report based on specific practical experiences.

B.Tech. (V Sem.)	17ME90 - ENERGY, ENVIRONMENT AND POLLUTION (*Add on course – I)	L	T	P	Cr.
		3	-	-	3

Pre-requisite: Environmental science

Course Educational Objective: The objective of this course is to make the student awareness on different energy sources, energy management, principles and control of pollution on environment.

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

CO1: Understand various types of non conventional energy resources and their potential.
CO2: Apply the various principles of waste energy management techniques.
CO3: Comprehend the different waste management techniques.
CO4: Analyse different methods of controlling thermal pollution as per standards.
CO5: Design comfort environmental properties by considering risk parameters.

UNIT – I

Introduction to Energy:

Energy, environment, Energy sources- Solar energy principles and applications, Biomass: Generation, characterization. Biogas: Aerobic and anaerobic bio-conversion processes, microbial reactions purification, properties of biogas, storage and enrichment. Geothermal: Geothermal regions, geothermal sources, geothermal energy conversion technologies.

UNIT – II

Environmental management:

Environment variability: Natural (Volcanoes, Forest fires) and Anthropogenic (Antarctic Ozone Hole, Global Warming), Green house gas theory, Effects of Urbanization, Landscape changes, Influence of Irrigation, Energy management and conservation, Contamination of ground water, Treatment & disposal, Atmospheric ozone depletion, Global energy.

UNIT – III

Environmental Pollution: Causes, effects and control measures of air pollution, water pollution, marine pollution, noise pollution, thermal pollution, nuclear radiation hazards.

Solid waste management: Solid waste management- sources of solid wastes, effects and control measures of urban industrial wastes,Hazardous waste management

UNIT – IV

Thermal Pollution and its control: Pollution control methods used for thermal pollution-(i) Pre combustion control,(ii) Combustion control (iii) Post-combustion Control.

Gaseous pollutants control-Flue gas desulfurization (FGD) Systems, Particulate and gaseous pollutants - SOx and NOx treatments, ESP, Air and water pollution by Thermal plants and its control , Pollution and its impact on aquatic life.

UNIT – V

Risk assessment: Methodology for Risk assessment and analysis; Environmental chemistry and biology, Global warming potential-Atmospheric changes, Energy balance and global temperature.

Comfort environment: Environment For Comfort Living & Working - Comfort & Climate – Temperature, humidity and ventilation Control– AC load, Natural & Artificial Lighting,Noise Sources, control.

TEXT BOOKS

1. J. Twidell and T. Weir, Renewable Energy Resources, Taylor & Francis, 2007.
2. A.P. Sincero, and G.A. Sincero, Environmental Engineering, Prentice Hall, New Jersey, 1996.
3. P.N.Palanisamy et al., "Environmental Science" 2nd edition, Dorling Kindersley (India) Pvt.Ltd. Licenses of Pearson Education in South Asia, 2013.
4. Samir Sarkar, Fuel and Combustion, Orient Longman Limited, Hyderabad, 2001.

REFERENCE

1. G. N. Tiwari, Solar Energy: Fundamentals, Design, Modelling and Applications, Narosa Publishing House, 2010.
2. R. Rajagopalan, "Environmental Studies (From Crisis to Cure)", by Oxford University Press, 2011, 2ndEdition.
3. U. Bhattcharjee and T. C. Kandpal, Potential of fly ash utilization in India, Energy 27, 151-66, 2002.

B.Tech. (V Sem.)	17PD05 - EMPLOYABILITY ENHANCEMENT SKILLS - I	L	T	P	Cr.
		1	-	-	0

Prerequisite: NIL

Course Educational Objective (CEO): This course will make students proficient in Quantitative techniques, language & communication skills to qualify in placement tests, ,demonstrate industry-readiness skills by applying concepts and tools that will serve as building blocks for analytical thinking and professional development.

Course Outcomes (COs): After the completion of this course, student will be able to:

CO1: Apply Quantitative techniques and logical thinking to qualify in recruitment tests and other professional tasks.
CO2: Communicate effectively in various professional and social contexts.
CO3: Apply Verbal skills effectively in Job Interviews as well other professional contexts.
CO4: Demonstrate various principles involved in Quantitative problem solving, thereby reducing the time taken for performing job functions.
CO5: Practice lifelong learning through personal effectiveness as well as leadership.

UNIT – I

Quantitative Aptitude: Numbers, L.C.M & H.C.Fof numbers, Decimal Fractions,Simplification, Square root & cube root-Practice tests.
Verbal Ability: Introduction to Vocabulary-Root words (Prefixes, Suffixes) - Practice tests

UNIT – II

Quantitative Aptitude: Averages, Problems on Ages, Problems on Numbers, Surds and Indices-Practice tests.
Verbal Ability: Advanced vocabulary- Model tests for GRE/TOEFL/IELTS

UNIT – III

Quantitative Aptitude: Percentages, Profit and Loss- Practice tests
Verbal Ability: Synonyms & Antonyms, Idiomatic expressions-Practice tests

UNIT – IV

Quantitative Aptitude: Ratio And Proportion, Partnership, Chain rule- Practice tests
Verbal Ability: Words often confused & misused, One-word substitutes & Flash card activity-Practice tests

UNIT – V

Quantitative Aptitude: Number Series, Letter Series, Blood Relations, Coding and Decoding, Direction sense test- Practice tests
Verbal Ability: Phrasal verbs, Word analogies, Reading Comprehension-Practice tests

TEXT BOOKS

1. R.S.AGGARWAL, *Objective Arithmetic*, S. CHAND Publishers.
2. R.S.AGGARWAL, *Verbal & Non-Verbal Reasoning*, S. CHAND Publishers
3. Objective English. Edgar Thorpe, Pearson Education, New Delhi.2009
4. Sanjay kumar, Pushp Lata: Communication skills. Oxford, Delhi, 2012

REFERENCES

1. Meenakshi Raman, Sangeetha: Technical Communication, Oxford University Press, 2008
2. Baron's Guide on GRE
3. Dinesh Khattar, *The Pearson Guide to Quantitative Aptitude*, Pearson Education
4. M. Tyra, *Magical Book on Quicker Maths*, BSC Publishers
5. Quantitative Aptitude by Arun Sharma Vocabulary Builder for Students of Engineering and Technology (A self – study manual for vocabulary Enhancement) Y.Saloman Raju, Maruthi Publishers

B.Tech. (V Sem.)	17PD06 - INDUSTRIAL TRAINING/IN-HOUSE TRAINING	L	T	P	Cr.
		-	-	-	-

PRE-REQUISITES: Knowledge acquired in the theory and practical courses during the first two years.

COURSE EDUCATIONAL OBJECTIVE: The main objective of this course is to develop employability skills through Industrial oriented training.

COURSE OUTCOMES: After completion of the course students are the able to:

CO1: Acquaintance to Industrial environment.
CO2: Understand administrative functions of the organisation.
CO3: Analyze the concepts of basic mechanical engineering by practical observation.
CO4: Improve the report writing skills.

B.Tech. (VI Sem.)	17ME20 - HEAT TRANSFER	L	T	P	Cr.
		2	2	-	3

Prerequisite Subject: Thermodynamics, Thermal Engineering

Course Educational Objectives: 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:

CO1: Understand the basic heat transfer principles and their practical relevance in Planes, Cylinders and Spherical components.

CO2: Analyze steady and unsteady state heat transfer concepts and fins

CO3: Formulate the expressions to solve free and forced convection problems related to external and internal flows.

CO4: Apply the concepts of heat transfer in boiling, condensation and radiation thermal systems.

CO5: Design the heat exchanger for engineering applications

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 Non black surfaces-Emissivity-Kirchhoff's law – Radiation heat exchange between two black isothermal surfaces- shape factor- Heat exchange between non black 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, 4th Edition, 2012

REFERENCES

1. M.Necati Ozisik, Heat Transfer- A basic Approach,4th Edition, McGraw-Hill book company, 1985
2. J.P.Holman, Heat transfer - Tata McGraw-Hill, 9th Edition, 2010
3. P.K.Nag, Heat and Mass Transfer- TMH 2nd Edition, 2007
4. P.S.Ghoshdastidar Heat Transfer - Oxford Higher Education 6th Edition 2011.
5. C.P.Kothandaraman and Subramanian, Heat and Mass Transfer, New Age International Publications 7th Edition 2010.

B.Tech. (VI Sem.) 17ME21 - MECHANICAL ENGINEERING DESIGN - II

L	T	P	Cr.
2	2	-	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
CO1: Select suitable bearings under different load, speed and life conditions.
CO2: Design internal combustion engine components for safe and continuous operation.
CO3: Select the belt and rope drives for elevators, cranes and hoisting machinery.
CO4: Design the springs under static and dynamic loads and combinations.
CO5: Evaluate the performance of the gear and the gear box for various loading conditions.

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
CYLINDER: Design and proportions of Cylinder- Cylinder liners.
PISTON: Forces acting on piston – Construction – Design and proportions of piston
CONNECTING ROD: Forces on connecting rod –Rankine's formula - Stress due to whipping action.
CRANK SHAFT:Strength and proportions of center crank shaft– Crank pins

UNIT - III :
BELT DRIVES:
Flat belt drive – Materials –Design of belt and pulleys for flat belt drive- V-belts – Designation - Design of V-belt drive.
WIRE ROPES: Introduction- Construction- Designation of wire ropes – Classification – Selection of wire rope – Stresses in hoisting ropes.

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:
Spur gears- Helical gears –Lewis equation - Beam strength of gear tooth – Design of spur gears – Estimation of centre distance, module and face width- Check for dynamic and wear strength.
GEAR BOX: Introduction – Functions – Progression ratio – Speed diagram – Kinematic arrangement – Design of spur gear box.

TEXT BOOKS

1. Bhandari V.B, Design of Machine Elements, 3rd Edition, Tata McGraw-Hill 2010
2. Sundararajamoorthy T. V, Shanmugam .N, "Machine Design", AnuradhaPublications, Chennai, 2003.

REFERENCES

1. Norton R.L, "Design of Machinery", Tata McGraw-Hill Book Co, 2004.
2. Shigley J.E and Mischke C. R., "Mechanical Engineering Design", Tata McGraw-Hill,2003.

HAND BOOKS TO BE ALLOWED

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

B.Tech. (VI Sem.)	17ME22 - CAD/CAM	L	T	P	Cr.
		3	-	-	3

Prerequisite Subject: Machine Drawing, Machine Design, Machine Tools

COURSE EDUCATIONAL OBJECTIVES: The main objective of this course is to familiarize the principles of geometric modelling, numerical control and part programming.

COURSE OUTCOMES: After completion of the course students are able to:

CO1: Comprehend the principles of CAD/CAM for design and manufacturing
CO2: Formulate mathematical equations for geometrical entities like curves, surface, and solids.
CO3: Program for part profiles to accomplish numerical control machining
CO4: Develop a pseudo codes for different parts using GT codes and apply in automated manufacturing systems.
CO5: Become cognizant about CAQC techniques that are to be applied in manufacturing industry and able to comprehend the applications of Computer Integrated Manufacturing.

UNIT - I

FUNDAMENTALS OF CAD: Introduction – The design process – The application of Computers for design- Benefits of CAD.

COMPUTER GRAPHICS: Raster scan graphics-Transformation of geometry: Translation, scaling, reflection, rotation, 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 – NC modes – NC elements -NC Coordinate systems – Structure of CNC Machine Tools – Spindle design –Spindle drives – Feed drives – actuation systems.

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 – CAPP: 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 – 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 – Lean manufacturing.

TEXT BOOKS

1. MikelP.Groover and Emory W.Zimmers, CAD/CAM-prentice Hall of India private Ltd.New Delhi, 20thedition, May 2010.
2. Ibrahim Zeid, Mastering CAD/CAM, TATA McGraw-Hill publishing CO.Ltd, New Delhi2011.

REFERENCES

1. P.N Rao,CAD/CAM Principle and applications, Tata McGraw Hill Education Private Ltd,New Delhi,8th edition 2013.
2. P.Radhakrishnan,S.Subramanyam&V.Raju,CAD/CAM/CIM,New Age International Publishers,3rd edition 2010.
3. MikelP.Groover,Automaiton,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

B.Tech. (VI Sem.) **17ME23 - FINITE ELEMENT ANALYSIS**

L	T	P	Cr.
3	-	-	3

PRE-REQUISITES: Numerical Methods, Mechanics of Materials, Machine Design and Heat Transfer

COURSE EDUCATIONAL OBJECTIVE: The main objective of this course is to understand the principles of finite elements and to develop Finite element models for engineering applications.

COURSE OUTCOMES: At the end of the course, the student will be able to
CO1: Formulate the equilibrium equations for static engineering problems
CO2: Solve the flexure elements subjected to different loading conditions
CO3: Analyze 2-D structures with iso-parametric elements along with axisymmetric problems
CO4: Apply the finite element techniques for solving thermal problems.
CO5: Develop consistent mass matrices for different elements by considering the mechanical vibrations

UNIT – I
INTRODUCTION: Stress and Equilibrium - Strain – Displacement relations- Stress – strain relations
ONE DIMENSIONAL PROBLEM:Finite element modeling 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, Finite element modeling of two dimensional stress analysis with Constant Strain Triangles and treatment of boundary conditions

UNIT - III
AXISYMMETRIC LOADING AND NUMERICAL INTEGRATION:
Finite element modeling of axisymmetric solids subjected to Axisymmetric loading with triangular elements. Two dimensional four noded isoparametric elements, problems on isoparametric formulation of four node quadrilateral element, Numerical integration-Gauss Quadrature.

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, 3rd edition, Prentice – Hall, 2008.
2. S.S Rao, The Finite Element Methods in Engineering, 4th edition, B.H.Pergamon, 2010.

REFERENCES

1. JN Reddy, An introduction to Finite Element Method, 3rd edition, McGraw Hill, 2011.
2. Kenneth H. Huebner, Donald L. Dewhirst, Douglas E Smith and Ted G. Byron, The Finite Element Method for Engineers, 4th edition, John Wiley &Sons, 2001.
3. David Hutton, Fundamentals of Finite Element Analysis, Tata McGraw Hill, 2005
4. George R Buchanan and R.RudraMoorthy, Finite Element Analysis,Tata McGraw Hill, 2006.

B.Tech. (VI Sem.)	17ME24 - AUTOMOBILE ENGINEERING	L	T	P	Cr.
		3	-	-	3

Prerequisite Subject: Thermodynamics, Internal combustion engines

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 students are able to
CO1: Acquire the basic knowledge of anatomy of an Automobile and its components.
CO2: Comprehend the fuel supply system in petrol and Diesel Engines.
CO3: Realize the functions of various electrical systems used in automobiles.
CO4: Distinguish various transmission systems used in automobiles.
CO5: Compare various types of Steering systems, Braking systems and Suspension systems.

UNIT-I

INTRODUCTION: Components of Automobile, Classification of Automobiles, Chassis and Frame, Rear wheel drive- Front wheel drive-Four wheel drive.

ENGINE: Basic terminology and working of engines, Engine construction Details- Cylinder Block and Crankcase- Cylinder Head- Oil Pan- Manifolds- Gaskets- Cylinder Liners- Piston- Connecting Rod- Engine Valves, Firing Order, Turbo charging.

AUTOMOBILE POLLUTION: Emissions from Automobiles- Nitrogen oxides, Soot, Carbon monoxide, Hydrocarbons, Particulates, Emission Regulations

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 Injection pumps – Jerk type pump, Fuel Injector, Governor- Types of Governor.

UNIT - III

IGNITION SYSTEM: Types of Ignition systems, Battery Ignition system- Components of Battery Ignition system, Ignition timing, Spark plug, Magneto Ignition system, Electronic Ignition system- Capacitive discharge Ignition system.

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, Rear axle drives.

WHEELS AND TYRES: Types of Wheels, Wheel dimensions, Tyre- Types of Tyres, Carcass types, Tyre Materials, Tyre designations.

UNIT - V

FRONT AXLE AND STEERING: Front Axle, Types of stub axle, Wheel alignment, Steering geometry- Camber- Kingpin inclination- Combined angle and scrub radius- Castor- Toe in and Toe out, Understeer and Oversteer, Power steering, Steering Linkages, Steering gears.

SUSPENSION SYSTEM: Introduction, Types of Suspension springs, Leaf springs, Coil springs, Torsion bars, Shock Absorbers, Independent suspension- Types, Air-suspension.

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, 13th Edition, Standard Publishers Distributors, 2014.
2) R.B.Gupta, Automobile Engineering, 8th edition, Tech India publication series, 2013.

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.

B.Tech. (VI Sem.)	17ME25 - CONDITIONAL MONITORING	L	T	P	Cr.
		3	-	-	3

PRE-REQUISITES: Dynamics of Machines

COURSE EDUCATIONAL OBJECTIVE: The 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
CO1: Understand basic principles of condition monitoring techniques.
CO2: Analyze the vibration characteristics through condition monitoring.
CO3: Interpret the faults through various monitoring techniques.
CO4: Apply the sensors for monitoring of various systems.
CO5: Suggest suitable sensors for condition monitoring.

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. MohantyA. R.Machinery Condition Monitoring: Principles and Practices CRC press, 2014.

REFERENCES
1. V. Ramamurti,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 Choudary K K., Instrumentation, Measurement and Analysis, Tata McGraw Hill.
6. Collacot R.A.- Mechanical fault diagnosis and condition monitoring

B.Tech. (VI Sem.) **17ME26 - MODERN MACHINING PROCESSES**

L	T	P	Cr.
3	-	-	3

Prerequisite Subject: Metal Cutting and Machine Tools

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:

CO1: Assort appropriate unconventional machining processes for machining materials and to develop relevant industrial solutions for machining hard materials.
CO2: Understand the principles of Electro Chemical Machining Process for machining of hard materials.
CO3: Apply Electrical Discharge Machining principles for machining intricate components.
CO4: Comprehend the basic principles and applications of thermal machining processes like EBM, LBM and PAM.
CO5: Identify the need of Rapid Prototyping in manufacturing sectors.

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: Process, 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: General Principle and applications of Electric Discharge Machining– Power circuits for 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: Principle, process, 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, Liquid basedRapid Prototyping: Stereo Lithography Apparatus (SLA), solid Ground Curing (SGC) Solid based Rapid Prototyping: Selective Laser Sintering (SLS), EOS's EOSINT Systems. Applications of Rapid Prototyping.

TEXT BOOK

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.

B.Tech. (VI Sem.)	17ME27 - MANAGING INNOVATION AND ENTREPRENEURSHIP	L	T	P	Cr.
		3	-	-	3

Prerequisite Subjects: Industrial Engineering

Course Educational Objectives: The main objective of this course is to introduce the concepts of risk management, financial planning and entrepreneurship

Course Outcomes:After completion of the course student will be able to:
CO1: Develop strategies for implementing innovations in industries
CO2: Comprehend the role of an entrepreneur in the society
CO3: Evaluate the strengths and weaknesses using various management techniques
CO4: Apply concepts of business and financial planning to start an industry
CO5: Use various marketing management techniques for effective running of an industry.

UNIT-I

CREATIVITY AND INNOVATION: Concepts, shifting, composition of the economy, purposeful innovation and seven sources of innovative opportunity, the innovation process. Innovative strategies: strategies that aim at introducing an innovation. Innovation and entrepreneurship: can they work together? Planning – incompatible with innovation and entrepreneurship

UNIT -II

INTRODUCTION TO ENTREPRENEURSHIP: Definition of Entrepreneur, Entrepreneurial Traits, Traditional entrepreneurship vs Modern Entrepreneurship, Entrepreneur vs. Manager, Entrepreneur vs Intrapreneur. The Entrepreneurial decision process.Role of Entrepreneurship in Economic Development, Ethical, Environmental challenges and Social responsibility of Entrepreneurs, Opportunities for Entrepreneurs in India and abroad, Woman as Entrepreneur.

UNIT - III

CREATING AND STARTING THE VENTURE: Sources of new Ideas, Generation of new entry Opportunity, Opportunity Analysis, creating, problem solving, product planning and development process. SWOT Analysis; first-Mover advantages and disadvantagesTypes of business organizations, Features and evaluation of joint ventures, acquisitions, merges, franchising.

UNIT - IV

THE BUSINESS PLAN, FINANCING AND MANAGING: Nature and scope of Business plan, Writing Business Plan, Evaluating Business plans, Using and implementing business plans. Marketing plan, Introduction to financial plan and the organizational plan, Assessment of Benefits and Costs Government grants and Subsidies Launching formalities. ; Survival and Success Sources of capital, Record keeping, recruitment, motivating and leading teams, financial controls. Marketing and sales controls.E-commerce in Entrepreneurship, Internet advertising.

UNIT - V

PRODUCTION AND MARKETING MANAGEMENT: Thrust of production management, Selection of production Techniques, plant utilization and maintenance, requirements at work place, materials management. Marketing functions, market segmentation, market research and channels of distribution, Sales promotion and product pricing.

TEXT BOOKS

1. Hisrich : Entrepreneurship, TMH,New Delhi, 2009
2. Martin M.J ,"Managing innovation and entrepreneurship in technology based firm",. John Wiley publishers,1994,

REFERENCES

1. Vasantha Desai ,Entrepreneurship, TMH,New Delhi, 2009
2. Rajeev Roy: Entrepreneurship, Oxford University Press, New Delhi,2010
3. V.Gangadhar, Narsimha Chary: Entreprenuership Development, Kalyani Publishers, New Delhi, 2007
4. P.Narayana Reddy: Entrepreneurship. Cengage learning, New Delhi,2010

B.Tech. (VI Sem.)	17FE61 - PRESENTATION SKILLS LAB	L	T	P	Cr.
		-	-	2	1

Pre-requisites: Students should have fundamental knowledge in making Conversations in English and be with readiness to speak

Course Educational Objective: To help students make oral presentations, power point presentations, participate in group discussions and Write project/research reports/technical reports/ formal letters by gathering information and organizing ideas relevantly and coherently.

Course Outcomes: At the end of the course, the student will be able to
CO1: Make power point presentations and oral presentations.
CO2: Use standard vocabulary contextually.
CO3: Manage skilfully through group discussions.
CO4: Negotiate skilfully for better placement.

Syllabus: English Communication Skills Lab (ELCS) 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: synonyms and antonyms, one-word substitutes, analogy, idioms and phrases.
ICS Lab:
Practice: Ice-Breaking Activity and JAM Session – Introducing Oneself – Extempore - Public Speeches.

Exercise – II
CALL Lab:
Understand: Features of Good Conversation – Strategies for Effective Communication.
ICS Lab: Group Discussion

Exercise – III
CALL Lab:
Understand: Data collection – Organizing data - Making Poster – Making slides.
ICS Lab:
Practice: Poster Presentation – Power Point Presentations.

Exercise – IV
CALL Lab:
Understand: Types of Résumé – Letter Writing.
ICS Lab:
Practice: Writing Résumé & Letters

Exercise – V
CALL Lab:
Understand: Reading comprehension – Listening Comprehension – scanning, skimming, reading between lines and critical reading.
ICS Lab:
Practice: Reading comprehension - Listening Comprehension – scanning, skimming, reading between lines and critical reading.

Exercise - VI
CALL Lab:
Understand: Interview Skills
ICS Lab:
Practice: Mock Interviews

Lab Manual:
Board of Editors, "ELCS Lab Manual – A Workbook of CALL and ICS Lab Activities", Orient Black Swan Pvt. Ltd., Hyderabad, 2016.

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

B.Tech. (VI Sem.)	17ME70 - CAD/CAM LAB	L	T	P	Cr.
		-	-	2	1

Prerequisite Subject: CAD/CAM

Course Educational Objectives: The main objective of this course is to model, assemble and manufacture engineering components using computer aided tools.

Course Outcomes: After completion of the lab students are able to:
CO1: Design and assemble of the components using geometric modeling software
CO2: Apply the finite element analysis for components design.
CO3: Develop NC code for different part profiles and perform machining on CNC Machines.
CO4: Manipulate the robot by writing programs and executing them.

LIST OF EXPERIMENTS

1. Assembly Modeling (At least three examples)
2. Analysis of trusses
3. Analysis of Beams
4. Plane stress, plane strain analysis
5. Analysis of Axi-symmetric solids
6. Analysis of 3D solids
7. Estimation of natural frequencies and mode shapes for simple problems
8. Steady state heat transfer Analysis
9. Development of NC code using CAM packages
10. Machining of simple components on NC lathe and Mill by transferring NC Code from a CAM package
11. Machining of Simple components on NC-Mill by transferring NC Code/from a CAM Package
12. Robot programming, simulation and execution.

SOFTWARE PACKAGES

CATIA /ANSYS/NASTRAN /Iron CAD etc.

REFERENCE

Lab Manuals

B.Tech. (VI Sem.)	17ME71 - HEAT TRANSFER LAB	L	T	P	Cr.
		-	-	2	1

Prerequisite Subject: HEAT TRANSFER

Course Educational Objectives The objective of this course is to understand the modes of heat transfer for different heat transfer equipments.

Course Outcomes : After completion of the lab students are able to:
CO1: Estimate the thermal conductivity of different materials and powders
CO2: Experiment both free and forced convection to predict heat transfer coefficient.
CO3: Validate the Stefan Boltzmann Constant and estimate emissivity of grey body.
CO4: Compare parallel and counter flow heat exchanger performance characteristics.

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
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

B.Tech. (VI Sem.)	17PD07 - SEMINAR	L	T	P	Cr.
		-	-	2	1

PRE-REQUISITES: Knowledge acquired in the theory and practical courses during previous semesters.

COURSE EDUCATIONAL OBJECTIVE: To ensure that the students attain the skills of presenting the technical reports, improve oral communication; overcome the fear of public speaking and proficient in preparing the technical content for the valuable presentation.

COURSE OUTCOMES: After completion of the course students are the able to:

CO1: Understand the concepts of mechanical engineering
CO2: Exposed to communication environment, overcomes stage fear
CO3: Understand the concepts by discussions with the peer group and experts.
CO4: Improve the report writing skills.

B.Tech. (VI Sem.)	17ME91 - DESIGN OF EXPERIMENTS (Add on course – II)	L	T	P	Cr.
		3	-	-	3

PRE-REQUISITES: Mathematics courses, Probability and Statistics

COURSE EDUCATIONAL OBJECTIVE:

This course provides the concepts of analyzing the experimental data and design of experiments. It covers the basics of probability, sampling criterion and analyzing the experimental data, concepts of single and several factors experimental design criteria. Further, the regression analysis and optimization of the parameters are addressed.

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

CO1: Identify the need for the strategies of design of experiments and understand the fundamentals of probability.
CO2: Acquirethe knowledge of random variables used in the experimental strategies.
CO3: Analyze the experimental data using the sampling criteria.
CO4: Design and analyze the experiments with single factor and multiple factors.
CO5: Apply the knowledge of regression analysis and optimization of the engineering systems**.**

UNIT-I

INTRODUCTION: Strategy of experimentation, some typical applications of experimentaldesign, Basic principles, Guidelines for designing experiments, a brief history of statistical design, using statistical design in experimentation.

BASICS OF PROBABILITY: Random experiments, sample space and events, interpretation of probability, axioms of probability, conditional probability, probability rules, Baye's theorem.

UNIT-II

RANDOM VARIABLES: Definition, attributes of a random variable, types of random variables, examples

DISCRETE RANDOM VARIABLES: Introduction, probability distributions and probability mass functions, cumulative distribution function, mean and variance of a discrete random variable, Binomial and Poisson distribution.

CONTINUOUS RANDOM VARIABLES: Introduction, probability distributions and probability density functions, cumulative distribution function, mean and variance of a continuous random variable, normal distribution.

UNIT-III

SIMPLE COMPARATIVE EXPERIMENTS: Introduction, Basic statistical concepts, Sampling andSampling Distribution, Confidence interval on the mean of a normal distribution: Variance known and unknown, one-sided and two-sided confidence bounds.

UNIT-IV

DESIGN AND ANALYSIS OF EXPERIMENTS WITH SINGLE FACTOR: Basic principles and guidelines of design of experiments, single factor experiments, Analysis of Variance (ANOVA)

DESIGN AND ANALYSIS OF EXPERIMENTS WITH MULTIPLE FACTORS: Introduction to Factorial design,the two factor ANOVA, 2^k factorial designs

UNIT-V

REGRESSION ANALYSIS: Introduction, simple linear regression analysis, multiple linear regression analysis, goodness of the regression fit: correlation coefficient.

OPTMIZATION: Introduction, General representation of an optimization problem, Classification of optimization problems, optimization of single and multiple variable problems using calculus methods, representation of feasible domain for the objective function on graphical plot.

TEXT BOOKS

1. Montgomery D.C.,Runger G.C., Applied Statistics and Probability for Engineers , John Wiley 5th Edition 2012
2. Montgomery D.C., Design and Analysis of Experiments, John Wiley, 8th Edition 2013

REFERENCES

1. Robert L. Mason, Richard F. Gunst, James L. Hess, Statistical Design and Analysis of Experiments: With Applications to Engineering and Science, John Wiley, 2nd Edition 2003.
2. Montgomery D.C., Peck E.A., Vining G.G., Introduction to Linear Regression Analysis, John Wiley, 5th Edition 2012.

B.Tech. (VI Sem.)	17PD08 - EMPLOYABILITY ENHANCEMENT SKILLS – II	L	T	P	Cr.
		1	-	-	0

Prerequisite: NIL

Course Educational Objective (CEO): This course will make students proficient in Quantitative techniques, language & communication skills to qualify in placement tests, demonstrate industry-readiness skills by applying concepts and tools that will serve as building blocks for analytical thinking and professional development.

Course Outcomes (COs): After the completion of this course, student will be able to:
CO1: To identify, analyze and apply quantitative techniques related to qualify in Placement tests.
CO2: To effectively utilize verbal ability & communication skills to qualify in Placement tests.
CO3: To effectively communicate in professional as well as social contexts.
CO4: To apply key soft skills effectively in Job Interviews as well in other professional contexts
CO5: Inculcate lifelong learning through personal effectiveness as well as leadership.

UNIT – I:
Verbal Ability: Tenses& Conditional Clauses
Quantitative Aptitude: Alligation or Mixture**,** Simple Interest and Compound Interest

UNIT – II:
Verbal Ability: Sentence Completions
Quantitative Aptitude: Time and work, Pipes and Cistern, Permutations and Combinations, Probability

UNIT – III:
Verbal Ability: Spot the Errors
Quantitative Aptitude: Time and Distance, Problems on trains,Boats and Streams, Races and Games of Skill

UNIT – IV:
Verbal Ability: Jumbled Sentences, Cloze Tests
Quantitative Aptitude: Area, Volume and Surface Areas, Progressions

UNIT – V:
Verbal Ability: Advanced Reading Comprehension
Quantitative Aptitude: Clocks and Calendars, Cubes and Dice

TEXT BOOKS

1. Objective Arithmetic, S. CHAND Publishers.
2. R.S.AGGARWAL, *Verbal & Non-Verbal Reasoning*, S. CHAND Publishers.
3. Objective English. Edgar Thorpe, Pearson Education, New Delhi.2009.
4. Sanjay Kumar, Pushpa Lata: Communication skills. Oxford, Delhi, 2012.
5. Vocabulary Builder for Students of Engineering and Technology (A self – study manual for vocabulary Enhancement) Y.Saloman Raju, Maruthi Publishers

REFERENCES

1. Meenakshi Raman, Sangeetha: Technical Communication, Oxford University Press, 2008
2. Baron's Guide on GRE
3. Dinesh Khattar, *The Pearson Guide to Quantitative Aptitude*, Pearson Education
4. M. Tyra, *Magical Book on Quicker Maths*, BSC Publishers
5. Quantitative Aptitude by Arun Sharma
6. Vocabulary Builder for Students of Engineering and Technology (A self – study manual for vocabulary Enhancement) Y.Saloman Raju, Maruthi Publishers

B.Tech. (VII Sem.)	17ME28 - REFRIGERATION AND AIR CONDITIONING	L	T	P	Cr.
		2	2	-	3

Prerequisite Subjects: Thermodynamics

Course Educational Objectives:This course provides understanding of refrigeration and air conditioning fundamentals, psychometric process and principles for estimating load and design of air conditioning systems.

Course Outcomes: After completion of the course, students will be able to:

CO1: Understand the basic concepts of refrigeration and their applications.

CO2: Evaluate the performance parameters of different types of refrigeration systems.

CO3: Identify the desirable refrigerant and its use in various refrigeration systems.

CO4: Analyze the psychrometric properties and processes used in Air Conditioning systems.

CO5: Design of Air Conditioning systems for human comfort conditions.

UNIT - I

FUNDAMENTALS OF 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

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 Superheating --Actual Vapour compression cycle and its applications.

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 system, 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 - Psychrometric properties and relations- Psychrometric chart Psychrometric processes-Sensible, Latent and Total heat–Sensible Heat Factor and Bypass Factor.

HUMAN COMFORT: Thermodynamics of Human body-Effective temperature – Comfort chart.

UNIT - V

AIR CONDITIONING SYSTEMS: Introduction-Components of Air conditioning system-Classification of Air conditioning systems-Central and Unitary systems- Summer, Winter and Year round systems- Cooling load estimation.

DESIGN OF AIR CONDITION SYSTEMS: Summer air conditioning –ADP-System with Ventilated and re-circulated air with and without bypass factor- RSHF, GSHF and ESHF.

NOTE: Refrigerants &Psychrometric properties- by M.L. Mathur & F.S. Mehta data book will be supplied in the exam hall.

TEXT BOOKS

1. C. P. Arora. , Refrigeration and air conditioning - TMH, 2nd Edition, 2000.
2. R. Dossat, Principles of Refrigeration - - Pearson 4th Edition 2001

REFERENCES

1. S. C. Arora, Domkundwar, A course in refrigeration and air conditioning-Dhanapat Rai& sons 5th Edition ,1997.
2. Manohar Prasad, Refrigeration and Air conditioning, New Age international, 2003
3. Wilbert F.Stoecker, Jerold W. J.Jones, MGH, 1986.

B.Tech. (VII Sem.) **17ME29 - ROBOTICS**

L	T	P	Cr.
2	2	-	3

Prerequisite Subject: Engineering Mechanics&Kinematics 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 development.

Course Outcomes: At the end of the course, the student will be able to:
CO1: Understand the basics of robots, end effectors and its applications.
CO2: Familiarize the working of actuators and sensors for robotic application.
CO3: Formulate D-H matrices for different kinematics problems.
CO4: Model the dynamic behaviour of robot.
CO5: Analyse the trajectory of robotic motion.

UNIT - I
INTRODUCTION : Basic concepts – Robot anatomy –Components of robots- Robot motions – Number of D.O.F – Work volume-Robot applications in Material transfer and machine loading/ unloading applications – Processing operations – Assembly and inspection – Future applications.
ROBOT END EFFECTORS: Introduction – Types of end effectors – Mechanical grippers – Vacuum cups, magnetic grippers, adhesive gripers and others – Robot / End effectors interface – Considerations in gripper selection and design.

UNIT - II
ACTUATORS: Characteristics of actuating system- pneumatic actuators-hydraulic actuators-electric motors.
SENSORS: Sensor characteristics-Position sensors: Potentiometers, LVDT, Resolvers, encoders, Magnetostrictive Displacement Transducers (MDT) – velocity sensors: encoders, tachometers.

UNIT - III
MANIPULATOR KINEMATICS: Introduction –Coordinate Frames, Description of Objects in space, Transformation of vectors, Inverting a Homogeneous Transform, Fundamental Rotation Matrices, Problems- D-H representation – problems on forward 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.

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 MikellP.Groover, Mitchell Weiss, Roger N. Nagel&Nicholas G. Odrey,Ashish Dutta, Industrial Robotics, Second Edition McGraw- Hill Education(India) Private Limited,2012

2 Robert J.Schilling, Fundamentals of robotics analysis & control, PHI learning private limited, New Delhi,4thEdition 2002

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

B.Tech. (VII Sem.) **17ME30 - METROLOGY AND INSTRUMENTATION**

L	T	P	Cr.
2	2	-	3

Prerequisite Subject: Probability and statistics, Applied Physics and Technical Drawing.

Course Educational Objectives: The main objective of this course is to ascertain basic principles of measurements and instruments.

Course Outcomes: After completion of the course student will be able to:

CO1: Analyse different measuring techniques in quality control departments of industries and to ensure quality of products.
CO2: Design and use effectively the instruments tomeasure linear and angular parameters.
CO3: Apply measuring systems for surface roughness and perform alignment/acceptance test effectively.
CO4: Design effectively the instruments for measuring stress, strain, force, torque etc.
CO5: Understand the usage of Pressure, Fluid flow and Temperaturemeasuring systems.

UNIT – I

BASIC CONCEPTS: Introduction, Fundamental Measuring Processes and methods, Generalized measurement system and its functional elements, Performance characteristics.
ANALYSIS OF EXPERIMENTAL DATA: Causes and types of experimental errors, Treatment of experimental data, Method of least squares, Graphical analysis and curve fitting.

UNIT - II

LINEAR MEASUREMENT: Standards of measurements- line and end standard. Basic principle and applications of slip gauges, dial indicator and micrometers.
ANGULAR MEASUREMENTS: Bevel protractor – angle slip gauges – sine bar, rollers and spheres used to determine the tapers, Applications of angular measurement.
OPTICAL MEASURING INSTRUMENTS: Tool maker's microscope and its uses – collimators, optical projector – optical flats and their uses, interferometer, and those applications.

UNIT – III

SURFACE TEXTURE: 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 – CLA, R, R.M.S Values – Ra values, and Rz values. Basic principle of profile meter and Tomlinson surface meter. ISI symbols for indication of surface finish, Applications surface texture.
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. Indian Standard Institution System.

UNIT – IV

MEASUREMENT OF DISPLACEMENT: Introduction, Classification, Dimensional measurement, Gauge blocks, Optical methods, Pneumatic gauge, Applications of displacement measurement.
MEASUREMENT OF STRESS AND STRAIN: Introduction, Strain measurements, Electrical Resistance Strain Gauge, gauge factor, Measurement of Resistance Strain-Gage Outputs, Temperature Compensation, Strain-Gage Rosettes , Strain gage Rosettes, Applications of strain measurement.
MEASUREMENT OF FORCE AND TORQUE: Introduction, Elastic Transducer, Strain Gage Load Cells, Dynamometers- Mechanical, Hydraulic, Electrical, Applications of force and torque measurement.

UNIT –V

MEASUREMENT OF PRESSURE: Introduction, Manometers, Dial type pressure gauge, Pressure Transducers, Pitot, Static, and Pitot-Static Tube and Its characteristics, Low Pressure Measurement Gauges, Applications of pressure measurement.

MEASUREMENT OF FLUID FLOW: Introduction, Rotameter, Turbine flow meter, Laser Doppler Anemometer, Hot-wire Anemometer, Applications of fluid flow measurement.

MEASUREMENT OF TEMPERATURE: Introduction, Types of thermometers, Thermocouples, RTD, Thermisters, Pyrometers, Applications of temperature measurement.

TEXT BOOKS

1. D.S.Kumar, Mechanical Measurements and Controls, 4th Edition, Metropolitan Book Co-Private Ltd.
2. R.K.Jain, Engineering Metrology, Khanna Publishers.3rd edition, 2003.
3. BeckWith, Marangoni,Linehard, Mechanical Measurements, Person Education Asia.6th edition,2011.

REFERENCES

1. A.K, Sawhneypuneet "A course in Mechanical Measurements and instrumentation control" DhanpatRai publications, 12thEdition, 2012
2. J.P. Holman, Experimental Methods for Engineers, McGraw Hill.
3. Ernest O. Doebelin, Measurement systems Application and Design, International Student Edition, 4thEdition, McGraw-Hill Book Company, 1998.
4. M. Mahajan, A text book of Metrology, DhanpatRai& Co.
5. I C Gupta, Engineering Metrology, DanpathRai.

B.Tech. (VII Sem.) **17AE25 - COMPUTATIONAL FLUID DYNAMICS**

L	T	P	Cr.
3	-	-	3

Course Educational Objectives: To learn the basic governing equations of fluid dynamics, mathematical behaviour of partial differential equations, phenomena of various discretization techniques, techniques to solve the simple incompressible flow problems, and basic techniques to solve simple heat transfer problems .

Course Outcomes: At the end of the semester, the student will be able to
CO1: Formulate the basic fluid dynamics problem mathematically
CO2: Analyze the mathematical behaviour of partial differential equations
CO3: Apply the grid generation principles for different problems.
CO4: Solve elementary incompressible fluid problems using the CFD techniques
CO5: Solve the elementary heat transfer problems using the CFD techniques

UNIT - I
Introduction
Computational Fluid Dynamics as a Research and Design Tool, Applications of Computational Fluid Dynamics.
Governing Equations of Fluid Dynamics: Introduction, Control Volume, Substantial Derivative, Divergence of Velocity, Continuity Equation, Momentum Equation and Energy Equation, Conservation and Non-conservation forms of governing flow equations.

UNIT - II
Mathematical Behavior of Partial Differential Equations
Introduction, Classification of Quasi-Linear Partial Differential Equations, Eigen Value Method, Hyperbolic Equations, Parabolic Equations, Elliptic Equations.

UNIT - III
Basics Aspects of Discretization
Introduction, Introduction of Finite Differences, Difference Equations, Explicit and Implicit Approaches, Errors and Stability Analysis, Grid Generation.

UNIT - IV
Incompressible Fluid Flow: Introduction, Implicit Crank-Nicholson Technique, Pressure Correction Method, Computation of Boundary Layer Flows

UNIT - V
Heat Transfer
Finite Difference Applications in Heat conduction and Convention, Heat conduction - steady heat conduction in a rectangular geometry, transient heat conduction in a plane wall, Two-Dimensional transient heat conduction, Finite difference application in convective heat transfer.

TEXT BOOK
1. Anderson.J.D, Computational Fluid Dynamics-Basics with Applications, Mc Graw Hill, 1995.
2. Thanigaiarasu. S, Computational Fluid Dynamics and Heat Transfer.

REFERENCES
1. Anderson, D. A, Tannehill. J. C, Pletcher. R. H, Computational Fluid Mechanics and Heat Transfer, CRC Press, 2012.
2. Patankar. S. V, Numerical Heat Transfer and Fluid Flow, CRC Press, 1980.
3. Sengupta. T. K, Fundamentals of Computational Fluid Dynamics, University Press, 2004.

B.Tech. (VII Sem.) **17ME31 - FUNDAMENTALS OF TRIBOLOGY**

L	T	P	Cr.
3	-	-	3

PRE-REQUISITES: Engineering Chemistry, Fuels and Lubricants Lab, Kinematics of Machines

COURSE EDUCATIONAL OBJECTIVE: This course is to provide the knowledge on principles of Tribology 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: Compute the surface topographical parameters and analyze the friction and wear problems with basic principles.
CO2: Analyse viscous characteristics of different lubricants in order to minimize the friction.
CO3: Perform basic design calculations of hydrodynamic lubrication bearings.
CO4: Analyze the various design parameters for hydrostatic lubricated bearings under different loads and temperature condition.
CO5: Indentify the materials required for design of anti frictional bearings.

UNIT - I

INTRODUTION 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.

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, effects of wear

UNIT - II

VISCOSITY AND LUBRICANTS: Viscosity, flow of fluids, viscosity and its variation - absolute and kinematic viscosity, temperature variation, viscosity index determination of viscosity, different viscometers used, Viscosity standards, Lubricants and their physical properties, Various theories of lubrication

UNIT - III

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.

UNIT – V

ANTI-FRICTION BEARINGSAND BEARING MATERIALS : Anti-friction bearings, types, Advantages and disadvantages, General requirements of bearing materials, types of bearing materials, General bearing design considerations

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TEXT BOOKS

1. Basu S.K, Sen Gupta and Ahuja, Fundamentals of Tribology, PHI Learning Private Limited, 2009.
2. Gwidon W Stachowiak and Andrew W Batchlor, Engineering Tribology, 3rd Edition, Elsevier.

REFERENCES

1. Sushil Kumar Srivatsava, Tribology in Industry, S. Chand &Co.
2. B.C. Majumdar, Tribology, S.Chand& Co
3. Rabinowicz, Friction and Wear of materials, John willey& Sons.
4. Halling. J, Macmillian, Principles of Tribology,.
5. Williams .J.A, Engineering Tribology, Oxford University Press.

B.Tech. (VII Sem.)	17ME32 - MECHATRONICS	L	T	P	Cr.
		3	-	-	3

Prerequisite Subject: Robotics

Course Educational Objectives: The main objective of this course is to familiarize the concepts of mechatronic systems in engineering products.

Course Outcomes: After completion of the course students are able to:

CO1: Implement the mechatronic systems in various industrial fields.
CO2: Apply Signal conditioning in sensors for more accurate measurements.
CO3: Develop basic mathematical models in mechatronic systems.
CO4: Understand actuators and Microcontrollers in Automobile engine control systems and robotics.
CO5: Integrate programmable motion controllers in the areas of Automation, Aerospace and Robotic fields

UNIT-I

IntroductiontoMechatronic Systems–MeasurementSystems–Control Systems–Microprocessor based Controllers.

Sensors and Transducers – Performance Terminology – Displacement, Position and Proximity; Velocity, Motion, Force,FluidPressure, LiquidFlow, LiquidLevel, Temperature,LightSensors–Selection ofSensors

UNIT-II

Signal Conditioning: Introduction to signal conditioning operational amplifier-inverting amplifier, summing amplifier, integrating amplifier, differential amplifier, logarithmic amplifier, comparator, amplifier errors- protection-filtering-wheatstone bridge.

Digital signals: analogue and digital signals, Digital to analogue and analogue to digital converters – Multiplexers-Data acquisition and applications.

UNIT-III

Basic system models: Mathematical models-mechanical system building blocks-electrical system building blocks-fluid system building blocks –rotational-translational systems – electromechanical systems

UNIT-IV

ContinuousanddiscreteprocessControllers –ControlMode–Two–Stepmode– ProportionalMode – Derivativecontrol –Integralcontrol–PIDControllers–Digital Controllers–VelocityControl– AdaptiveControl.

UNIT-V

ProgrammableLogic Controllers – Basic Structure–Input/ OutputProcessing– ladder programming– Mnemonics–Timers,Internalrelaysandcounters - Case studiesofMechatronics systems- Pick andplaceRobot- Car EngineManagement system- Automaticcarparkbarrier.

TEXT BOOKS

1. W.Bolton Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering,Pearson Education Press, 3rd Edition, 2005.
2. M.D.Singh/J.G.Joshi,Mechatronics, PHI,1st edition, 2006.

REFERENCES

1. Newton C Braga,Mechatronics Source Book , Thomson Publications, Chennai,1st edition,2003.
2. N. Shanmugam / Anuradha, Mechatronics Agencies Publisers, 1stEdition, 2001.
3. Devdasshetty/Richard,Mechatronics System Design, Thomson, cengage learning, 2nd Edition,2010.

B.Tech. (VII Sem.)	17ME33 - PRODUCTION PLANNING AND CONTROL	L	T	P	Cr.
		3	-	-	3

Prerequisite Subject: Industrial Management and Operation Research

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: Exhibit the ability in developing production planning for operating economy, effectiveness and cost control.
CO2: Apply the forecasting techniques in estimating the number of products.
CO3: Use the inventory management techniques to determine the optimum quantity of material.
CO4: Develop the route sheet required for a production process/activities.
CO5: Decide the dispatch procedure required for a production processes and other activities.

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 – purpose of inventories – relevant inventory costs, EOQ model and assumptions in EOQ. ABC analysis – VED analysis. Inventory control systems –P–Systems and Q-Systems. 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 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, 2007.
2. P.Rama Murthy, Production and Operations Management, New Age International, 2nd Edition,2005.

REFERENCES

1. Production and Operations Management/ S.N.Chary, TMcH, 4th Edition 2010.
2. Elements of Production Planning and Control/ SamuelEilon, Universal Publishing Corporation, 2004.
3. Modern Production/ Operations Management/ Elwood S.Buffa and Rakesh K.Sarin, Wiley; Eighth edition, 2007.
4. Operations Management / Joseph.G.Monks, McGraw-Hill Inc., 3rd revised edition.

B.Tech. (VII Sem.)	17ME34 - POWER PLANT ENGINEERING	L	T	P	Cr.
		3	-	-	3

Prerequisite Subject: Thermal Engineering and Internal Combustion Engines and Gas Turbines

Course Educational Objectives: The objective of the course is to study the various power plant potentials and its working principles.

Course Outcomes: After completion of the course student will be able to:
CO1: Understand the basics of various energy sources and various circuits in steam power plant.
CO2: Comprehend Diesel and Gas Turbine power generating plants.
CO3: Analyze salient features of Hydroelectric and Nuclear power plants.
CO4: Differentiates different direct energy conversion systems.
CO5: Evaluate economics of power generation and pollution issues related to power plants.

UNIT - I
INTRODUCTION: Energy sources and Power Development 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: Plant layout with auxiliaries-Fuel storage and Fuel supply system-Air supply system-Exhaust system-Water cooling system-Lubrication system-Starting system-Supercharging-Advantages and Disadvantages of Diesel plants over Thermal plants.
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.

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.
NUCLEAR POWER PLANT: 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.

UNIT - IV
POWER FROM NON-CONVENTIONAL SOURCES: Solar power plants-Utilization of Solar collectors-Principle of working of Wind energy-Types- Tidal Energy.
DIRECT ENERGY CONVERSION SYSTEM: Solar cell- Fuel cell-Thermo Electric and Thermo ionic conversion system-MHD generation.

UNIT - V
POWER PLANT ECONOMICS: Fixed cost-Operating cost.-Fluctuating loads-General arrangement of Power Distribution-Load curves-Load duration curve- Connected load- Maximum demand-Demand factor-Average load-Load factor-Diversity factor- Plant capacity factor**.**
POLLUTION AND CONTROL: Introduction- Particulate and gaseous pollutants-Air and Water pollution by Thermal plants and its control—Acid rains -Methods to control pollution.

TEXT BOOKS

1. P.K.Nag, Power Plant Engineering, , 4th Edition ,2014 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. M.M.ElWakil, Power plant technology, 3rd Edition 2010 TMH.
4. G.R.Nagpal, Power plant engineering, Khanna Publishers.14th Edition 2000.

B.Tech. (VII Sem.) **17AE29 - THEORY OF ELASTICITY**

L	T	P	Cr.
3	-	-	3

Course Educational Objectives: To understand the principles of elasticity theory, displacement of simple beams, linear elastic solids under mechanical loads.

Course Outcomes: At the end of the semester, the student will be able to
CO1: To analyze the equations of compatibility by using plane stress and plane strain conditions.
CO2: To apply Saint Venant's principles to determine the displacements of simple beams.
CO3: To analyze the stresses and strains in 3-Dimensional problems.
CO4: To solve the linear elasticity problems using various analytical techniques.
CO5: To analyze the vectors and tensors to enhance the theory of elasticity where ever necessary

UNIT - I
ELASTICITY: Two dimensional stress analysis - Plane stress - Plane strain - Equations of Compatibility - Stress function - Boundary conditions.
PROBLEM IN RECTANGULAR COORDINATES - Solution by polynomials - Saint Venant's principles -Determination of displacement - Simple beam problems.

UNIT - II
PROBLEMS IN POLAR COORDINATES - General equations in polar coordinates - Stress distribution symmetrical about axis - Strain components in polar coordinates - Simple and symmetric problems.

UNIT - III
ANALYSIS OF STRESS AND STRAIN IN THREE DIMENSIONS - Principle stresses – Homogeneous deformations – Strain at a point – Principal axes of strain - Rotation.

UNIT - IV
GENERAL THEOREMS: Differential equations of equilibrium and conditions of compatibility – Determination of displacement - Uniqueness of solution - Reciprocal theorem.

UNIT - V
BENDING OF PRISMATIC BARS - Stress function - Bending of cantilever beam - Beam of rectangular cross-section - Beams of circular cross-section.

REFERENCES
1. Timoshenko. S. P, Goodier. J. N, Theory of Elasticity, Third Edition, Tata McGraw Hill, 2010.
2. Lurie. A. I, Theory of Elasticity, Fourth Edition, Springer, 2005.
3. Sadhu Singh., Applied stress analysis, Khanna Publishers, 2000
4. Dally. J. W, and Riley.W. F, Experimental stress analysis, Mc Graw-Hill, 1991.
5. Love .A. E. H., A treatise on Mathematical theory of Elasticity, Dover publications Inc, 2011.

B.Tech. (VII Sem.)	17ME35 - ADDITIVE MANUFACTURING	L	T	P	Cr.
		3	-	-	3

PRE-REQUISITES: Machine drawing, Production Technology, Machine Tools.

COURSE OUTCOMES: At the end of the course, the student shall be acquainted with the knowledge of: Importance of AM in Manufacturing, Process of AM, Different AM Technologies, Select suitable materials for AM, Applications of AM in Automobile, Aerospace, Bio-medical.

COURSE OUTCOMES: After completion of the course student will be able to:
CO1: Understand the essential characteristics of additive manufacturing (AM) processes
CO2: Familiarize with knowledge of AM process and relation to Reverse Engineering.
CO3: Select suitable material and method of Additive Manufacturing.
CO4: Identify various applications of AM.
CO5: Apply the rapid prototyping tools and techniques in industrial arena.

UNIT-I: INTRODUCTION TO ADDITIVE MANUFACTURING
Introduction of AM, need, Development, Generic AM Process, Fundamentals, Classification of AM Systems, Benefits of AM, Related Technologies of AM, Standards on AM, Commonly Used Terms, general application of AM.

UNIT-II: REVERSE ENGINEERING
Introduction of Reverse Engineering, Relationship between RE and RP, Legal Aspects of Reverse Engineering, The generic processes of RE, Contact Scanners, Noncontact Scanners, RE–Hardware and Software, Computer Vision and Reverse Engineering, CMM. AM materials, software's, STL files, and STL errors.

UNIT-III: LIQUID BASED AND SOLID BASED ADDITIVE MANUFACTURING SYSTEMS
Classifications- Liquid based Systems- Stereo lithography Apparatus (SLA), Rapid Freeze Prototyping (RFP), Principle, process, advantages and applications – Solid based system –Fused Deposition Modeling – Principle, process, advantages and applications, Laminated Object Manufacturing.

UNIT-IV: POWDER BASED ADDITIVE MANUFACTURING SYSTEMS
Selective Laser Sintering – Principles of SLS process – Process, advantages and applications, Three Dimensional Printing – Principle, process, advantages and applications- Laser Engineered Net Shaping (LENS), Electron Beam Melting.

UNIT-V: RAPID TOOLING AND APPLICATIONS
Rapid Tooling introduction, Investment Casting, EDM Electrodes, Injection Molding. AM Applications: Surgical and Diagnostic Aids, Prosthetics Development, Manufacturing, Tissue Engineering and Organ Printing, Aerospace Applications, Case studies.

TEXT BOOKS
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. Ian Gibson, David Rosen, Brent Stucker, Additive Manufacturing Technologies, Second Edition, Springer, 2015.

REFERENCES
1. Kamrani A.K. and Nasr E.A., "Rapid Prototyping: Theory and practice", Springer, 2006.
2. Hilton P.D. and Jacobs P.F., "Rapid Tooling: Technologies and Industrial Applications", CRC press, 2000

B.Tech. (VII Sem.) **17ME36 - TOTAL QUALITY MANAGEMENT**

L	T	P	Cr.
3	-	-	3

Prerequisite Subjects: Industrial Mangement

Course Educational Objectives: The main objective of this course is to familiarize the concepts of quality management techniques in industries

Course Outcomes: After completion of the course students will be able to:
CO1: Comprehend the principles and strategies of quality control.
CO2: Apply the principles of total quality management in an industry.
CO3: Analyze statistical quality control tools towards improving the quality.
CO4: Adopt the principles of Taguchi techniques for industrial needs.
CO5: Implement ISO quality standards in an organization.

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- 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, Concepts of six sigma, New seven Management tools.

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
Dale H. Besterfiled., 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.

B.Tech. (VII Sem.) **17ME72 - ROBOTICS AND SIMULATION LAB**

L	T	P	Cr.
-	-	2	1

Prerequisite Subject: Robotics, CAD/CAM

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 lab students are able to:
1. Develop Robot Programmes to use to control commands
2. Experiment the robot operations like palletizing, gluing, spray painting, polishing, loading and unloading
3. Simulate forward and inverse kinematic movements of a robot using MATLAB.
4. Perform the demo operations on SCARA and PUMA using Robo analysers.

LIST OF EXPERIMENTS
1. Program for commands like joint command, circle command
2. Program for commands SPLINE command (continues path)
3. Program for PTP command
4. Palletizing
5. Loading / Unloading
6. Gluing
7. Spray painting
8. Polishing
9. Simulateof Robot with 2 Dof, 3 Dof, 4 Dof using ROBOANALYZER
10. SimulateSCARA,PUMA using ROBOANALYZER
11. Simulate forward and inverse kinematics RR Manipulator using MATLAB
12. Simulate forward and inverse kinematics RP Manipulator using MATLAB

SOFTWARE PACKAGES
ARISTO ROBOT, ROBOANALYZER, MATLAB

REFERENCE: Lab Manuals

B.Tech. (VII Sem.)	17ME73 - METROLOGY AND INSTRUMENTATION LAB	L	T	P	Cr.
		-	-	2	1

Prerequisite Subject: Metrology & Instrumentation

Course Educational Objectives:
The main objective of this course is to provide hands on experience in using metrological instruments and calibrate them.

Course Outcomes: After completion of the course student will be able to:
CO1: Perform linear, angular and gear measurements in manufacturing industries.
CO2: Analyze the measurement of the surface roughness and perform alignment tests.
CO3: Calibrate the displacement, load and speed measuring instruments
CO4: Measure the pressure, flow and vibration measuring instruments

PART-A: METROLOGY
At least five experiments may be conducted.
1. Measurement of lengths, heights, diameters by Vernier calipers and micrometers.
2. Measurement of bores by dial bore indicators.
3. Taper measurement by using balls and rollers.
4. Use of gear teeth Vernier calipers and checking the chordal addendum and chordal height of spur gear.
5. Machine tool alignment of test on the lathe or milling machine.
6. Measurement of screw thread parameters using Tool makers microscope.
7. Angle and taper measurements by Bevel protractor, Sine bars, etc.
8. Thread measurement by three wire method.
9. Surface roughness measurement by Taly Surf.

PART-B: INSTRUMENTATION
At least five experiments may be conducted.
1. Calibration of Pressure Gauges
2. Study and calibration of LVDT transducer for displacement measurement.
3. Calibration of strain gauge for load measurement.
4. Calibration of capacitive transducer for linear displacement.
5. Study and calibration of photo and magnetic speed pickups for the measurement of speed.
6. Study and calibration of a rotameter for flow measurement.
7. Study of Piezo-electric transducer.
8. Study and use of a Seismic pickup for the measurement of vibration amplitude of an engine bed at various loads.
9. Study and calibration of McLeod gauge for low pressure.

References: Lab Manual

B.Tech. (VII Sem.) **17PD09 - INTERNSHIP**

L	T	P	Cr.
-	-	2	1

PRE-REQUISITES: Industrial Training/In-House Training.

COURSE EDUCATIONAL OBJECTIVE:
The main objective of this course is to make the student employable through Industrial exposure.

COURSE OUTCOMES: After completion of the course students are the able to:
CO1: Apply the academic knowledge in Industry.
CO2: Understand administrative functions and ethical principles of the organisation.
CO3: Analyze and develop the concepts by practical observation.
CO4: Improve the report writing skills.

B.Tech. (VII Sem.)	17ME92 - COMPUTER INTEGRATED MANUFACTURING (Add on course – III)	L	T	P	Cr.
		3	-	-	3

Prerequisite Subject: CAD/CAM

Course Educational Objectives:
The main objective of this course is to control the entire production process using computers. This integration allows individual processes to exchange information with each other and initiate actions.

Course Outcomes: After completion of the course students are the able to
CO1: Understand the basics of production and derive production metrics.
CO2: Prepare CNC programs for manufacturing of different geometries on milling and lathe machines.
CO3: Apply group technology concepts for parts classification.
CO4: Select layouts of FMS for industrial applications.
CO5: Develop a CAPP system for rotational and prismatic parts.

UNIT - I: INTRODUCTION
Production Systems, production facilities, Manufacturing operations, manufacturing models and metrices, CIM Definition, CIM components, Evolution of CIM, needs of CIM, Benefits of CIM.

UNIT - II: NUMERICAL CONTROL
Basic components of NC system, NC motion control system, applications of NC, advantages and disadvantages of NC, computer Numerical control, advantages of CNC, functions of CNC, Direct Numerical Control, components of a DNC system, functions of DNC, advantages of DNC, NC part programming.

UNIT - III: CELLULAR MANUFACTURING SYSTEMS
Part Families, Parts Classification and Coding, Features of Parts Classification and Coding Systems, Opitz of Parts Classification and Coding Systems, Production Flow Analysis, Composite Part Concept, Machine Cell Design, Applications Of Group Technology. Quantitative analysis of cellular manufacturing, Rank Order Clustering Method, Arranging Machines in a GT cell, Hollier Method, Simple Problems**.**

UNIT - IV: FLEXIBLE MANUFACTURING SYSTEMS (FMS)
Flexibility, types of FMS, FMS Components, FMS Application & Benefits, FMS Planning and implementation issues, Quantitative analysis of FMS, Simple Problems.

UNIT - V: PROCESS PLANNING AND CONCURRENT ENGINEERING
Proces planning for parts, Process planning for assemblies, make or buy decisions, Computer aided process planning, Retrieval and generative CAPP systems, concurrent engineering and design for manufacturing, advanced manufacturing planning, lean production and just in time production systems.

TEXT BOOKS
1. Mikell P Groover, Automation, production Systems and Computer Integrated Manufacturing, 3 rd Edition, Prentice Hall Inc., New Delhi, 2007.
2. P. Radhakrishnan, " Computer Numerical Control ", New Central Book Agency, 1992.

REFERENCES
1. Nanua Singh, System Approach to Computer Integrated Manufacturing, Wiley & Sons Inc., 1996.
2. Andrew Kusiak, Intelligent Manufacturing System, Prentice Hall Inc., New Jersey, 1992

B.Tech. (VIII Sem.)	17ME37 - ENERGY CONSERVATION AND MANAGEMENT	L	T	P	Cr.
		3	-	-	3

Pre-requisites: Thermodynamics, Environmental Studies, Thermal engineering, Heat Transfer.

Course Educational Objective:
To provide detailed understanding of energy conservation and management, 3Es (Energy, Economics and Environment) and their interaction, energy audit and financial management.

Course Outcomes: At the end of the course, the student will be able to
CO1: Understand the fundamentals of energy management and energy conservation
CO2: Apply the energy audit procedures for energy conservation and management.
CO3: Analyze the performance of various thermal systems using energy auditing.
CO4: Evaluate energy projects based on energy conversion and financial criteria.
CO5: Identify Kyoto protocol principles on climate policy.

UNIT – I
ENERGY CONSERVATION: Principles of energy conservation, Energy conservation act 2001 and its features. Available resources of non renewable energy and scope of conversion. Need for organizing and managing energy management program. Energy policy, energy pricing and need for energy security.

UNIT – II
ENERGY AUDIT: Concept and types of energy audits, Audit process Guidelines for writing energy audit report, data presentation in report, finding recommendations, impact of renewable energy on energy audit recommendations and energy audit report. Energy audit recommendations of building systems, Lighting systems, HVAC systems, water heating systems. Instruments for conducting energy audit and monitoring energy savings.

UNIT – III
ENERGY CONSERVATION IN THERMAL UTILITEIES: Energy conservation inboilers and furnaces, Energy conservation in steam and condensate systems. Concept of co generative systems and types of co generative systems
WASTE HEAT RECOVERY: Potential benefits of waste heat recovery, Quantifying waste heat, Classification of waste heat by its quality. Storage of waste heat and equipment for waste heat recovery.

UNIT – IV
ENERGY ECONOMICS: Time value of money, cash flow diagrams, formulae relating present and future cash flows- single amount, uniform series and uniform gradient series. Life cycle cost analysis: Simple payback period, net present worth, net annual worth, internal rate of return, benefit cost ratio.

UNIT – V
CLIMATE POLICY: Kyoto protocol, clean development mechanism (CDM), Geo policies of GHG control; Carbon market

TEXT BOOKS

1. Energy Engineering and Management, Amlan Chakrabarti, PHI learning private limited. 2011
2. Energy Management and Conservation , K.V. Sharma and P.Venkateshiah , I.K. International Publishing House 2011
3. Hand book of Energy Audits, Albert Thumann, 6^{th} edition, The fair mount press

REFERENCE

1. Bureau of Energy Efficiency Reference book: 1,2,3,4
2. Energy Management Hand book, W.C Turner, John Wiley and sons, A Wiley inter science publication.

B.Tech. (VIII Sem.) 17ME38 - MECHANICS OF COMPOSITE MATERIALS

L	T	P	Cr.
3	-	-	3

PRE-REQUISITES: Mechanics of Materials

COURSE EDUCATIONAL OBJECTIVE: The main objective of this course is to introduce the basic concepts of the mechanical behaviour of composite material and performance of fiber reinforced composites.

COURSE OUTCOMES: At the end of the course, the student will be able to
CO1: Understand the characteristics of fiber reinforced composites and their applications.
CO2: Determine the mechanical properties of composites.
CO3: Analyze various laminates and its failure criteria.
CO4: Comprehend the failure theories of fiber reinforced composites.
CO5: Understand the different fabrication processes of composites.

UNIT - I
STRESS STRAIN RELATION: Introduction- Definition of composites-classification advantages, applications and limitations of composite materials, reinforcements and matrices, Generalized Hooke's Law – Compliance and reduced stiffness matrix- stress-strain relation of orthotropic lamina.

UNIT- II
METHODS OF ANALYSIS: Micro mechanics – Mechanics of materials approach, elasticity approach to determine material properties – Macro Mechanics – Stress-strain relations with respect to on axis, off axis.

UNIT- III
MULTI DIRCTIONAL COMPOSITES: Governing differential equation for a generallaminate, Classical Lamination Theory- Symmetric, Antisymmetric laminates, angle ply and cross ply laminates. Failure criteria for composites.

UNIT- IV
SANDWICH CONSTRUCTIONS: Basic design concepts of sandwich construction - Materials used for sandwich construction - Failure modes of sandwich panels.

UNIT- V
FABRICATION PROCESSES: Open and closed mould processes, lay-up, Vacuum bagging, Pultrusion, ResinTransfer Molding - Auto Clave-Filament Winding

TEXT BOOKS
1. Calcote, L R. "The Analysis of laminated Composite Structures", Von – Noastrand Reinhold Company, New York 1998.
2. Jones, R.M., "Mechanics of Composite Materials", McGraw-Hill, Kogakusha Ltd.,Tokyo, 1998, 2nd Edition.

REFERENCES
1. Agarwal, B.D., and Broutman, L.J., "Analysis and Performance of Fibre Composites", John Wiley and sons. Inc., New York, 1995.
2. Lubin, G., "Handbook on Advanced Plastics and Fibre Glass", Von Nostrand Reinhold Co., New York, 1989.

B.Tech. (VIII Sem.) 17ME39 - AUTOMATION IN MANUFACTURING

L	T	P	Cr.
3	-	-	3

Prerequisite Subject: Production Technology, Industrial Management, CAD / CAM

Course Educational Objectives: The main objective of this course is to emphasize the role of automation in manufacturing industries.

Course outcomes: After completion of the course students are able to:
CO1: Accomplish different levels of automation in manufacturing industries.
CO2: Apply the techniques of automation in material handling and storage equipments.
CO3: Comprehend the knowledge on manufacturing systems, assembly systems and able to design single station manufacturing cell.
CO4: Analyse various algorithms for both manual and automated flow lines.
CO5: Apply the optimized Adaptive Control System in automation.

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. CAD/CAM/CIM/ P. Radha Krishnan & S. Subrahamanyarn and Raju/New Age International Publishers/2003.
2. Automation, production systems and computer integrated manufacturing/ Mikell. P .Groover/PHI/3rd edition/2012.

REFERENCES

1. Computer Aided Manufacturing/Tien-Chien Chang, Richard A. Wysk and Hsu-Pin Wang/Pearson/ 2009.
2. Manufacturing and Automation Technology / R Thomas Wright and Michael Berkeihiser /Good Heart/Willcox Publishers/2011.

B.Tech. (VIII Sem.) 17ME40 - PROJECT PLANNING ANDMANAGEMENT

L	T	P	Cr.
3	-	-	3

Prerequisite Subjects: Industrial Management, Production Planning and Control

Course Educational Objectives:The main objective of this course is to create awareness of project management concepts.

Course Outcomes:After completion of the course students are the able to
CO1: Apply concepts of Project Management to understand the product life cycle.
CO2: Conduct feasibility studies for effective implementation of projects.
CO3: Optimise the time and cost of the projects using PERT & CPM techniques
CO4: Analyse the financial requirement and planning for the project.
CO5: Manage risks while handling the projects.

UNIT - I
INTRODUCTION TO PROJECT MANAGEMENT: Definition, functions, evolution of Project Management, classification of projects, Project Management in different environments
The Project Management Systems, Methodologies & Systems Development Cycle: Systems approach, systems analysis, systems development, project feasibility, project life cycle, project appraisal, project contracting, the phases of systems development cycle

UNIT - II
PROJECT FEASIBILITY STUDY: Developing a project plan, market & technical analysis, financial analysis, evaluation of project proposals, risk analysis, sensitivity analysis, social cost benefit analysis
PROJECT PLANNING: Planning fundamentals, project master plan, work breakdown structure & other tools of project planning, work packages project organization structure & responsibilities.

UNIT - III
PROJECT SCHEDULING: Use of Gantt Charts & network diagrams, activity of node diagrams, activity on arrow diagrams, the critical path, time based networks
PERT, CPM, Resource Allocation & GERT: Tools & techniques for scheduling development, crashing of networks, time cost relationship, resource leveling multiple project scheduling, GERT

UNIT - IV
COST ESTIMATING & BUDGETING: Cost estimating process elements of budgeting, project cost accounting & management information systems, cost schedules & forecasts

UNIT - V
MANAGING RISKS IN PROJECTS: Risk concept & identification, risk assessment, risk priority, risk response planning, risk management methods
PROJECT CONTROL: Information monitoring, internal & external project control, cost accounting systems for project control, control process, performance analysis, variance limits, and issues in project control.

TEXT BOOK
Project Management for Business & Technology (Principles & Practice) Nicholas, John M. Pearson Education

REFERENCES

1. Projects: Planning, Analysis, Selection, Implementation & Review, Prasanna Chandra 7th e Tata McGraw Hill 2009
2. Shtub, Bard and Globerson, PROJECT MANAGEMENT, Engineering, Technology and Implementation, Prentice Hall, India
3. P.K.JOY, Total Project Management, the Indian Context, Macmillan India Ltd.
4. N.J.Smith(Ed), Project Management, Blackwell Publishing,2002.

B.Tech. (VIII Sem.) 17ME41 - NUCLEAR SCIENCE AND ENGINEERING

L	T	P	Cr.
3	-	-	3

Pre Requisites: Engineering Physics, Thermodynamics.

Course Educational Objective: The objective of this course is to make students familiar with nuclear physics, reactions and characteristics of different nuclear reactors.

Course Outcomes: After completion of the course students are the able to
CO1: Understand the basics of nuclear physics and its reactions.
CO2: Analyse the nuclear decay chains and its effect on environment.
CO3: Comprehend the working principles of nuclear detectors and accelerators.
CO4: Apply conservation laws to calculate energy released in nuclear reactions.
CO5: Describe the working of different nuclear reactors and its applications.

UNIT-I
BASIC CONCEPTS IN NUCLEAR PHYSICS
Nuclear constituents – charge, mass, shape, and size of nucleus, Binding energy, packing fraction, nuclear magnetic moment, saturation and short range nuclear forces, Radioactivity – Laws of radioactive decay, half life, mean life, specific activity, Nuclear models – single particle shell model, evidence and limitations of shell model, liquid drop model : Introduction, assumptions, semi-empirical mass formula

UNIT-II
MECHANISMS OF NUCLEAR DECAY
Law of radioactive decay, half life, mean life, specific activity, partial radioactive decay, successive disintegration, α decay: Barrier penetration, β decay: Fermi theory, selection rules, parity non-conservation, γ decay of excited states.

UNIT-III
NUCLEAR DETECTORS AND ACCELERATORS
Types of detectors, Geiger-Mueller counter, Scintillation counter, classification of accelerators, Cyclotron, Betatron.

UNIT-IV
INTRODUCTION TO NUCLEAR ENGINEERING
Theories of Nuclear reactions, Conservation laws, Q-value equation, Nuclear fission, explanation on the basis of liquid drop model, energy available from fission, Nuclear chain reaction, Nuclear fusion.

UNIT-V
NUCLEAR REACTORS & APPLICATIONS
Nuclear Reactor – Basic principle, classification, constituent parts, Heterogeneous reactor, Swimming pool reactor, Breeder reactor, Heavy water cooled and moderated CANDU type reactors, Gas cooled reactors Conservation equation and their applications to nuclear power systems - Nuclear reactor materials and applications-Nuclear imaging- Nuclear waste management.

TEXT BOOK
1. Irving Kaplan, "Nuclear Physics", Narosa Book Distributors, 2002.
2. D.C.Tayal, Nuclear Physics, Himalayan Publication house, Bombay, 1980.

REFERENCES

1. Kopelman, Materials for nuclear reactors, McGraw Hill, 1970.
2. R.D. Evans, "*The atomc Nucleus", McGraw-Hill,1955.*
3. J.H.Horlock ,"Combined Power Plants" ,Pergamon Press, 1992.
4. G.F. Knoll, Radiation detection and measurement, John Wiley &Sons, 3ed, London, 2000.
5. RE. Fand J.K.Shultis, Radiological Assessment, Prentice Hall, 1993.
6. J.J. Duderstadt and L.J. Hamilton, Nuclear Reactor Analysis, John Wiley, 1976.

B.Tech. (VIII Sem.) **17ME42 - FRACTURE MECHANICS**

L	T	P	Cr.
3	-	-	3

PRE-REQUISITES: Mechanics of Materials, Machine Design

COURSE EDUCATIONAL OBJECTIVE: The main objective of this course is to familiarize with the basic concepts of Engineering fracture mechanics.

COURSE OUTCOMES: At the end of the course, the student will be able to
CO1: Identify the different modes of cracks and stress functions for various applications.
CO2: Formulate the expressions for energy release rate during crack propagation
CO3: Develop displacement field equations for various cracks.
CO4: Apply the concept of J-Integral for solving engineering problems.
CO5: Estimate the crack propagation using different tests.

UNIT - I
INTRODUCTION: Historical review-Source of micro and macro cracks-an atomic view of fracture stress concentration flaws-Ductile and Brittle fracture-Modes of cracks.
The Airy stress function-Complex stress function- Solution to crack problems. Effect of finite size-Special cases-Elliptical cracks-Numerical problems.

UNIT – II
ENERGYRATE - Griffith's Analysis -Energy Release Rate - Definition -Mathematical Formulation - Change in Compliance Approach - Change in the Strain Energy Approach- Energy Release Rate of DCB Specimen.

UNIT - III
STRESS INTENSITY FACTOR: Introduction, Linear Elastic Fracture Mechanics (LEFM), stress and displacement fields in isotropic elastic materials, stress intensity factor.
Field Equations: Equilibrium Equations, Strain Displacement and Compatibility Relations, Stress-Strain Relations, Bi-harmonic Differential Equation,Elementary Properties of Complex Variables, Westerguard's approach-Mode I (Opening Mode).

UNIT – IV
J-INTEGRAL: Relevance and scope- Definition of the J-integral- Path Independence- stress-strain relation - A Simplified Relation for the J-Integral -Applications to Engineering Problems-Equivalence of G and J for Elastic Materials.

UNIT - V
CRACK TIP OPENING DISPLACEMENT: Introduction, relationship between CTOD, K_I and G_I for small scale yielding, equivalence between CTOD and J
TEST METHODS: Introduction, K_{IC}-Test technique, Various Test Specimens, Constraints on Specimen-Dimensions, Fatigue Crack Growth to Sharpen the Tip, ClipGauge, loaddisplacement test.

TEXT BOOKS
1. Prasanth kumar, ”Elements of Fracture Mechanics” McGraw Hill Education (India) Private Limited, Seventh reprint 2014.
2. Elementary Engineering Fracture Mechanics - David Brock, Noordhoff.

REFERENCES

1. Engineering fracture mechanics - S.A. Meguid Elsevier.
2. Fracture of Engineering Brittle Materials, Applied Science - Jayatilake, London.
3. Fracture and Fatigue Control in Structures - Rolfe and Barsom, Prentice Hall.
4. Introduction to fracture mechanics - Karen Hellan, McGraw Hill.
   Fundamentals of fracture mechanisms - Knott, ButterworthsFracture Mechanics-Fundamental and Application - Anderson, T.L CRC press1998.

B.Tech. (VIII Sem.)	17ME43 - ESTIMATION, COSTING AND ENGINEERING ECONOMICS	L	T	P	Cr.
		3	-	-	3

PRE-REQUISITES : Production Technology, Industrial Management

COURSE EDUCATIONAL OBJECTIVE: The objective of this course is to inculcate the base knowledge of students related to concepts of economics and accounting to make them effective business decision makers and to understand fundamentals of economics, which is an important social science subject helps to engineers to take certain business decisions in the process of optimum utilization of resources.

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

CO1 Understand the importance of estimation and costing in industries

CO2 Distinguish various costs associated with product manufacturing in industries.

CO3 Estimate the cost of basic manufacturing operations like sheet metal working, welding, forging and foundry

CO4 Apply the concepts of cost control in manufacturing industry.

CO5 Implement the concepts of depreciation and replacement models in engineering.

UNIT-I

INTRODUCTION TO ESTIMATING AND COSTING: Estimating: Definition, importance of estimating, aims, functions, organization of estimating department, qualities of estimator, constituents of estimation, profit. Costing- Definition, aims of costing, standard cost, advantage of standard cost. Difference between estimating and costing, procedure for costing, costing methods, Cost control- How to control costs, control on indirect materials and tools, advantages of efficient costing, pricing policy.

UNIT-II

ELEMENTS OF COSTS: Elements of costs- Material, labour costs, expenses, direct costs, Material costing-Introduction, cost of material, control over material costs, waste control, valuation of material issued from stores, indirect costs, factory expense, administrative expense, selling and distribution expenses. fixed and variable overheads, Components of cost- Selling price, allocation of on cost, percentage on prime cost, direct labour cost, Labour costing- Introduction, objectives of labor costing , wages and incentives, direct material cost, man hour rate, machine hour rate, combination of man hour and machine hour rate, unit rate method, examples of on costs. Value analysis, simplification, standardization, rationalization.

UNIT-III

ESTIMATION OF VARIOUS MANUFACTURING PROCESSES:

ESTIMATION IN SHEET METAL SHOP: Operations in sheet metal shop, blank layouts, estimation of time, capacity for power process.

ESTIMATION IN FORGING SHOP: Forging-Hand forging, machine forging, forging operations, estimation procedure and estimation of weight, losses and time.

ESTIMATION IN WELDING SHOP: Types of welding joints, estimation of welding cost, estimation of gas cutting cost, estimation of arc welding cost, factors effecting welding cost.

ESTIMATION IN PATTERN MAKING & FOUNDRY SHOPS: Estimation of pattern cost, estimation of foundry shop foundry cost.

UNIT-IV

COST ACCOUNTING, COST CONTROL AND COST REDUCTION:

Important terms, cost accounting, standard costing, procedure for costing, costing methods, techniques of cost control, cost reduction, cost saving areas, variance analysis.

UNIT-V

ELEMENTS OF ECONOMICS:

DEPRECIATION: Introduction, Computing depreciation charges, break-even analysis, Depreciation- Introduction, straight line method of depreciation, declining balance method of depreciation- sum of the years digits method of depreciation, sinking fund method of depreciation/ Annuity method of depreciation, service output method of depreciation.

REPLACEMENT MODELS: Replacement of items that deteriorate whose maintenance cost increases with time without change in the money value, Replacement of items that fail suddenly: Individual replacement policy, group replacement policy.

TEXT BOOK

Banga, Sharma, "Estimation and costing", 16th edition, Khanna Publishers, 2013

REFERENCES

1. B P Sinha, Mechanical Estimation and costing-THM Publishing Co Ltd.
2. Panneer Selvam. R, "Engineering Economics", Prentice Hall of India Ltd, 2001
3. Truett & Truett, "Managerial economics- Analysis, problems & cases" 8th edition Wiley India, 2004
4. P.Sankara Iyer, "Operations Research", 1st edition, Tata McGraw-hill,2008

B.Tech. (VIII Sem.)	17ME44 - PLANT LAYOUT AND MATERIAL HANDLING	L	T	P	Cr.
		3	-	-	3

Prerequisite Subject: Production Technology, Industrial Management

Course Educational Objectives: The main objective of this course is to provide comprehensive understanding of the issues involved in the design of an industrial production system. It will cover the problems in plant location, product analysis, process design, equipment selection, materials handling, and plant layout.

Course outcomes: After completion of the course students are able to:
CO1: Understand the layout designs for different industries.
CO2: Apply various techniques and tools for layout planning.
CO3: Adopt the advanced technologies in manufacturing operations.
CO4: Suggest suitable material handling equipment for industrial applications.
CO5: Analyze the different material storage equipment.

UNIT – I
Introduction:
Classification of layout, Advantages and limitations of different layouts, Layout design considerations, overview of layouts.
Process layout & product layout:
Selection, specification, implementation and follow up, comparison of process layout and product layout.

UNIT – II
Layout construction techniques: Systematic layout planning; activity relationship analysis, pair wise exchange, graph-based construction algorithmic.
Computerized Layout and Analytical Methods: ALDEP, CORELAP, CRAFT, BLOCPLAN, etc. Warehouse operations: function, storage operations.

UNIT – III
Manufacturing operation: JIT, TQM, AM, CIM, SCM, Facility systems,
Material Handling: Introduction, material handling systems, material handling principles; Classification of material handling equipment, relationship of material handling system to plant layout.

UNIT – IV
Material transportation equipment: Industrial trucks, Conveyors, cranes, hoists, Automated Guided Vehicles, Rail Guided Vehicles and Selfguided vehicles, Analysis of transportation equipment.

UNIT – V
Material storage equipment: Storage strategies, Manual storage equipment, automated storage and retrieval systems, Classification of AS/RS, Analysis of AS/RS.
Identification equipment: Bar codes, RFID, etc.

TEXT BOOKS

1. Plant Layout and Material Handling, by- James M. Apple, John Wiley & Sons, 3rd edition /1978.
2. Plant Layout and Material Handling, by- B. K. Aggarwal, Jain Brothers, 2013.

REFERENCES

1. Plant Layout and Material Handling, by- Fred E. Meyers, Prentice Hall, 1993.
2. Materials Handling Handbook, by- Raymond A. Kulwiec, John Wiley & Sons, 2nd edition/2008.

B.Tech. (VIII Sem.) **17PD11 - PROJECT WORK**

L	T	P	Cr.
-	-	24	12

PRE-REQUISITES: Knowledge gained in all the theory and practical courses, as well as the knowledge gained in industrial training, internship and executing the mini project.

COURSE EDUCATIONAL OBJECTIVE: The main objective of this course is to make the student plan and execute a project as a team using the available recourses within and outside the institute.

COURSE OUTCOMES: After completion of the course students are the able to:

CO1: Implement the concepts of mechanical engineering.

CO2: Formulate and solve theoretical or practical engineering problems.

CO3: Analyze the concepts by practical observation.

CO4: Implement the knowledge in the report writing skills.

CO5: Manage and plan the work as a team

B.Tech. (VIII Sem.) **17PD12 - COMPREHENSIVE VIVA-VOCE**

L	T	P	Cr.
-	-	2	1

PRE-REQUISITES: Basic knowledge in the courses studied in all semesters.

COURSE EDUCATIONAL OBJECTIVE: To make the students assess the quantum of knowledge acquired by a student in the core courses of mechanical engineering and to evaluate their competence for employment/higher learning/research.

COURSE OUTCOMES: After completion of the course students are the able to:

CO1: Understand the concepts of mechanical engineering.
CO2: Analyze the practical industry oriented problems.
CO3: Solve the complex problems in engineering.
CO4: Communicate effectivelywith the panel members.