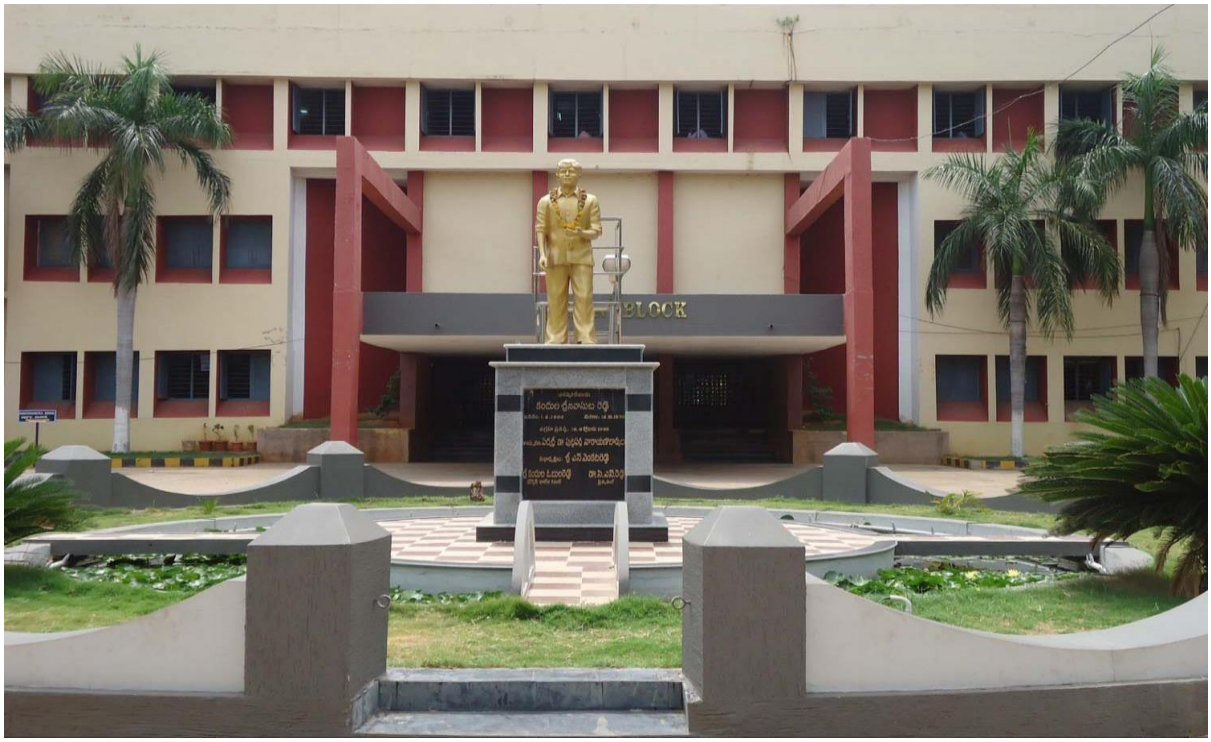
UG Programs in Engineering (R20UG)
Curriculum and Syllabus for
I - VIII SEM B.Tech
Department of Mechanical Engineering



Kandula Srinivasa Reddy Memorial College of Engineering (Autonomous)
Kadapa 516003 AP

(Approved by AICTE, Affiliated to JNTUA, Ananthapuramu, Accredited by NAAC)(An ISO 9001-2008 Certified Institution)

KSRM COLLEGE OF ENGINEERING (AUTONOMOUS)

VISION & MISSION

VISION:

KSRMCE seeks to be recognized as one of the best engineering colleges in India in providing high standards of academics with most productive, creative learning environment by including research, innovation thoughts and producing graduates with human values & leadership qualities to serve nation.

MISSION:

M1: To provide high quality education in Engineering & Technology in order to bring out knowledgeable engineers.
M2: To creative environment a collaborative environment with stakeholders to take up need-based research and industry specific programs.
M3: To organize co-curricular and extracurricular activities for character and personality development to produce highly competent and motivated engineers and professionals to serve and lead the society.

DEPARTMENT OF MECHANICAL ENGINEERING

VISION & MISSION

VISION:

To evolve as a department of high repute in Mechanical Engineering and allied fields through effective teaching, learning process and research activities, operating with a sense of professional and social responsibility.

MISSION:

M1: To produce Mechanical Engineers with sound knowledge through quality teaching-learning process and well-designed curriculum.

M2: To induce critical thinking attitude and inculcate the use of modern tools through inter-disciplinary research and develop entrepreneurial skills through industry-institute interaction.

M3: To provide opportunities/platforms for students to nurture leadership abilities and ethical values.

PROGRAMME OUTCOMES

PEO1: To apply engineering principles to develop products, processes or knowledge to solve mechanical and associated engineering problems for successful career in mechanical engineering and allied fields.

PEO2: To pursue higher education, research and development and engage in the process of life-long learning.

PEO3: To demonstrate leadership qualities, professional ethics, and communication skills and adapt current technologies to meet the societal requirements.

PROGRAM EDUCATIONAL OBJECTIVES

PROGRAMME OUTCOMES

Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12 **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES

PSO 1: To apply their knowledge in the domain of engineering mechanics, thermal andfluid sciences to solve engineering problems utilizing advanced technology.

PSO 2: To successfully apply the principles of design, analysis and implementation of mechanical systems/processes which have been learned as a part of the curriculum?

PSO 3: To Develop and implement new ideas on product design and development with thehelp of modern CAD/CAM tools, while ensuring best manufacturing practices.

Annexure -1 Curriculum

For B.Tech (Mechanical Engineering), R20

SEMESTER - I								
Subject Code	**Subject Category**	**Course Name**	**L**	**T**	**P**	**IM**	**EM**	**CR**
2021101	BSC	Linear Algebra and Calculus	3	0	0	40	60	3
20EC102	BSC	Engineering Chemistry	3	0	0	40	60	3
2005103	ESC	C-Programming & Data Structures	3	0	0	40	60	3
2014104	ESC	Basic Electrical & Electronics Engineering	3	0	0	40	60	3
20EW105	LC	Engineering Workshop	0	0	3	40	60	1.5
2005106	LS	IT Workshop	0	0	3	40	60	1.5
20EC107	BSC	Engineering Chemistry Lab	0	0	3	40	60	1.5
2005108	ESC	C-Programming & Data Structures Lab	0	0	3	40	60	1.5
2014109	ESC	Basic Electrical & Electronics Engineering Lab	0	0	3	40	60	1.5
		Total						**19.5**

SEMESTER - II								
Subject Code	**Subject Category**	**Course Name**	**L**	**T**	**P**	**IM**	**EM**	**CR**
2021201	BSC	Differential Equations and Vector Calculus	3	0	0	40	60	3
20EP202	BSC	Engineering Physics	3	0	0	40	60	3
2024203	HSMC	Communicative English	3	0	0	40	60	3
2003204	ESC	Material Science	3	0	0	40	60	3
2003205	ESC	Engineering Drawing	1	0	2	40	60	2
2003206	ESC	Engineering Drawing Lab	0	0	2	40	60	1
20EP207	BSC	Engineering Physics Lab	0	0	3	40	60	1.5
2024208	HSMC	Communicative English Lab	0	0	3	40	60	1.5
2003209	ESC	Material Science Lab	0	0	3	40	60	1.5
20MC210	MC	Environmental Science	3	0	0	40	0	0
		Total						**19.5**

SEMESTER -III								
Subject Code	**Subject Category**	**Course Name**	**L**	**T**	**P**	**IM**	**EM**	**CR**
2003301	ESC	Fundamentals of Statics and Dynamics.	3	0	0	40	60	3
2003302	ESC	Fluid Mechanics &Hydraulic Machinery	3	0	0	40	60	3
2003303	PCC	Manufacturing processes	3	0	0	40	60	3
2003304	PCC	Engineering Thermodynamics	3	0	0	40	60	3
2003305	ESC	Mechanics of Materials	3	0	0	40	60	3
2003306	ESC	Fluid Mechanics &Hydraulic Machinery Lab	0	0	3	40	60	1.5
2003307	PCC	Manufacturing Technology Lab	0	0	3	40	60	1.5
2003308	ESC	Mechanics of Materials Lab	0	0	3	40	60	1.5
2003309	SC	Skill Oriented Course – ICATIA	1	0	2	40	60	2
	Total							**21.5**

	SEMESTER -IV							
Subject Code	**Subject Category**	**Course Name**	**L**	**T**	**P**	**IM**	**EM**	**CR**
2025401	HSS	Humanities Elective- I (Business Economics and Accounting for Engineers)	3	0	0	40	60	3
2021402	BSC	Probability Statistics and Numerical Methods	3	0	0	40	60	3
2003403	PCC	Applied Thermodynamics	3	0	0	40	60	3
2003404	PCC	Kinematics of Machinery	3	0	0	40	60	3
2003405	PCC	Machine tools	3	0	0	40	60	3
2003406	PCC	Applied Thermodynamics lab	0	0	3	40	60	1.5
2003407	PCC	Manufacturing Technology Lab-II	0	0	3	40	60	1.5
2003408	PCC	Computer Aided Machine Drawing.	0	0	3	40	60	1.5
2003409	SOC	Skill Oriented Course – IICNC Programming and simulation.	1	0	2	40	60	2
2024410	HSMC	Universal Human Values	3	0	0	40	60	3
	Total					**360**	**540**	**24.5**

B. Tech. - V Semester

Subject Code	Subject Category	Course Name	Hours / Week			IM	EM	CR
			L	T	P			
2003501	PCC	Heat Transfer	3	0	0	40	60	3
2003502	PCC	Design of Machine Members	3	0	0	40	60	3
2003503	PCC	Metrology and Measurements	3	0	0	40	60	3
	PEC-I	**Professional Elective - I**						
2003504		Alternative Fuels and Emission Control in Auto motives	3	0	0	40	60	3
2003505		Automation & Robotics	3	0	0	40	60	
2003506		Tool Design	3	0	0	40	60	
2003507		Power Plant Engineering	3	0	0	40	60	
2003508		Non Destructive Testing (NDT)	3	0	0	40	60	
	OEC-I	**Open Elective – I**						
20OE301		Introduction to Hybrid and Electric Vehicles	3	0	0	40	60	3
20OE302		Rapid Prototyping	3	0	0	40	60	
20OE303		Design for Manufacturing and Assembly	3	0	0	40	60	
20OE304		Energy systems engineering	3	0	0	40	60	
20OE305		Smart Materials	3	0	0	40	60	
2003514	PCC	Metrology and Measurements Laboratory	0	0	3	40	60	1.5
2003515	PCC	Heat Transfer Laboratory	0	0	3	40	60	1.5
2003516	SC	Data Science For Beginners	1	0	2	40	60	2
20MC509	MC	CONSTITUTION OF INDIA	2	0	0	40		
2003517	PROJ	Socially Relevant Project	0	0	0	100	00	1.5
Total			**18**	**00**	**08**	**460**	**480**	**21.5**

B. Tech. - VI Semester

Course Code	Category	Course title	Hours / Week			IM	EM	CR
			L	T	P			
2003601	PCC	Operations Research	3	0	0	40	60	3
2003602	PCC	Finite Element Methods (FEM)	3	0	0	40	60	3
2003603	PCC	Introduction to CADCAM	3	0	0	40	60	3
	PEC-II	**Professional Elective – II (MOOCs)**						
2003604		Dynamics of machinery	3	0	0	40	60	3
2003605		Solar and Wind Energy Systems	3	0	0	40	60	
2003606		Computational Fluid Dynamics (CFD)	3	0	0	40	60	
2003607		Six Sigma and Lean manufacturing	3	0	0	40	60	
2003608		Energy Auditing	3	0	0	40	60	
	OEC-II	**Open Elective – II**						
20OE306		Automotive Electronics, Sensors & Drives	3	0	0	40	60	3
20OE307		Robotics and Applications in Manufacturing	3	0	0	40	60	
20OE308		Sensors in Intelligent Manufacturing	3	0	0	40	60	
20OE309		Non-Conventional sources of energy	3	0	0	40	60	
20OE310		Supply Chain Management	3	0	0	40	60	
2003609	PCC	Computer Aided Machining Laboratory	3	0	0	40	00	1.5
2003610	PCC	Computer Aided Drafting Laboratory	0	0	3	40	60	1.5
2003611	PCC	SOLID WORKS	0	0	3	40	60	1.5
20246S4	SC	Soft skills lab (Skill Oriented Course)	1	0	2	40	60	2
20MC612	MC	Management Organization Behavior	2	0	0	40		
Total			**18**	**00**	**11**	**400**	**540**	**21.5**

B. Tech. – VII&VIII Semester (R20UG)

S.NO	Course Code	Category	Course title	Hours / Week			IM	EM	CR
				L	T	P			
			Professional Elective course -III						
1	2003701	PEC	Modern manufacturing methods	3	0	0	40	60	3
	2003702	PEC	Design for manufacturing	3	0	0	40	60	3
	2003703	PEC	Solar and wind energy systems	3	0	0	40	60	3
	2003704	PEC	Mechanical behavior of material's	3	0	0	40	60	3
	2003705	PEC	Total quality management	3	0	0	40	60	3
2	2003706	PEC	**Professional Elective course -IV**						
			1.Automobile engineering	3	0	0	40	60	3
	2003707	PEC	2.Additive manufacturing	3	0	0	40	60	3
	2003708	PEC	3.Mechanical vibrations	3	0	0	40	60	3
	2003709	PEC	4.Matearial characterization	3	0	0	40	60	3
	2003710	PEC	5.Production and operations management	3	0	0	40	60	3
3	2003711	PEC	**Professional Elective course - V**						
			1.Vehicle diagnosis and control	3	0	0	40	60	3
	2003712	PEC	2.Mechatronics&MEMS	3	0	0	40	60	3
	2003713	PEC	3.Design of oil Hydraulics and pneumatics	3	0	0	40	60	3
	2003714	PEC	4.Refrigeration&air conditioning	3	0	0	40	60	3
	2003715	PEC	5.Geometric dimension and tolerances	3	0	0	40	60	3
4			**Open elective course- III**						
	20OE311	OEC	Entrepreneurship	3	0	0	40	60	3
	20OE312	OEC	Solar Energy Systems	3	0	0	40	60	3
	20OE313	OEC	Internal combustion engine	3	0	0	40	60	3
5			**Open elective course- IV**						
	20OE314	OEC	Energy Auditing	3	0	0	40	60	3
	20OE315	OEC	Sustainable engineering	3	0	0	40	60	3
	20OE316	OEC	**Industrial engineering & management**	3	0	0	40	60	3
			Humanities Elective course						
	2006701	HSS	Human resources and development	3	0	0	40	60	3
	2006702	HSS	Digital marketing	3	0	0	40	60	3
	2006703	HSS	Project management	3	0	0	40	60	3
7	2003716	PROJ	Internship	0	0	0	100	--	3
8	20246SC	SC	**Skill course –V** Advanced English communication skills	1	0	2	40	60	2
			Total				**380**	**420**	**23**

	B.Tech. VIII SEM (R20UG)								Credits
S.NO	COURSE CODE	**Category**	**COURSE NAME**	Hours per week			**IM**	**EM**	
				L	T	P	**40**	**60**	**12**
1	2003801	PROJ	Full internship/project work	0	0	0	40	60	
			Total				**40**	**60**	**12**

B.TECH I SEM (R20) UG

Course Title	LINEAR ALGEBRA & CALCULUS				B.Tech ME I Sem (R20)		
Course Code	Category	Hours/Week		Credits	Maximum Marks		
2021101	BS	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 90 Minutes					End Exam Duration: 3Hrs		

Course Objectives:

- This course will illuminate the students in the concepts of calculus and linear algebra.
- To equip the students with standard concepts and tools at an intermediate to advanced level mathematics to develop the confidence and ability among the students to handle various real world problems and their applications

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Develop the use of matrix algebra techniques that is needed by engineers for practical applications
CO 2	Utilize mean value theorems to real life problems
CO 3	Classify the functions of several variables which is useful in optimization techniques.
CO 4	Evaluate multiple integrals.
CO 5	Define Beta and Gamma functions.

Bridge Course: Limits, continuity, Types of matrices

UNIT -I

Rank of a matrix by Echelon form, Normal form. Solving system of homogeneous and non-homogeneous linear equations. Eigen values and Eigen vectors for real matrices – Cayley-Hamilton theorem (without proof), finding inverse and power of a matrix by Cayley–Hamilton theorem. Diagonalization by orthogonal transformation.

UNIT -II

Mean Value Theorems: (08 Hours)
Rolle's theorem, Lagrange's mean value theorem, Cauchy's mean value theorem, Taylor's and Maclaurin's theorems with remainders (without proof), related problems.

UNIT -III

Multivariable Calculus: (10 Hours)
Partial derivatives, total derivative, chain rule, change of variables, Jacobians, Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers.

UNIT -IV

Multiple Integrals: **(10 Hours)**
Evaluation of double integrals in Cartesian coordinates and polar coordinates – Change of variables in double integrals – Change the order of integration in double integrals – Evaluation of triple integrals in Cartesian and polar coordinates – Change of variables between Cartesian, cylindrical and spherical polar coordinates.

UNIT -V

Beta and Gamma functions: **(08 Hours)**
Beta and Gamma functions and their properties, relation between Beta and Gamma functions,evaluation of definite integrals using Beta and Gamma functions.

Text Books:

1. Higher Engineering Mathematics, Dr. B.S. Grewal, Khanna Publishers-43 edition 2014.
2. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Publications, 9th edition- 2013.
3. Introductory Linear Algebra with applications, Kolman, Bernard Hill, David R
4. Linear Algebra, Hoffman Kennethkunze Ray

Reference Books:

1. Higher Engineering Mathematics, B.V. Ramana, Mc. Graw Hill Education (India) Pvt. Ltd, NewDelhi, 11th Edition, Reprint 2010.
2. Linear Algebra: A Modern Introduction, D Poole, 2nd Edition, Brooks/Cole, 2005.
3. A Text Book of Engineering Mathematics, N.P. Bali and Manish Goyal, Lakshmi Publications,Reprint 2008
4. Linear Algebra and its applications, Gilbert Strang.

Course Title	ENGINEERING CHEMISTRY				B.Tech ME I Sem (R20)		
Course Code	Category	Hours/Week		Credits	Maximum Marks		
20EC102	BS	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 90 Minutes					End Exam Duration: 3Hrs		

Course Objectives:

- To familiarize engineering chemistry and its applications
- To train the students on the principles and applications of electrochemistry and polymers.
- To introduce instrumental methods, molecular machines and switches

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Understand the basic quantum approach of Molecular orbital theory and calculation of bond order
CO 2	Remember the principle of Band diagrams in application of conductors and semiconductors.
CO 3	Compare the materials of construction for battery and electrochemical sensors.
CO 4	Explain the preparation, properties, and applications of thermoplastics & thermosetting, Elastomers & con ducting polymers
CO 5	Analyze the principles of spectroscopy and different application of analytical instruments.

UNIT I

Water Technology (10 hrs)

Introduction –Soft Water and hardness of water, hardness of water by EDTA Method, Estimation of dissolved oxygen (Winkler's method)-Boiler troubles – Priming, foaming, scale and sludge, Caustic embrittlement, Industrial water treatment – specifications for drinking water, Bureau of Indian Standards (BIS) and World health organization (WHO) standards, ion- exchange processes - desalination of brackish water, reverse osmosis (RO) and electro dialysis.

Learning outcomes:

The student will be able to

- List the differences between temporary and permanent hardness ofwater
- (L1)Explain the principles of reverse osmosis and electrodialysis. (L2)
- Compare quality of drinking water with BIS and WHO standards. (L2)
- Illustrate problems associated with hard water - scale and sludge. (L2)
- Explain the working principles of different Industrial watertreatment processes(L2)

UNIT II

Electrochemistry and Applications: (10 hrs)

Introduction to electrodes – concepts, electrochemical cell, Nernst equation, cell potential calculations.

Primary cells – Zinc-air battery, Secondary cells – Nickel-Cadmium (NiCad),and lithium ion batteries- working of the batteries including cell reactions; Fuel cells, hydrogen-oxygen, methanol fuel cells – working of the cells.

Corrosion: Introduction to corrosion, electrochemical theory of corrosion, differential aeration cell corrosion, galvanic corrosion, metal oxide formation by dry electrochemical corrosion, Pilling Bed worth ratios and uses, Factors affecting the corrosion,Cathodic and anodic protection, electroplating and electro less plating (Nickel and Copper).

Learning Outcomes:

At the end of this unit, the students will be able to

- Apply Nernst equation for calculating electrode and cell potentials
- (L3) Apply Pilling Bedworth rule for corrosion and corrosion
- prevention (L3)
- Demonstrate the corrosion prevention methods and factorsaffecting corrosion (L2)Compare different batteries and their applications (L2)

UNIT III:

Polymers and Fuel Chemistry: **(8 hrs)**

Introduction to polymers, Polymer dispersion index, functionality of monomers, Mechanism of chaingrowth, step growth and coordination polymerization.

Thermoplastics and Thermo-setting plastics-: Preparation, properties andapplications of poly styrene. PVC and Bakelite

Elastomers – Preparation, properties and applications of Buna S, Buna N, Thiokol Fuels – Typesof fuels, calorific value, numerical problems based on calorific value; Analysis of coal, **Liquid Fuels** refining of petroleum, fuels for IC engines, knocking and anti-knock agents, Octane and Cetane values, cracking of oils; alternative fuels- propane, methanol and ethanol, bio-fuels.

Learning Outcomes:

At the end of this unit, the students will be able to

- Explain different types of polymers and their applications
- (L2)Solve the numerical problems based on Calorific
- value(L3) Select suitable fuels for IC engines (L3)
- Explain calorific values, octane number, refining of petroleum andcracking of oils (L2)

UNIT-IV

Advanced Engineering Materials (10 hrs)

Refractories- Classification, Properties, Factors affecting the refractory materials andApplications.

Lubricants- Classification, Functions of lubricants, Mechanism, Properties of lubricating oils –Viscosity, Viscosity Index, Flash point, Fire point, Cloud point.

Building materials- Portland cement, constituents, phases and reactivity of clinker, Setting andHardening of cement.

Learning Outcomes:

At the end of this unit, the students will be able to

- Identify the factors affecting the
- refractorymaterial(L3)Illustrate the functions and
- properties of lubricants(L2)
- Demonstrate the phases and reactivity of concrete formation
- (L2)Identify the constituents of Portland cement (L3)
  Enumerate the reactions at setting and hardening of the cement (L3)

UNIT V:

Surface Chemistry and Applications: (10 hrs)

Introduction to surface chemistry, colloids, micelle formation, synthesis of colloids (Dispersion method), chemical and electrochemical method (chemical vapour deposition) of preparation of nanometals and metal oxides, stabilization of colloids and nanomaterials by stabilizing agents, applications of colloids and nanomaterials –medicine.

Learning Outcomes:

At the end of this unit, the students will be able to

- Summarize the concepts of colloids, micelle and nanomaterials
- (L2)Explain the synthesis of colloids with examples (L2)
- Outline the preparation of nanomaterials and metal oxides (L2)
- Identifythe application of colloids and nanomaterials in medicine.(L2)

Text Books:

1. A textbook of Engineering chemistry by Shashi Chawla, Dhanpat Rai & Co publications
2. Atkins' Physical Chemistry, Peter Atkins, Julio de Paula and James Keeler, OxfordUniversity Press, 2010.
3. Textbook of Polymer Science, Third Edition, Fred W. Billi Meyer, TR, A Wiley-Inter SciencePublications
4. An Introduction to Electrochemistry, Glasstone, Arihant Publications.

Reference Books:

1. Textbook of Engineering Chemistry, Jain and Jain, Dhanpat Rai & Co publications, 2013
2. New Concise Inorganic Chemistry, 5th Edition, J. D. Lee, Oxford University Press, 2008.
3. Principles of Instrumental Analysis, 6th edition, Douglas A. Skoog, Cengage Publications.
4. Advanced Inorganic Chemistry, Cotton F Albert, Wilkinson Geoffrey, Prism Publications

Course Title	C PROGRAMMING & DATA STRCUTURES				B.Tech I Sem (CSE, EEE, ME)(R20) B.Tech II Sem (CE, ECE)			
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
2005103 (I Sem) 2005203 (II Sem)	**ES**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	0	0	3	40	60	100
Mid Exam Duration: 90 Minutes					**End Exam Duration: 3Hrs**			

Course Objectives:

- The course aims to provide exposure to problem-solving through programming
- It aims to train the student to the basic concepts of the C programming language
- Gain knowledge of data structures and their applications

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Formulate simple algorithms for arithmetic and logical problems and to translate algorithms to programs (in C Language).
CO 2	Choose the loops and decision-making statements to solve the problem
CO 3	Implement different Operations on arrays
CO 4	Use functions to solve the given problem
CO 5	Understand structures, unions and pointers
CO 6	Understand need of data structures in real time situations

UNIT I:

Introduction to C programming: - C language elements, variable declarations and data types, operators and expressions, decision statements - If and switch statements, loop control statements
- while, for, do-while statements. **Jumping statements:** break, continue and goto statements

UNIT II:

Arrays: Introduction, Declaration and initialization of 1D and 2D arrays, **Functions:** types of functions, Recursion and argument passing, pointers, storage allocation, pointers to functions, expressions involving pointers, Storage classes – auto, register, static, extern. **Strings:** string handling functions, and Command line arguments.

UNIT III:

Pointers: Introduction to pointers, declaring and initialization of pointer variable, accessing the address of variables, accessing a variable through its pointer, chain of pointers. **Structures and unions:** Introduction, defining a structure, declaring structure variable, structure initialization, accessing members of structure, copying and comparing structure variables, structures within structures, array of structures, and introduction of union.

UNIT IV:

Data Structures: Overview of data structures, stacks and queues, representation of a stack, stack related terms, operations on a stack, implementation of a stack, evaluation of arithmetic expressions, infix, prefix, and postfix notations, evaluation of postfix expression, conversion of expression from infix to postfix, recursion, queues - various positions of queue, representation of queue, insertion, deletion, searching operations.

Searching and sorting: linear search, binary search, bubble (exchange) sort, selection sort, insertion sort.

UNIT V:

Linked Lists – Single linked list, Operations on Single Linked List: insertion, deletion and searching operations, doubly linked lists and its operations, circular linked lists and its operations.

Trees - Tree terminology, representation, Binary trees, representation, binary tree traversals. Binary tree operations.

Text Books:

1. Fundamentals of Data Structures in C, Ellis Horowitz, SartajSahni, SusanAnderson-Freed, Computer Science Press.
2. Programming in C and Data Structures, J.R.Hanly, Ashok N. Kamthane and A. Ananda Rao, Pearson Education
3. Rema The raja, Programming in C, second edition, Oxford.
4. E. Bal guru swamy, C Programming and Data structures, fourth Edition,McGraw-Hill.

Reference Books:

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language,Prentice Hall of India
2. R.G. Dromey, How to solve it by Computer,Pearson.
3. YashavantKanetkar, Let us C, 15th edition, BPBPublications.
4. Dr. P. ChennaReddy, Computer Fundamentals and C Programming,SecondEdition.

Course Title	BASIC ELECTRICAL & ELECTRONICSENGINEERING Part 'A': Basic Electrical Engineering Part 'B': Electronics Engineering				B.Tech ME I Sem (R20)			
Course Code	Category	Hours/Week			Credits	Maximum Marks		
2014104	ES	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 90 Minutes					End Exam Duration: 3Hrs			

Course Objectives:

The objective of the course is to learn basics of DC and AC circuits, Electrical Machines, Transformers and Power Systems. Theory, construction, and operation of electronic devices, biasing of BJTs and FETs, design and construction of amplifiers, concepts & principles of logic devices.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Understand the basic fundamentals of DC & AC circuits, network reduction techniq machines and power system fundamentals
CO 2	Understand theory, construction, and operation of electronic devices, working ofdiodes and its applications, working of transistors, microcontrollers & their applications.
CO 3	Determine the currents, voltages using mesh and nodal analysis, Average and RMS values for different waveforms, equivalent circuit parameters using OC & SC test of single phase transformer.
CO 4	Obtain the EMF equation and characteristics of dc machines and Induction motor.
CO 5	Analyze small signal amplifier circuits to find the amplifier parameters
CO 6	Design small signal amplifiers using proper biasing circuits to fix up proper Q point

Part A: Basic Electrical Engineering

UNIT-I

DC Circuits: Electrical circuit elements (R - L and C) - Kirchhoff laws - Series and parallel connection of resistances with DC excitation. Superposition Theorem. Simple Numerical Problems.

AC Circuits: Representation of sinusoidal waveforms – Average and RMS values - phasor representation - real power - reactive power - apparent power - power factor - Analysis of single- phase ac circuits consisting of RL - RC - RLC series circuits, simple numerical problems.

UNIT-II

DC Machines: Principle and operation of DC Generator - EMF equations - OCCcharacteristics ofDC generator – principle and operation of DC Motor – Torque equation – Performance Characteristics of DC Motor, speed control (Flux & Armature control of shuntmotor), Simple numerical problems.

Transformers: Principle and operation of Single Phase Transformer – Emf equation, equivalentcircuit, OC and SC tests on transformer, simple numerical problems.

Induction Motor: Principle and operation of 3-phase Induction Motor [Elementary treatmentonly].

UNIT-III

Basics of Power Systems: Typical AC power supply scheme – Generation of 3-phase supply, Definition of short, medium and long transmission lines – Concepts of AC & DC distribution system.

Text Books:

1. V.K. Mehta & Rohit Mehta, "Principles of Power System" – S.Chand – 2018.
2. V.D.TORO "Electrical Engineering Fundamentals".prentice hall India,1989
3. D. P. Kothari and I. J. Nagrath - "Basic Electrical Engineering" - Tata McGraw Hill -2010.
4. D.C. Kulashreshtha."Basic Electrical Engineering ',M C Graw hill,2009

Reference Books:

1. L.S.Bobrow ,"Fundamentals of electrical Engineering"..
2. E. Hughes - "Electrical and Electronics Technology" - Pearson - 2010.
3. C.L. Wadhwa – "Generation Distribution and Utilization of Electrical Energy", 3rd Edition,New Age International Publications
4. Fundamentals of Electrical Circuits Charles K. Alexander and Matthew ,N.O Sadiku ,MC Grawhill,5thEdition ,2013

Part 'B'- Electronics Engineering

UNIT-I

Diodes and Applications: Semiconductor Diode, Diode as a Switch& Rectifier, Half Wave and Full Wave Rectifiers with and without Filters; Operation and Applications of Zener Diode, LED,Photo Diode.

Transistor Characteristics: Bipolar Junction Transistor (BJT) – Construction, Operation, Amplifying Action, Common Base, Common Emitter and Common Collector Configurations, Operating Point, Biasing of Transistor Configuration; Field Effect Transistor (FET) – Construction, Characteristics of Junction FET, Concepts of Small Signal Amplifiers –CE & CC Amplifiers.

UNIT-II

Operational Amplifiers and Applications: Introduction to Op-Amp, Differential Amplifier Configurations, CMRR, PSRR, Slew Rate; Block Diagram, Pin Configuration of 741 Op-Amp, Characteristics of Ideal Op-Amp, Concept of Virtual Ground; Op-Amp Applications - Inverting, Non-Inverting, Summing and Difference Amplifiers, Voltage Follower, Comparator, Differentiator, Integrator.

UNIT-III

Digital Electronics: Logic Gates, Simple combinational circuits–Half and Full Adders, BCD Adder. Latches and Flip-Flops (S-R, JK and D), Shift Registers and Counters. Introduction to Microcontrollers and their applications (Block diagram approach only).

Text Books:

1. R.L.Boylestad& Louis Nashlesky, Electronic Devices &Circuit Theory, PearsonEducation,2007.
2. Principles of Electronics, V.K. Mehta, Rohit Mehta, S Chand.
3. Operational Amplifiers with Linear Integrated Circuits, William D. Stanley, 4th Edition,Pearson.
4. R. P. Jain, Modern Digital Electronics,3rd Edition, Tata Mcgraw Hill,2003.

Reference Books:

1. Santiram Kal, Basic Electronics- Devices, Circuits and IT Fundamentals, PrenticeHall,India, 2002.
2. R. S. Sedha, A Text Book of Electronic Devices and Circuits, S.Chand& Co, 2010.
3. Ramakanth A. Gayakwad, Op-Amps & Linear ICs, 4thEdition, Pearson, 2017.
4. Raj Kamal, Microcontrollers: Architecture, Programming, Interfacing and SystemDesign,2nd Edition, Pearson, 2012.

Course Title	ENGINEERING WORKSHOP				B.Tech ME I Sem (R20)			
Course Code	Category	Hours/Week			Credits	Maximum Marks		
20EW105	ES	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		0	0	3	1.5	40	60	100
					End Exam Duration: 3Hrs			

Course Objectives:

- Sheet metal operations,
- Fitting
- Electrical house wiring skills
- Wood working

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Apply wood working skills in real world applications
CO 2	Build different objects with metal sheets in real world applications
CO 3	Apply fitting operations in various applications
CO 4	Apply different types of basic electric circuit connections
CO 5	Use soldering and brazing techniques

WOOD WORKING:

Familiarity with different types of woods and tools used in wood working and makefollowing joints

Half – Lapjoint

Mortise and

Tenonjoint

Corner Dovetail joint or Bridlejoint.

SHEET METAL WORKING:

Familiarity with different types of tools used in sheet metal working,
Developments offollowing sheet metal job from GI sheets

a)Taperedtray b) Conicalfunnel c)Elbowpipe d)Brazing

FITTING:

Familiarity with different types of tools used in fitting and do the following fittingexercises

a) V-fit b)Dovetailfit c) Semi-circularfit d) square fitting

ELECTRICAL WIRING:

Familiarities with different types of basic electrical circuits and make the followingconnections

a) Parallelandseriesb) Twowayswitch c)Godownlighting d) Tubelight

e) Threephasemotor f) Soldering ofwires

Note: In each section a minimum of three exercises are to be carried out.

Text Books:

1. Mechanical Workshop Practice, K.C. John, 2nd Edition, PHI.

2. Engineering Workshop, Lindsay White, Oxford University Press.

Reference Books:

1. Mechanical Experiments and Workshop Practice, G.S. Sawhney, IK International Pvt Ltd.

Course Title	IT WORKSHOP				B.Tech I Sem (CSE, ME) (R20) B.Tech II Sem (CE,EEE, ECE)			
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
2005106 (I Sem) 2005206 (II Sem)	**ES**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		0	0	3	1.5	40	60	100
					End Exam Duration: 3Hrs			

Course Objectives:

- To make the students know about the internal parts of a computer, assembling and dissembling a computer from the parts, preparing a computer for use by installing the operating system.
- To provide Technical training to the students on Productivity tools like Word processors, Spreadsheets, Presentations and Latex.
- To learn about Networking of computers and use Internet facility for Browsing and Searching

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Disassemble and Assemble a Personal Computer and prepare the computer ready use.
CO 2	Prepare the Documents using Word processors and Prepare spread sheets for Calculations .using excel and also the documents using Latex.
CO 3	Prepare Slide presentations using the presentation tool.
CO 4	Interconnect two or more computers for information sharing.
CO 5	Access the Internet and Browse it to obtain the required information.

Preparing your Computer

Task 1:

Learn about Computer: Identify the internal parts of a computer, and its peripherals. Represent the same in the form of diagrams including Block diagram of a computer. Write specifications for each part of a computer including peripherals and specification of Desktop computer. Submit it in the form of a report.

Task 2:

Assembling a Computer: Disassemble and assemble the PC back to working condition. Students should be able to trouble shoot the computer and identify working and non- working parts. Student should identify the problem correctly by various methods.

Task 3:

Install Operating system: Student should install Linux on the computer. Student may install another operating system (including proprietary software) and make the system dual boot or multi boot. Students should record the entire installation process.

Task 4:

Operating system features: Students should record the various features that are supported by the operating system(s) installed. They have to submit a report on it. Students should be able to access CD/DVD drives, write CD/DVDs, access pen drives, print files, etc. Students should install new application software and record the installation process.

Task 5:
Networking and Internet

Students should connect two computers directly using a cable or wireless connectivity and share information. Students should connect two or more computers using switch/hub and share information. Crimpling activity, logical configuration etc. should be done by the student. The entire process has to be documented.

Task 6:
Browsing Internet: Student should access the Internet for Browsing. Students should search the Internet for required information. Students should be able to create e-mail account and send email.
They should get acquaintance with applications like Facebook, Skype etc. If Intranet mailing facility is available in the organization, then students should share the information using it. If the operating system supports sending messages to multiple users (LINUX supports it) in the same network, then it should be done by the student. Students are expected to submit the information about different browsers available, their features, and search process using different natural languages, and creating email account.

Task 7:
Antivirus: Students should download freely available Antivirus software, install it and use it to check for threats to the computer being used. Students should submit information about the features of the antivirus used, installation process, about virus definitions, virus engine etc.

Productivity tools

Task 8:
Word Processor: Students should be able to create documents using the word processor tool. Some of the tasks that are to be performed are inserting and deleting the characters, words and lines, Alignment of the lines, Inserting header and Footer, changing the font, changing the color, including images and tables in the word file, making page setup, copy and paste block of text, images, tables, linking the images which are present in other directory, formatting paragraphs, spell checking, etc. Students should be able to prepare project cover pages, content sheet and chapter pages at the end of the task using the features studied. Students should submit a user manual of the word processor considered,
Image Manipulation tools.

Task 9:
Presentations: creating, opening, saving and running the presentations, selecting the style for slides, formatting the slides with different fonts, colors, creating charts and tables, inserting and deleting text, graphics and animations, bulleting and numbering, hyperlinking, running the slide show, setting the timing for slide show.

Task 10:
Spreadsheet: Students should be able to create, open, save the application documents and format them as per the requirement. Some of the tasks that may be practiced are Managing the worksheet environment, creating cell data, inserting and deleting cell data, format cells, adjust the cell size, applying formulas and functions, preparing charts, sorting cells. Students should submit a user manual of the Spreadsheet.

Task 11:

Latex: Introduction to Latex and its installation and different IDEs. Creating first document using Latex, using content into sections using article and book class of LaTeX. Styling Pages: reviewing and customizing different paper sizes and formats. Formatting text (styles, size, alignment, colors and adding bullets and numbered items, inserting mathematical symbols, and images, etc.). Creating basic tables, adding simple and dashed borders, merging rows and columns. Referencing and Indexing: cross- referencing (refer to sections, table, images), bibliography (references).

Text Books:

1. Introduction to Computers, Peter Norton, McGraw Hill

2. MOS study guide for word, Excel, PowerPoint & Outlook Exams, Joan Lambert, JoyceCox,PHI.
3. Introduction to Information Technology, ITL Education Solutions limited, PearsonEducation.
4. Networking your computers and devices, Rusen, PHI

Reference Books:

1. Trouble shooting, Maintaining & Repairing PCs, Bigelows, TMH.
2. Lamport L. LATEX: a document preparation system: user's guide and referencemanual,Addison-wesley; 1994.
3. The Complete Reference PC Hardware, Craige Zacker, John Rourke, Tata McGraw Hill.
4. Microsoft Office 365 & Office 2019 Introductory, Sandra Cable, Steven M. Freund, Ellen Monk,Susan L. Sebok, Joy L. Starks, and Misty E. Vermaat, Cengage.

Course Title	CHEMISTRY LAB				B.Tech ME I Sem (R20)			
Course Code	Category	Hours/Week			Credits	Maximum Marks		
20EC107	BS	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		0	0	3	1.5	40	60	100
					End Exam Duration: 3Hrs			

Course Objectives:

- To verify the fundamental concepts with experiments.
- The student will have exposure to various experimental skills and hand-on experience which is very essential for an Engineering student.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Determine the cell constant and conductance of solutions.
CO 2	Synthesis of advanced polymer Bakelite.
CO 3	Calculate the strength of an acid present in secondary batteries.
CO 4	Illustrate the IR of some organic compounds
CO 5	Explain acid-base titrations using pH metry.

LIST OF EXPERIMENTS:

1. Determination of Hardness of a groundwater sample.
2. Estimation of dissolved oxygen by Winkler's method
3. pH metric titration of strong acid vs. strong base.
4. pH metric titration of weak acid vs. strong base
5. Determination of cell constant and conductance of solutions
6. Potentiometer - determination of redox potentials and emfs
7. Determination of Strength of an acid in Pb-Acid battery
8. Preparation of a polymer (Bakelite).
9. Determination of percentage of Iron in Cement sample by colorimetry
10. Estimation of Calcium in port land Cement
11. Preparation of nanomaterial's by precipitation.
12. Adsorption of acetic acid by charcoal
13. Determination of percentage Moisture content in a coal sample
14. Determination of Viscosity of lubricating oil by Redwood Viscometer 1.
15. Determination of Viscosity of lubricating oil by Redwood Viscometer 2.

Text Books:

1. Vogel's Text book of Quantitative Chemical Analysis, J. Mendham et.al., Pearson Education, SixthEdition, 2012.
2. Laboratory manual on Engineering Chemistry, Anupama Rajput, Dhanpat Rai& Co Publications.
3. Essentials of Experimental Engineering Chemistry, Shashichawla, DhanpatRai& Co Publications.

Course Title	C PROGRAMMING & DATA STRUCTURESLAB				B.Tech I Sem (CSE, EEE, ME)(R20) B.Tech II Sem (CE, ECE)			
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
2005108 (I Sem)	**ES**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
2005208 (II Sem)		0	0	3	1.5	40	60	100
					End Exam Duration: 3Hrs			

Course Objectives:

- know how to write and debug programs
- know the principles of designing structured programs
- Write basic C programs using, Selection statements, Repetitive statements,
- Functions, Pointers, Arrays, Strings and structures
- To apply suitable data structure to solve real world problems

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Formulate the algorithms for simple problems
CO 2	Translate given algorithms to a working and correct program
CO 3	Correct syntax errors as reported by the compilers
CO 4	Identify and correct logical errors encountered at runtime
CO 5	Write iterative as well as recursive programs
CO 6	Represent data in arrays, strings and structures and manipulate them through a program
CO 7	Write programs on data structures like stack, queue, liked list, trees etc.

1. Ramesh ‘s basic salary is input through the keyboard. His dearness allowance is 40% of basic salary and house rent allowance is 20% of basic salary. Write a C program to calculate his gross alary.
2. Write a program to take input of name, roll no and marks obtained by a student in 5 subjects each have its 100 full marks and display the name, roll no with percentage score secured.
3. a) Write a C program to find out whether a given number is even number or odd number.
   b) Write a C program to check whether a given year is leap year or not.
4. Design and develop an algorithm that takes three coefficients (***a***, ***b***, and ***c***) of Quadratic equation ($ax^2+bx+c=0$) as input and compute all possible roots. Implement a C program for the developed algorithm and execute the same to output the possible roots for a given set of coefficients with appropriate messages.
5. If the ages of the Ramesh, Suresh and Mahesh are input through the keyboard, write a C program to determine youngest of the three.
6. A character is entered through keyboard. Write a C program to determine whether the character entered is a capital letter, a small case letter, a digit or a special symbol using if- else and switch case. The following table shows the range of ASCII values for various characters.

Characters	ASCII values
A–Z	65 – 90
a– z	97 – 122

0 – 9	48 – 57
Special symbols	0 – 47, 58 – 64, 91 – 96, 123 – 127.

7. Write a C program which takes two integer operands and one operator from the user, performs the operation and then prints the result. (Consider the operators +, -, *, /, % and use switch statement).

8. Design and develop an algorithm to find whether a given number is Armstrong numberor not. Implement a C program for the developed algorithm.

9. Design and develop an algorithm to check whether a given number is palindrome or not.Implement a C program for the same.

10. Write a C program to generate all the prime numbers between 1 and n, where n is a valuesupplied by the user.

11. Write a C program to generate the first N terms of Fibonacci sequence.

12. Write a C program to find the smallest and largest number in a given array.

13. Write a C program to find the frequency of a particular number in a list of integers.

14. Write a C program to sort the list of elements using

a) Bubble Sort b) Selection sort.

15. Write a C program to search for an element in a list of elements using

a) Linear search b) Binary search

16. Write a C program to read two matrices and perform the following operations

a) Addition of two matrices

b) Multiplication of two matrices

17. Partitioning an array

Given a randomly ordered array of n elements, write a C program to partition the elements into two subsets such that elements $\leq X$ are in one subset and elements $\geq X$ are in another subset.

18. Write a C program to rearrange the elements in an array so that they appear in reverse order.

19. If a string and its reversed string are same then the string is called as palindrome string. Design and develop an algorithm to check whether a given string is a palindrome or not and implement a C program for the same.

20. Write a C program to read two strings and perform the following operations without using built string library functions.

i) String length ii) String reversing

iii) Comparison of two strings iv) Concatenation of two strings

21. Write a C program to count the number of vowels, consonants, digits, blankspace sand special characters in a given string.

22. Write a C program to swap the contents of two variables using

a) Call by value

b) Call by reference.

23. Write a C program using recursion to

a) Find the factorial of a given number

b) Print the Fibonacci series up to a given number.

c) Find the GCD of two integers.

24. Write a C program to define a structure with the following members.
Roll No., Name, marks in Sub1, Sub2, Sub3. Read the n students records and find the total marks of each student and print the result in the following format.

Roll No	Name	Sub1	Sub2	Sub3	Total marks	result
189Y1A0501	Kavya	80	70	75	225	Distinction

25. Write C programs that implement stack (its operations) using
i) Arrays
ii) Pointers

26. Write C programs that implement Queue (its operations) using
i) Arrays
ii) Pointers

27. Write a C program that uses Stack operations to perform the following:
i) Converting infix expression into postfix expression
ii) Evaluating the postfix expression

28. Write a C program that uses functions to perform the following operations on single linkedlist.
i) Creation ii) Insertion iii) Deletion iv) Traversal

29. Write a C program that uses functions to perform the following operations on

Doublelinked list.

i) Creation ii) Insertion iii) Deletion iv) Traversal

30. Write a C program that uses functions to perform the following:
i) Creating a Binary Tree of integers
ii) Traversing the above binary tree in preorder, in order and post order.

Text Books:

1. Fundamentals of Data Structures in C, Ellis Horowitz, SartajSahni, SusanAnderson-Freed, Computer Science Press.
2. Programming in C and Data Structures, J.R.Hanly, Ashok N. Kamthane and A.AnandaRao, Pearson Education.
3. Rema Theraja, Programming in C, second edition,Oxford.
4. E. Balagurusamy, C Programming and Data structures, Fourth Edition,McGrawHill.

Reference Books:

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, PrenticeHall of India.
2. R.G. Dromey, How to solve it by Computer, Pearson.
3. Yashavant Kanetkar, Let us C, 15th edition, BPBPublications.
4. Dr. P. Chenna Reddy, Computer Fundamentals and C Programming,Second Edition.

Course Title	BASIC ELECTRICAL & ELECTRONICSENGINEERING LAB Part 'A': Basic Electrical Engineering Lab Part 'B': Electronics Engineering Lab				B.Tech (C E , ME &CSE) I Sem (R20)			
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
2014109	**ES**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		0	0	3	1.5	40	60	100
					End Exam Duration: 3Hrs			

Course Objectives:

The objective of the course is to verify KCL, KVL, superposition theorem, measurement of real & reactive power for RL & RC circuits, performance characteristics of DC machines and transformers. Analyze the characteristics of Diodes, BJT, MOSFET, UJT, design the amplifier circuits from the given specifications and verification of truth tables.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Verify Kirchhoff's laws, superposition theorem theoretically and practically for any given circuit, truth table for different logic gates and measure real & reactive Power for RL & RC circuits.
CO 2	Illustrate various characteristics of DC machines from the measured data(Practically).
CO 3	Obtain the efficiency and regulation for single phase transformer
CO 4	Learn the characteristics of basic electronic devices like PN junction diode, Zenerdiode & BJT
CO 5	Analyze the application of diode as rectifiers, clippers and clampers and other circuits

Part A: Basic Electrical Engineering Lab

LIST OF EXPERIMENTS: -

Basic Electrical Engineering Lab (Any 5 experiments)

1. Verification of Kirchhoff laws
2. Verification of Superposition Theorem
3. Magnetization characteristics of a DC Shunt Generator
4. Speed control of DC Shunt Motor
5. OC & SC test of 1 – Phase Transformer
6. Load test on 1-Phase Transformer
7. Brake test on DC Shunt Motor
8. Measurement of Real & Reactive Power by single phase RL,RC circuits

Text Books:

1. V.K. Mehta & Rohit Mehta, "Principles of Power System" – S.Chand – 2018.
2. E. Hughes - "Electrical and Electronics Technology" - Pearson - 2010.
3. C.L. Wadhwa – "Generation Distribution and Utilization of Electrical Energy", 3rd Edition, New Age International Publications.
4. D. P. Kothari and I. J. Nagrath - "Basic Electrical Engineering" - Tata McGraw Hill -2010.

Reference Books:

1. Fundamentals of Electrical Engineering-I, Don Johnson, University Press.
2. Basic Electrical Engineering, SK. Sahdev, Pearson.
3. Basic Electrical Engineering, Abhijith Chakrabarti, Sudipta Nath, Chandan Kumar Chanda, TataMcGraw Hill.
4. Basic Concepts of Electrical Engineering, Kuldeep Sahay, Shivendra Pathak, New Age InternationalPublishers.

Part B: Electronics Engineering Lab

LIST OF EXPERIMENTS:-

Basic Electronics Engineering Lab (Any 5 experiments)

1. PN Junction diode characteristics A) Forward bias B) Reverse bias.
2. Zener diode characteristics and Zener as voltage Regulator.
3. Full Wave Rectifier with & without filter.
4. Wave Shaping Circuits. (Clippers & Clampers)
5. Input & Output characteristics of Transistor in CB / CE configuration.
6. Frequency response of CE amplifier.
7. Inverting and Non-inverting amplifiers using Op-AMPs.
8. Verification of Truth Table of AND, OR, NOT, NAND, NOR, Ex-OR, Ex-NOR gatesusing ICs.
9. Verification of Truth Tables of S-R, J-K& D flip flops using respective ICs.

Text Books:

1. R.L.Boylestad& Louis Nashlesky, Electronic Devices &Circuit Theory, PearsonEducation,2007.
2. Principles of Electronics, V.K. Mehta, Rohit Mehta, S Chand.
3. Operational Amplifiers with Linear Integrated Circuits, William D. Stanley, 4th Edition,Pearson.
4. R. P. Jain, Modern Digital Electronics,3rd Edition, Tata Mcgraw Hill,2003.

Reference Books:

1. Santiram Kal, Basic Electronics- Devices, Circuits and IT Fundamentals, PrenticeHall,India, 2002.
2. R. S. Sedha, A Text Book of Electronic Devices and Circuits, S.Chand& Co, 2010.
3. Ramakanth A. Gayakwad, Op-Amps & Linear ICs, 4thEdition, Pearson, 2017.\
4. Raj Kamal, Microcontrollers: Architecture, Programming, Interfacing and SystemDesign,2nd Edition, Pearson, 20

B.Tech II SEM ME (R20)

Course Title	DIFFERENTIAL EQUATIONS ANDVECTOR CALCULUS				B.Tech M E II Sem (R20)		
Course Code	**Category**	**Hours/Week**		**Credits**	**Maximum Marks**		
2021201	**BS**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	0	0	3	40	60	100
Mid Exam Duration: 90 Minutes					**End Exam Duration: 3Hrs**		

Course Objectives:

- To enlighten the learners in the concept of differential equations.
- To furnish the learners with basic concepts and techniques at plus two level to lead theminto advanced level by handling various real world applications

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Classify second and higher order liner D.E's with constant coefficients.
CO 2	Solve partial differential equations.
CO 3	Analyze the applications of partial differential equations.
CO 4	Understand vector differentiation concepts.
CO 5	Apply vector integration concepts.

UNIT- I

Linear differential equations of higher order (constant coefficients) :
Definitions, homogeneous and non- homogeneous, complimentary function, general solution,particular integral, Wronskian, Method of variation of parameters.

UNIT-II

Partial Differential Equations:
Introduction and formation of Partial Differential Equations by elimination of arbitrary constantsand arbitrary functions, solutions of first order equations using Lagrange's method.

UNIT-III

Applications of Partial Differential Equations:

Classification of PDE, method of separation of variables for second order equations. Applications of Partial Differential Equations: One dimensional Wave equation.

UNIT-IV

Vector differentiation:
Scalar and vector point functions, vector operator del, del applies to scalar point functions-Gradient, del applied to vector point functions-Divergence and Curl, vector identities.

UNIT-V

Vector integration:
Line integral-circulation-work done, surface integral-flux, Green's theorem in the plane (without proof), Stoke's theorem (without proof), volume integral, Divergence theorem (without proof) and applications of these theorems.

Text Books:

1. Higher Engineering Mathematics, Dr. B.S. Grewal, Khanna Publishers-43 edition 2014.
2. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Publications, 9th edition- 2013
3. Calculus and Analytic geometry, G.B. Thomas and R.L. Finney, Pearson, 9th Edition, Reprint, 2002.
4. Advanced Engineering Mathematics, Greenberg Michael D, Cengage Publishers.

Reference Books:

1. Higher Engineering Mathematics, B.V. Ramana, Mc. Graw Hill Education (India) Pvt. Ltd, NewDelhi, 11th Edition, Reprint 2010.
2. A Text Book of Engineering Mathematics, N.P. Bali and Manish Goyal, Lakshmi Publications,Reprint 2008.
3. Applied Calculus, Hegarty John C.
4. Advanced Calculus, Widder V David, Pearson Publishers.

Course Title	ENGINEERING PHYSICS				B.Tech ME II Sem (R20)		
Course Code	Category	Hours/Week			Credits	Maximum Marks	
20EP202	BS	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 90 Minutes					End Exam Duration: 3Hrs		

Course Objectives:

- To make a bridge between the physics in school and engineering courses.
- To identify the importance of the optical phenomenon i.e. interference, diffraction and polarization related to its Engineering applications
- To understand the mechanisms of emission of light, the use of lasers as light sources for low and high energy applications, study of propagation of light wave through optical fibers along with engineering applications.
- To explain the significant concepts of dielectric and magnetic materials that leads to potential applications in the emerging micro devices.
- To enlighten the concepts of Quantum Mechanics and to provide fundamentals of de 'Broglie waves, quantum mechanical wave equation and its applications, the importance of free electron theory and band theory of solids.
- Evolution of band theory to distinguish materials, basic concepts and transport phenomenon of charge carriers in semiconductors. To give an impetus on the subtle mechanism of superconductors using the concept of BCS theory and their fascinating applications.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Study the different realms of physics and their applications in both scientific and technological systems through physical optics. (L2)
CO 2	Identify the wave properties of light and the interaction of energy with the matter (L3). Asses the electromagnetic wave propagation and its power in different media (L5).
CO 3	Understands the response of dielectric and magnetic materials to the applied electric and magnetic fields. (L3)
CO 4	Study the quantum mechanical picture of subatomic world along with the discrepancies between the classical estimates and laboratory observations of electron transportation phenomena by free electron theory and band theory. (L2)
CO 5	Elaborate the physical properties exhibited by materials through the understanding of properties of semiconductors and superconductors. (L5)

UNIT-I

WAVE OPTICS

Interference- Principle of superposition – Interference of light – Conditions for sustained interference - Interference in thin films (Reflection Geometry) – Colors in thin films – Newton's Rings – Determination of wavelength and refractive index.

Diffraction- Introduction – Fresnel and Fraunhofer diffraction – Fraunhofer diffraction due to single slit, double slit and N-slits (qualitative) – Grating spectrum

UNIT-II

LASERS AND FIBER OPTICS

Lasers- Introduction – Characteristics of laser – Spontaneous and Stimulated emission of radiation – Einstein's coefficients – Population inversion – Lasing action – Pumping mechanisms
Nd-YAG laser – He-Ne laser – Semiconductor diode laser- Applications of lasers.

Fiber optics- Introduction – Principle of optical fiber – Acceptance Angle – Numerical Aperture Classification of optical fibers based on refractive index profile and modes – Block diagram ofOptical fiber Communication system - Propagation Losses (qualitative)
Applications.

UNIT-III

DIELECTRIC AND MAGNETIC MATERIALS

Dielectric Materials- Introduction – Dielectric polarization – Dielectric polarizability, Susceptibility and Dielectric constant – Types of polarizations: Electronic, Ionic and Orientation polarizations (Qualitative) – Lorentz internal field – Clausius-Mossotti equation.

Magnetic Materials- Introduction to magnetic materials (Origin of magnetic moment ofan atom and Classification of magnetic materials) –Weiss theory of ferromagnetism- soft ferrites and hard ferrites- Hysteresis – Soft and Hard magnetic materials- Applications magnetic materials.

UNIT IV

QUANTUM MECHANICS, FREE ELECTRON THEORY

Quantum Mechanics- Dual nature of matter – Schrodinger's time independent and dependent wave equation – Significance of wave function – Particle in a one- dimensional infinite potential well.

Free Electron Theory- Classical free electron theory (Merits and demerits only) – Quantum freeelectron theory – Equation for electrical conductivity based on quantum free electron theory – Fermi-Dirac distribution – Density of states – Fermi energy.

UNIT – V

SEMICONDUCTORS AND SUPERCONDUCTORS

Semiconductors- Introduction – Intrinsic semiconductors – Electrical conductivity – Fermi level Extrinsic semiconductors –Dependence of Fermi energy on carrier concentration and temperature – Drift and diffusion currents – Einstein's equation – Direct and indirect band gap semiconductors – Hall effect – Hall coefficient – Applications of Hall effect.

Superconductors- Introduction – Properties of superconductors – Meissner effect – Type I and Type II superconductors – BCS theory – Josephson effects (AC and DC) –High Tc superconductors – Applications of superconductors.

Text Books:

1. Engineering Physics – Dr. M.N. Avadhanulu & Dr. P.G. Krishnasagar,S. Chand and Company
2. Optics- Ajoy Ghatak , McGraw Hill Publishers,6th edition,1stJanuary,2018.
3. Fundamental of Physics- Halliday, Resnick and Walker, Wiley publications.
4. Solid State Physics, Hall H E, paramount Publications.

Reference Books:

1. Engineering Physics – K.Thyagarajan, McGraw Hill Publishers
2. Semiconductor Devices-S.M.Sze , Wiley Publications.
3. Lasers & Non-linear Optics Nelkon M parker P, Arnold Heinemann Publications
4. Semiconductor physics and devices- Basic principle – Donald A, Neamen, Mc Graw Hill

Course Title	COMMUNICATIVE ENGLISH				B.Tech ME II Sem (R20)		
Course Code	Category	Hours/Week			Credits	Maximum Marks	
2024203	HS	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 90 Minutes					End Exam Duration: 3Hrs		

Course Objectives:

- Facilitate effective listening skills for better comprehension of academic lectures and English spoken by native speakers
- Focus on appropriate reading strategies for comprehension of various academic texts and authentic materials
- Help improve speaking skills through participation in activities such as roleplays, discussions and structured talks/oral presentations
- Impart effective strategies for good writing and demonstrate the same in summarizing, writing well organized essays, record and report useful information
- Provide knowledge of grammatical structures and vocabulary and encourage their appropriate use in speech and writing

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Retrieve the knowledge of basic grammatical concepts
CO 2	Understand the context, topic, and pieces of specific information from social or Transactional dialogues spoken by native speakers of English.
CO 3	Apply grammatical structures to formulate sentences and correct word forms.
CO 4	Analyze discourse markers to speak clearly on a specific topic in informal Discussions.
CO 5	Evaluate reading/listening texts and to write summaries based on global comprehension of these texts.
CO 6	Create a coherent paragraph interpreting a figure/graph/chart/table.

UNIT-I

Lesson: On the Conduct of Life: William Hazlitt

Listening: Identifying the topic, the context and specific pieces of information by listening to short audio texts and answering a series of questions. **Speaking:** Asking and answering general questions on familiar topics such as home, family, work, studies and interests; introducing oneself and others. **Reading:** Skimming to get the main idea of a text; scanning to look for specific pieces of information. **Writing :**Beginnings and endings of paragraphs - introducing the topic, summarizing the main idea and/or providing a transition to the next paragraph.

Grammar and Vocabulary: Parts of Speech; Word formation, synonyms and antonyms; Idioms and Phrases; phrasal verbs.

UNIT-II

Lesson: The Brook: Alfred Tennyson
Listening: Answering a series of questions about main idea and supporting ideas after listening to audio texts. **Speaking:** Discussion in pairs/small groups on specific topics followed by short structured talks. **Reading:** Identifying sequence of ideas; recognizing verbal techniques that help to link the ideas in a paragraph together. **Writing:** Paragraph writing (specific topics) using suitable cohesive devices; mechanics of writing - punctuation, capital letters.
Grammar and Vocabulary: Sentence structure; articles; Tenses; Prepositions.

UNIT-III

Lesson: A City Night Peace - Oliver Goldsmith
Listening: Listening for global comprehension and summarizing what is listened to. **Speaking:** Discussing specific topics in pairs or small groups and reporting what is discussed **Reading:** Reading a text in detail by making basic inferences -recognizing and interpreting specific context clues; strategies to use text clues for comprehension. **Writing:** Summarizing, Paragraph Writing **Grammar and Vocabulary:** Voice; Reported Speech; Degrees of Comparison, Subject with agreement.

UNIT-IV

Lesson: Being Rich, Being Good - Chetan Bhagat
Listening: Making predictions while listening to conversations/ transactional dialogues without video; listening with video. **Speaking:** Role plays for practice of conversational English in academic contexts (formal and informal) - asking for and giving information/directions. **Reading:** Studying the use of graphic elements in texts to convey information, reveal trends/patterns/relationships, communicate processes or display complicated data. **Writing:** Letter Writing: Official Letters/Report Writing **Grammar and Vocabulary:** Information Transfer; Simple, Compound and Complex sentences; Question Tags.

UNIT-V

Lesson: Politics and the English Language: George Orwell
Listening: Identifying key terms, understanding concepts and answering a series of relevant questions that test comprehension. Speaking: Formal oral presentations on topics from academic contexts - without the use of PPT slides. Reading: Reading for comprehension. **Writing:** Writingstructured essays on specific topics using suitable claims and evidences.
Grammar and Vocabulary: Reading Comprehension; Dialogue Writing; Common Errors.

Text Books:

1. Language and Life: A Skills Approach- I Edition 2019, Orient Black Swan
2. Oxford Learners Dictionary, 12th Edition, 2011
3. Norman Lewis Word Power Made Easy- The Complete Handbook for Building aSuperiorVocabulary (2014)
4. Speed Reading with the Right Brain: Learn to Read Ideas Instead of Just Wordsby DavidButler.

Reference Books:

1. Bailey, Stephen. Academic writing: A handbook for international students.Routledge, 2014.
2. Chase, Becky Tarver. Pathways: Listening, Speaking and CriticalThinking. Heinley ELT;2nd Edition, 2018.
3. Raymond Murphy's English Grammar in Use Fourth Edition (2012) E-book
4. Hewings, Martin. Cambridge Academic English (B2). CUP, 2012.

Web links:

www.englishclub.com
www.easyworldofenglish.com
www.languageguide.org/english/
www.bbc.co.uk/learningenglish www.eslpod.com/index.html
www.myenglishpages.com

Course Title	MATERIAL SCIENCE					B.Tech ME II Sem (R20)		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
2003204	ESC	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 2Hrs					End Exam Duration: 3Hrs			

Course Objectives:

- To teach the principles of physical metallurgy, i.e. crystallography of metals, constitution of alloys, phase diagrams.
- Expose commercially important metals and alloys (both ferrous and non ferrous) with engineering constraints.
- Explain the methods to change the properties of materials through heat treatment processes
- Familiarize properties and applications of ceramics, polymers and composite materials.
- Demonstrate the fundamental properties of nano-materials and their applications.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Understand the importance of iron - iron carbide phase diagram
CO 2	Understand the importance of non-ferrous metals and alloys in engineering applications.
CO 3	Explain the principles of binary phases
CO 4	Utilize nonferrous metals and alloys in engineering.
CO 5	Understand the importance of Heat Treatment

UNIT-I

Structure of Metals: Crystal Structures: Unit cells, Metallic crystal structures, Imperfection in solids: Point, Line, interstitial and volume defects; dislocation strengthening mechanisms and slip systems, critically resolved shear stress.

Constitution of Alloys: Necessity of Alloying, substitution and interstitial solid solutions-Phase diagrams: Interpretation of binary phase diagrams and microstructure development; eutectic, peritectic, peritectoid and monotectic reactions. Iron-Iron-carbide diagram and microstructural aspects of ferrite, cementite, austenite, ledeburite, and cast iron.

Learning Outcomes:

At the end of this unit the student will be able to

- understand the importance of material science in
- engineering.(L2)recall the definitions and terminology of
- crystallography. (L1) distinguish metals and alloys. (L4)
- make use of the principles of construction of binary phase diagrams.
- (L3)identify various invariant reactions in binary phase diagrams.
- (L3)
  know the concept of metallography in studying the microstructures of metals and alloys.(L2)

UNIT-II

Steels:
Plain carbon steels, use and limitations of plain carbon steels. AISI& BIS classification of steels. Classification of alloys steels. Microstructure, properties and applications of alloy steels- stainless steels and tool steels.

Cast irons:
Microstructure, properties and applications of white cast iron, malleable cast iron, grey cast iron, nodular cast iron and alloy cast irons.

Learning Outcomes:
At the end of this unit the student will be able to

- Classify various types of steels, their properties and applications. (l2)
- Identify various types of cast irons, their properties and applications.
- (l3)Compare steels and cast irons and their limitations in applications. (l3)

UNIT-III

Heat Treatment of Steels: Annealing, tempering, normalizing and hardening, isothermal transformation diagrams for Fe-Fe3C alloys and microstructure development. Continuous cooling curves and interpretation of final microstructures and properties- austempering, martempering, case hardening - carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening, and vacuum and plasma hardening

Learning Outcomes:
At the end of this unit the student will be able to

- Know the influence of heat treatment in modification of properties of steels.
- (l2)Develop a heat treatment cycle based on properties required. (l3)
- Comprehend the principles of surface hardening methods. (l2)

UNIT-IV

Non-ferrous Metals and Alloys: Microstructure properties and applications of copper, aluminums, titanium, nickel and their alloys. Study of Al-Cu phase
Diagram

Learning Outcomes:
At the end of this unit the student will be able to

- Demonstrate various properties and applications of non-ferrous alloys.
- (l4)Differentiate between hardening of ferrous and non-ferrous alloys. (l4)

UNIT-V

Ceramics, Polymers and Composites: Structure, properties and applications of ceramics,polymers and composites. Introduction to super alloys and nanomaterial's.

Learning Outcomes:

At the end of this unit the student will be able to

- Understand the properties of ceramics and their applications. (l2)
- Summarize the properties of polymers and composites and their use.
- (l2)Interpret the properties of nano materials and their applications.
- (l2)
  Identify the difference between the micro and nano scale materials and their uses. (L3)

Text Books:

1. V.Raghavan, Material Science and Engineering, 5/e, Prentice Hall of India, 2004.
2. R.Balasubramaniam, Callister's Material Science and Engineering, 2/e, Wiley India, 2014.
3. Introduction to Material science by Barry Royce Schlenker
4. Engineering material Science by Milton Ohring

Reference Books:

1. Y. Lakhtin, Engineering Physical Metallurgy, University Press of the Pacific, 2000.
2. S.H.Avner, Introduction to Physical Metallurgy, 2/e, Tata McGraw- Hill, 1997.
3. L.H.VanVlack, Elements of Material Science and Engineering, 6/e, Pearson Education,2008.
4. George E.Dieter, Mechanical Metallurgy, 3/e, McGraw-Hill, 2013.

Course Title	ENGINEERING DRAWING				B.Tech CSE II Sem (R20)		
Course Code	Category	Hours/Week			Credits	Maximum Marks	
2003205	ES	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		1	0	2	2	40	60	100
Mid Exam Duration: 90 Minutes					End Exam Duration: 3Hrs		

Course Objectives:

- Bring awareness that Engineering Drawing is the Language of Engineers.
- Familiarize how industry communicates technical information.
- Teach the practices for accuracy and clarity in presenting the technical information. Develop the engineering imagination essential for successful design

Course Outcomes: On successful completion of this course, the students will be able to	
CO 1	Draw various curves applied in engineering.
CO 2	Show projections of solids and sections graphically.
CO 3	Draw the development of surfaces of solids.
CO 4	Know draw orthographic and isometric projections.
CO 5	Evaluate different methods of perspective view.

UNIT-I

Introduction to Engineering Drawing: Principles of Engineering Drawing and itsSignificance-Conventions in drawing-lettering - BIS conventions.

a) Conic sections including the rectangular hyperbola- general method only,

b) Cycloid, epicycloids and hypocycloid c) Involutes

UNIT- II

Projection of points, lines and planes: Projection of points in any quadrant, lines inclined to one or both planes, finding true lengths, angle made by line. Projections of regular plane surfaces.

Projections of solids: Projections of regular solids inclined to one or both planes by rotational or auxiliary views method.

UNIT- III

Sections of solids: Section planes and sectional view of right regular solids- prism, cylinder, pyramid and cone. True shapes of the sections.

Development of surfaces: Development of surfaces of right regular solids-prism,cylinder, pyramid, cone and their sectional parts.

UNIT-IV

Orthographic Projections: Systems of projections, conventions and application toorthographic projections - simple objects.

Isometric Projections: Principles of isometric projection- Isometric scale;Isometric views: lines, planes, simple solids.

UNIT- V

Perspective projection –applications of perspective view –terminology ofperspective view-methods of drawing perspective view-simple problems.

Text Books:

1. N.D.Bhatt, Engineering Drawing, 53/e, Charotar Publishers,2016.
2. K.C.John, Engineering Graphics, 2/e, PHI,2013
3. Basant Agarwal & C.M.Agarwal, Engineering Drawing, Tata McGraw-Hill, Copy Right,2008.
4. Dhanajay A Jolhe, Engineering Drawing, Tata McGraw-Hill, Copy Right,2009
5. Interpreting Engineering DrawingsBook by Ted Branoff.
6. Mechanical Drawing: Board & CAD TechniquesBook by Jay D. Helsel.
7. A Textbook of Engineering Drawing: For Undergraduate ...Book by Addisu Dagne Zegeye

Reference Books:

1. Venugopal, Engineering Drawing and Graphics, 3/e, New Age Publishers,2000
2. Shah and Rana, Engineering Drawing, 2/e, Pearson Education,2009
3. K.L.Narayana & P.Kannaiah, Engineering Drawing, 3/e, ScitechPublishers,Chennai, 2012.
4. K.C.John, Engineering Graphics, 2/e, PHI,2013
5. BasantAgarwal&C.M.Agarwal, Engineering Drawing, Tata McGraw-Hill, Copy Right, 2008.
6. Sketch up for Dummies book by Bill Fane, Josh Reilly, and Mark Harrison

Additional Sources:

1. Youtube: http-sewor, Carleton. cag,kardos/88403/drawings.html conic sections-online,red woods.edu

Course Title	ENGINEERING DRAWING LAB				B.Tech CSE II Sem (R20)		
Course Code	Category	Hours/Week			Credits	Maximum Marks	
2003206	ES	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		0	0	2	1	40	60	100
					End Exam Duration: 3Hrs		

Course Objectives:

- Familiarize how industry communicates technical information.
- Teach the practices for accuracy and clarity in presenting the technical information.
- Develop the engineering imagination essential for successful design.
- Bring awareness that Engineering Drawing is the Language of Engineers
- Instruct the utility of drafting & modeling packages in orthographic and isometric drawings.
- Train the usage of 2D and 3Dmodeling.
- Instruct graphical representation of machine components

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Use computers as a drafting tool.
CO 2	Draw isometric and orthographic drawings using CAD packages
CO 3	Analyze orthographic drawings using CAD packages.

COMPUTER AIDED DRAFTING:

Introduction to AutoCAD: Basic drawing and editing commands: line, circle, rectangle, erase, view, undo, redo, snap, object editing, moving, copying, rotating, scaling, mirroring, layers, templates, polylines, trimming, extending, stretching, fillets,arrays, dimensions.

Dimensioning principles and conventional representations.

Orthographic Projections: Systems of projections, conventions and application toorthographic projections - simple objects.

Isometric Projections: Principles of isometric projection- Isometric scale; Isometricviews:lines, planes, simple solids.

Text Books:

1. Basant Agarwal & C.M.Agarwal, Engineering Drawing, Tata McGraw-Hill,CopyRight, 2008.
2. K.C.John, Engineering Graphics, 2/e, PHI, 2013
3. K. Venugopal, V.Prabhu Raja, Engineering Drawing + Auto Cad, New AgeInternational Publishers.
4. Kulkarni D.M, AP Rastogi and AK Sarkar, Engineering Graphics with AutoCad,PHI Learning, Eastern Economy editions.

Reference Boo ks:

1. T. Jayapoovan, Engineering Graphics using Auto Cad, Vikas PublishingHouse
2. K.L.Narayana & P.Kannaiah, Engineering Drawing, 3/e,ScitechPublishers, Chennai, 2012.
3. Linkan Sagar, BPB Publications, Auto Cad 2018 Training Guide.
4. A Textbook of Engineering Drawing: For Undergraduate ...Book by Addisu Dagne Zegeye

Additional Sources:

1. Youtube: http-sewor,Carleton.cag, kardos/88403/drawings.htmlconicsections-online, red woods.edu

Course Title	ENGINEERING PHYSICS LAB				B.Tech CSE II Sem (R20)		
Course Code	Category	Hours/Week			Credits	Maximum Marks	
20EP207	BS	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		0	0	3	1.5	40	60	100
					End Exam Duration: 3Hrs		

Course Objectives:

- Understands the concepts of interference, diffraction and their applications.
- Understand the role of optical fiber parameters in communication.
- Recognize the importance of energy gap in the study of conductivity and Hall Effect in a semiconductor.
- Illustrates the magnetic and dielectric materials applications.
- Apply the principles of semiconductors in various electronic devices.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Operate various optical instruments (L2)
CO 2	Estimate wavelength of laser and particles size using laser(L2)
CO 3	Evaluate the acceptance angle of an optical fiber and numerical aperture (L3)
CO 4	Estimate the susceptibility and related magnetic parameters of magnetic materials (L2)
CO 5	Apply the concepts of ultrasonics by acoustic grating (L2)

Note: In the following list, out of 15 experiments, any 12 experiments(minimum 10) must be performed in a semester

List of Engineering Physics Experiments

1. Determine the thickness of the wire using wedge shape method
2. Determination of the radius of curvature of the lens by Newton's ringmethod
3. Determination of wavelength by plane diffraction grating method
4. Determination of dispersive power of prism.
5. Determination of wavelength of LASER light using diffraction grating.
6. Determination of particle size using LASER.
7. To determine the numerical aperture of a given optical fiber and hence tofind itsacceptance angle
8. Determination of dielectric constant by charging and discharging method.
9. Magnetic field along the axis of a circular coil carrying current – StewartGee'smethod.
10. Study the variation of B versus H by magnetizing the magnetic material (B-Hcurve)
11. To determine the resistivity of semiconductor by Four probe method
12. To determine the energy gap of a semiconductor

Text Books:

1. S. Balasubramanian, M.N. Srinivasan "A Text book of Practical Physics"- S ChandPublishers, 2017.
2. http://vlab.amrita.edu/index.php -Virtual Labs, Amrita University

Course Title	COMMUNICATIVE ENGLISH LAB				B.Tech ME II Sem (R20)		
Course Code	Category	Hours/Week			Credits	Maximum Marks	
2024208	HS	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		0	0	3	1.5	40	60	100
					End Exam Duration: 3Hrs		

Course Objectives:

- Students will be exposed to a variety of self-instructional, learner friendlymodes of language learning.
- Students will learn better pronunciation through stress, intonation and rhythm.
- Students will be trained to use language effectively to face interviews, group discussions, and public speaking.
- Students will be initiated into greater use of the computer in resume preparation, report writing, format making etc.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Listening and repeating the sounds of English Language
CO 2	Understand the different aspects of the English language, proficiency with emphasis on LSRW skills.
CO 3	Apply communication skills through various language learning activities
CO 4	Analyze the English speech sounds, stress, rhythm, intonation and syllable division for better listening and speaking comprehension
CO 5	Evaluate and exhibit acceptable etiquette essential in social and professional settings
CO 6	Create awareness on mother tongue influence and neutralize it in order to improve fluency in spoken English.

UNIT-I

- Listening Skills
- Phonetics
- Introducing oneself

UNIT-II

- Describing objects
- JAM / Interpretation of Hypothetical Situations
- Role play

UNIT-III

- Hypothetical situations (If… ..... were)
- Elocution
- TED talks videos

UNIT-IV

- Visual Description
- Situational conversations

UNIT-V

- Oral Presentations
- PowerPoint presentations

Suggested software:

- Orell
- Walden Infotech
- Young India Films
- K-Van solutions

Reference Books:

1. Bailey, Stephen. Academic writing: A handbook for international students.Routledge,2014.
2. Chase, Becky Tarver. Pathways: Listening, Speaking and CriticalThinking. Heinley ELT;2nd Edition, 2018.
3. Skillful Level 2 Reading & Writing Student's Book Pack (B1) MacmillanEducational.
4. Hewings, Martin. Cambridge Academic English (B2). CUP, 2012.
5. A Textbook of English Phonetics for Indian Students by T.Balasubramanyam

Web Links:

www.esl-lab.com
www.englishmedialab.com
www.englishinteractive.net

Course Title	MATERIAL SCIENCE LAB				B.Tech ME II Sem (R20)			
Course Code	Category	Hours/Week			Credits	Maximum Marks		
2003209	ESC	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		0	0	3	1.5	40	60	100
Mid Exam Duration: 2Hrs					End Exam Duration: 3Hrs			

Course Objectives:

1. To understand the microstructure and hardness of engineering materials.
2. To explain grain boundaries and grain sizes of different engineering materials.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Differentiate various microstructures of ferrous and non-ferrous metals and alloys
CO 2	Differentiate various microstructures of ferrous and non-ferrous metals and alloys.
CO 3	Visualize grains and grain boundaries
CO 4	Importance of hardening of steels
CO5	Differentiate hardness of super alloys, ceramics and polymeric materials

LIST OF SAMPLE EXPERIMENTS:

1. Calculate the following
2. Metallography sample preparation
3. Microstructure of pure metals – Iron, copper and aluminum as per ASTM standards
4. Microstructure of low carbon steel, mild steel and high carbon microstructure of castirons.
5. Microstructure of non-ferrous alloys – aluminum, copper, titanium, nickel and theiralloys.
6. Hardenability of steels by Jominy End Quench Test.
7. Microstructure of heat treated steels.
8. Hardness of various untreated and treated steels.
9. Microstructure of ceramics, polymeric materials.
10. Microstructure of super alloy and nano-materials.
11. Hardness of ceramics, super alloys, nano-materials and polymeric materials (onesample on each)

Text Books:

1. Introduction to Material science by Barry Royce Schlenker
2. Engineering material Science by Milton Ohring
3. V.Raghavan, Material Science and Engineering, 5/e, Prentice Hall of India, 2004.
4. R.Balasubramaniam, Callister's Material Science and Engineering, 2/e, Wiley India, 2014.

Reference Books:

1. Y. Lakhtin, Engineering Physical Metallurgy, University Press of the Pacific, 2000.
2. S.H.Avner, Introduction to Physical Metallurgy, 2/e, Tata McGraw- Hill, 1997.
3. L.H.VanVlack, Elements of Material Science and Engineering, 6/e, Pearson Education, 2008.
4. George E.Dieter, Mechanical Metallurgy, 3/e, McGraw-Hill, 2013.

Course Title	Environmental Science				B.Tech CSE II Sem (R20)		
Course Code	Category	Hours/Week			Credits	Maximum Marks	
20MC210	MC	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	0	0	40	--	40
Mid Exam Duration: 90 Minutes							

Course Objectives:

- To make the students to get awareness on environment.
- To understand the importance of protecting natural resources, ecosystems for future generations and pollution causes due to the day to day activities of human life.
- To save earth from the inventions by the engineers.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	**Explain** multidisciplinary nature of environmental studies and various Renewable and Nonrenewable resources.
CO 2	**Understand** the Energy flow, bio-geo chemical cycles and ecological pyramids
CO 3	**Illustrate** various causes of pollution and related preventive measures.
CO 4	**Summarize** Solid waste management, Social issues related to environment and their protection acts.
CO 5	**Evaluate** Causes of population explosion, value education and welfare programmes.

UNIT – I

Multidisciplinary Nature Of Environmental Studies: –Scope and Importance – Need for Public Awareness.

Natural Resources: Renewable and non-renewable resources – Natural resources and associated problems.

Forest resources: deforestation, case studies – Mining, dams and other effects on forest and tribal people.

Water resources: Use and over utilization of surface and ground water conflicts over water. **Food resources:** World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.

Energy resources: Renewable &Non-Renewable.

UNIT – II

Ecosystems: Concept of an ecosystem. – Structure and function of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Food chains, food web- Ecological succession and ecological pyramids – Introduction, types, characteristic features, structure and function of the following ecosystem:

Forest ecosystem.

Desert ecosystem

Aquatic ecosystems (lakes, rivers and oceans)

Biodiversity And Its Conservation : Introduction, Definition: genetic, species and ecosystem diversity – Bio-geographical classification of India – Value of biodiversity: consumptive use, Productive use, social, ethical, aesthetic and option values – Biodiversity at global levels – India as a mega-diversity nation – Hot-spots of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

UNIT – III

Environmental Pollution: Definition, Cause, effects and control measures of:
Air Pollution.
Water pollution
Soil pollution
Marine pollution
Noise pollution
Thermal pollution
Nuclear hazards

Solid Waste Management: Causes**,** effects and control measures of urban and industrial wastes – Role of an individual in prevention of pollution – Pollution case studies – Disaster management: floods, earthquake, cyclone and landslides.

UNIT – IV

Social Issues And The Environment: From Unsustainable to Sustainable development – Urban problems related to energy – Water conservation, rain water harvesting, its problems and concerns. Case studies – Environmental ethics: Issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents.Environment Protection Act. – Air (Prevention and Control of Pollution) Act. – Water (Prevention and control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act.

UNIT – V

Human Population And The Environment: Population growth, variation among nations. Population explosion – Family Welfare Programmes. – Environment and human health – Human Rights – Value Education – HIV/AIDS – Women and Child Welfare – Role of information Technology in Environment and human health.

Field Work: Visit to a local area to document environmental assets River/forest grassland/hill/mountain – Visit to a local polluted site-Urban/Rural/Industrial/Agricultural Study of common plants, insects, and birds – river, hill slopes, etc.

Text Books:

Text book of Environmental Studies for Undergraduate Courses, Erach Bharucha for University Grants Commission, Universities Press.
Fundamental Concepts of Environmental Chemistry- Sodhi G S – Oxford University
Environmental Chemistry- Anil Kumar De-Willey Publications
Environment Impact Assessment- Larry W. Canter- Mc Graw Hill publications

Reference Books:

G.R.Chatwal, "A Text Book of Environmental Studies" Himalaya Publishing House
Gilbert M. Masters and Wendell P. Ela, "Introduction to Environmental Engineering and Science, Prentice hall of India Private limited.
Environmental Science, A Global Concerns, William P. Cunningham, Mary Ann Cunningham, Mc Graw Hill publications.
Environmental Science & Engineering, Glynn Henry J ,Heinke Gary w, Pearson publications

KSRM COLLEGE OF ENGINEERING

NAME OF THE DEPARTMENT: MECHANICAL ENGINEERING

COURSE STRUCTURE – R20 REGULATIONS (U.G)

Course Structure (R20) – II Year

Semester-III							
S.No	**Code**	**Course Name**	**Category**	**L**	T	**P**	**Credits**
1.	2003301	Fundamentals of Statistics and Dynamics.	ES	3	0	0	3
2.	2003302	Fluid Mechanics &Hydraulic Machinery	ES	3	0	0	3
3.	2003303	Manufacturing Technology -1	PC	3	0	0	3
4.	2003304	Basic Thermodynamics	PC	3	0	0	3
5.	2003305	Mechanics of Materials	ES	3	0	0	3
6.	2003306	Fluid Mechanics &Hydraulic Machinery Lab	ES	0	0	3	1.5
7.	2003307	Manufacturing Technology Lab	PC	0	0	3	1.5
8.	2003308	Mechanics of Materials Lab	ES	0	0	3	1.5
9	2003309	Skill Oriented Course – I CATIA	SC	1	0	2	2
Total							**21.5**

Course Title	FUNDAMENTALS OF STATICS AND DYNAMICS				B. Tech. ME III Sem		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**	
2003301	**ES**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	0	--	3	40	60	100
Mid Exam Duration: 2Hrs					**End Exam Duration: 3Hrs**			

Course Objectives:

- The student should understand the some fundamental aspects of Engineering Mechanics.
- To apply and to solve a few basic problems in engineering mechanics like static equilibrium of particles and rigid bodies.
- To Analyze trusses and friction, Properties of surfaces and volumes, Dynamic equilibrium of particles, Dynamic equilibrium of rigid bodies.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Evaluate the resultant force and moment for given force system.
CO 2	Assess the forces in members of trusses, frames and problems related to friction.
CO 3	Determine the centroid of composite figures and centre of gravity of bodies .
CO 4	Determine area, moment of inertia and mass moment of inertia.
CO5	Adapt the laws of motion, kinematics of motion and their interrelationship.

MAPPING OF COs & POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2							2
CO2	3	3	2	2	2							2
CO3	3	3	2	2	2							2
CO4	3	3	2	2	2							2
CO5	3	3	2	2	2							2

UNIT I

BASIC CONCEPTS: System of Forces– Moment of Forces and its Application– Couples and Resultant of Force System- Equilibrium of system of forces- Free body diagrams –Types of Supports –Support reactions for beams with different types of loading – concentrated, uniformly distributed and uniformly varying loading.

UNIT II

ANALYSIS OF PERFECT FRAMES: Types of frames – cantilever frames and simply supported frames – Analysis of frames using method of joints.

Friction force – Laws of sliding friction – equilibrium analysis of simple systems with sliding friction – wedge friction-. Rolling resistance -Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion of simple rigid bodies such as cylinder, disc/wheel and sphere.

UNIT III

CENTROID AND CENTER OF GRAVITY: Centroids of simple figures – Centroids of Composite figures – Centre of Gravity of bodies

STRESS: Rigid bodies and deformable solids – Tension, Compression and Shear Stresses.

UNIT IV

AREA MOMENT OF INERTIA - Parallel axis and perpendicular axis theorems - Moments of Inertia of Composite Figures

MASS MOMENT OF INERTIA: Moment of Inertia of Simple solids, Moment of Inertia of composite masses.

UNIT V

Kinematics: Introduction, Velocity, Acceleration, Equations of Motion in a Straight Line under uniform Acceleration, Rectilinear Motion Under Variable Accelerations.

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

TEXT BOOKS:

1. Fedrinand L.Singer , Engineering Mechanics – B.S. Publishers 2nd Edition.
2. Mechanics of materials by EP. Popov, Printice hall of india 2017.
3. A.Nelson, Engineering Mechanics-Statics and dynamics, , Tata McGraw-Hill Company, 2009.

REFERENCES:

1. Timoshenko & Gere, Mechanics of Materials by, CBS, Revised Fourth Edition
2. B. Bhathacharya , Engineering Mechanics - Oxford University Publications, 2014.
3. Dr. R. K. Bansal ,Engineering Mechanics, Laxmi Publications,2005.

Course Title	FLUID MECHANICS & HYDRAULIC MACHINARY				B. Tech. ME III Sem		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
2003302	**ES**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	0	--	3	40	60	100
Mid Exam Duration: 2Hrs					**End Exam Duration: 3Hrs**			

Course Objectives:

. The students completing this course are expected:

1. To give insight knowledge on fluid statics and fluid dynamics
2. To teach different types of fluid flow, and boundary layer phenomena
3. To teach operation and working principles of Turbo machinery, pumps and Turbines.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Analyze the Properties of Fluid Flow.
CO 2	Categorize the different Fluids in Kinematics and Dynamics.
CO 3	Determine the major and minor losses in pipes.
CO 4	Examine Boundary Layer Separation in Fluid Flows.
CO5	Compare different Hydro dynamic forces of Jet and determine the various Turbines.

MAPPING OF COs & POs

	PO 1	PO 2	PO 3	PO 4	PO5	PO6	PO7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2										
CO 2	3	2										
CO 3	2	1										
CO 4	2	1										
CO 5	3	2		1								

UNIT I: Fluid Statics: Dimensions and units: fluid properties, mass density, weight density, specific gravity, viscosity, vapor pressure and their influence on fluid motion- atmospheric pressure, gauge pressure and vacuum pressure –measurement of pressure- Piezometer, U-tube and differential manometers.

UNIT II: Fluid Kinematics: classification of flows-steady & unsteady, uniform, non-uniform, laminar, turbulent, rotational, and irrotational flows-equation of continuity for one dimensional flow. Fluid dynamics: -Bernoulli's equation for flow along a stream line, momentum equation and its application on force on pipe bend.

UNIT III : Closed conduit flow: Laminar and turbulent flow through pipes: Reynolds experiment significance of Reynolds's number, Darcy Weisbach equation, chezy"s formula, friction factor - Minor losses in pipes- pipes in series and pipes in parallel- Measurement of flow: Pitot tube(Derivation Only),

UNIT-IV: Boundary Layer Flow: Introduction, Definitions, Drag force on a flat plate due to Boundary layer, Analysis of Turbulent Boundary layer, Separation of Boundary layer.

UNIT V: Basics of Hydraulic Machinery: Hydrodynamic force of jets on stationary and moving flat, inclined, and curved vanes, jet striking centrally and at tip, velocity diagrams, work done and efficiency.
Hydraulic Turbines : Classification of turbines, Pelton wheel, Francis turbine and Kaplan turbine-working proportions, work done, efficiencies, hydraulic design –draft tube theory-Unit and specific quantities ,Hydraulic Pumps: Working principle of Centrifugal and Reciprocating pump. (No-derivations and No Problems)

TEXT BOOKS

1. Fluid Mechanics and Machinery by Jagadeesh lal.
2. Fluid Mechanics and Hydraulic Machinery MODI and SETH, S.Chand & co, New Delhi
3. Fluid Mechanics and Hydraulic Machines By S. C. Gupta

REFERENCES:

1. Fluid Mechanics and Fluid Power Engineering by D.S. Kumar, Kotaria & Sons.
2. 3. Hydraulic Machines by Banga & Sharma, Khanna Publishers.
3. Fluid Mechanics and Hydraulic Machines by R. K. Rajput, Lakshmi Publications.

WEBSITES:

1) https://nptel.ac.in/courses/112/105/112105269/
2) https://nptel.ac.in/courses/112/105/112105171/
3) https://nptel.ac.in/courses/112/105/112105206/
4) https://nptel.ac.in/courses/112/105/112105183/

https://nptel.ac.in/courses/112/106/112106200/

Course Title	MANUFACTURING PROCESS				B. Tech. ME III Sem		
Course Code	Category	Hours/Week		Credits	Maximum Marks		
2003303	PC	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	--	3	40	60	100
Mid Exam Duration: 2Hrs					End Exam Duration: 3Hrs		

Course Objectives:

. The students completing this course are expected:

- The primary objective of this course is to introduce the concept of manufacturing technology with the help of various processes widely employed in industries.
- The course consists of casting, welding, sheet metal forming, extrusion and forging processes with the related details of equipment and applications.
- To understand various metal working process. To appreciate the capabilities, advantages and the limitations of the processes.
- To understand the various concepts of metal forming and forging along with their applications.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Interpret foundry practices like pattern making, mold making and Core making.
CO 2	Illustrate special casting processes, their Advantages, Limitations and Applications.
CO 3	Demonstrate the various types of joining processes and select the appropriate one according to the application.
CO 4	Explain and relate the basics of hot and cold working process, their advantages, Limitations and Applications.
CO5	Illustrate basic principles of Sheet metal operations.

MAPPING OF COs & POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3				3	2	2		3	2	1		3		
CO2	3				3	2	2			1	3		3		
CO3	3				2	2	2		3	2	3		3		
CO4	3				3	2	2		2	1	3		3		
Co5	3				3	2	2		2	1	3		3		

UNIT-I

METAL CASTING PROCESSES: Introduction, Steps involved in making a casting, casting terms, Pattern making - types of patterns, pattern materials, and pattern allowances. Mould making - type of moulding sands, moulding sand properties, methods of sand testing, moulding machines – types of moulding machines. Core making - Core sands, Types of cores, Core prints, Chaplets, Chills, Risers and Gating systems used in casting.

UNIT-II

SPECIAL CASTING PROCESSES: Shell Moulding, Precision Investment Casting, Permanent Moulding Casting, Die Casting, Vacuum Die Casting, Low Pressure Die Casting, Centrifugal Casting, Continuous Casting, Squeeze Casting. Melting of metals in casting- Cupola furnace, Casting Cleaning Casting Defects - Causes and Remedies.

UNIT-III

WELDING PROCESSES: Classification of welding processes, types of welded joints and their characteristics, Gas welding, Different types of flames and uses, Oxy – Acetylene Gas cutting. Basic principles of Arc welding, Manual metal arc welding, submerged arc welding, and Inert Gas welding- TIG & MIG welding. Resistance welding, Solid state welding processes- Friction welding, Friction stir welding, Forge welding, Explosive welding; Thermit welding, Plasma welding, Laser welding, electron beam welding, Soldering & Brazing. Welding Defects – Causes and Remedies.

UNIT-IV

METAL FORMING PROCESSES: Plastic deformation in metals and alloys, Hot working and Cold working, Strain hardening and Annealing.

Bulk forming processes: Forging - Types Forging, Smith forging, Drop Forging, Roll forging, Forging hammers, Rotary forging, forging defects; Rolling – fundamentals, types of rolling mills. Extrusion and its characteristics. Types of extrusion, Impact extrusion, Hydrostatic extrusion; Wire drawing and Tube drawing.

UNIT-V

SHEET METAL FORMING: Shearing operations- Punching, Blanking and piercing- Bending and forming- Drawing and its types- wire drawing and tube drawing- coining- Hot and cold spinning- Types of presses and press tools.

TEXT BOOK:

1) P N. Rao, "Manufacturing Technology", Vol-I, 4th Edition, Tata McGraw-Hill Publishing Limited,
2) P. Ghosh, A., and Malik, A. K., "Manufacturing Science, Affiliated East west Press Pvt. Ltd.2010
3) S. Kalpakjian, Manufacturing Processes for Engineering Materials, Fifth edition. Pearson Education, 2009

REFERENCE BOOKS:

1) P.C. Sharma, "A text book of production technology", S. Chand and Company, 2014
2) Begman, „Manufacturing Process", John Wilely & Sons,2011
3) Production Technology by K.L. Narayana, J.K. International Publications.3rd Edition,2014
4) Rajput R.K, "A text book of Manufacturing Technology", Lakshmi Publications, 2015
5) Hajra Choudhury, "Elements of Workshop Technology, Vol. I and II", Media Promoters Pvt. Ltd.Mumbai, 2020
6) Production Technology by R.K Jain, 6th edition, 2020.

Course Title	ENGINEERING THERMODYNAMICS				B. Tech. ME III Sem		
Course Code	**Category**	**Hours/Week**		**Credits**	**Maximum Marks**		
2003304	**PC**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	0	--	3	40	60	100
Mid Exam Duration: 2Hrs					**End Exam Duration: 3Hrs**		

Course Objectives:

. The students completing this course are expected:

- ❖ Concepts of heat, work, energy and governing rules for conversion of one form to other.
- ❖ Applications of I & II law of thermodynamics.
- ❖ To understand concept of entropy for identifying the disorder and feasibility of a thermodynamic process.
- ❖ To familiarize steam properties to understand working of steam power plants.
- ❖ To familiarize psychometric properties to understand working of Refrigeration and Air conditioning systems.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Describe the thermodynamic system, control volume, thermodynamic properties, thermodynamic equilibrium and energy transfer in the form of heat and work in various applications
CO 2	Analyze how energy transformation occurs from one form to another in open and closed systems and able to apply Steady Flow Energy Equation to various engineering devices.
CO 3	Identify the major difference in the working of a heat engine, heat pump and a refrigerator and execute the calculations of their efficiencies.
CO 4	Evaluate entropy changes in wide range of processes and determine the reversability and irreversability of a process from such calculations
CO5	Judge the properties of pure substances and familiarize with psychometric properties to understand the working of refrigeration and air conditioning systems.

MAPPING OF COs & POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1									
CO2	2	1	2									
CO3	3	2	1	1								
CO4	2	3	2	1								
CO5	1	2	2	1								

UNIT-I

Basic Concepts and Definitions: Classical and statistical thermodynamics, definitions of thermodynamic terms, quasi – static process, point and path functions, forms of energy, ideal gas and real gas, Zeroth law of thermodynamics.

Work and Heat: Non flow (P.dV) or displacement work in various reversible processes, Heat Transfer, comparison of work and heat.

UNIT-II

First Law of Thermodynamics: First law for a closed system undergoing a cycle and for a process, Joules experiment, PMM-I.

First Law Applied to Non-Flow and Flow Process, Corollaries and limitations of First Law of Thermodynamics. Simple problems.

UNIT-III

Second Law of Thermodynamics: Kelvin-Plank statement, Clausius statement, equivalence of Kelvin-plank and clausius statements, Heat engine, heat pump and refrigerator, reversibility and irreversibility, Carnot Cycle, Carnot's Theorem, PMM-II - simple problems.

UNIT-IV

Entropy: Clausius theorem, Definition of entropy, principle of entropy increase, T-s plot, change in entropy in various reversible processes.

Availability & Irreversibility: Definition of; exergy and energy, Availability in steady flow, non-flow processes and irreversibility.

UNIT-V

Properties of Steam : Formation of steam form ice to super-heated steam with reference to T-V, P-V & T-S diagrams, properties of steam, Quality of steam, expressions for the change in internal energy, enthalpy, work, heat, entropy in various processes, Use of steam Tables and Mollier's chart. Simple problems.

Psychometry

Definitions of - Dry Bulb temperature, Wet-Bulb Temperatures, Specific humidity (or) Humidity Ratio, Dew Point Temperature, Degree of Saturation, Relative Humidity, Sensible Heating, Sensible cooling, Humidification and Dehumidification. Measurement of psychometric properties using psychometric chart. Simple Problems.

TEXT BOOKS:

1) P.K. Nag Engineering Thermodynamics, 6th Edition 2019 Tata McGraw Hill, New Delhi.
2) Cengel, Thermodynamics – An Engineering Approach, 6th Edition 2019 Tata McGraw Hill, New Delhi.
3) V. Babu, Fundamentals of Engineering Thermodynamics, 2019

REFERENCE BOOKS:

1) B.P Mistra, Engineering Thermodynamics. .
2) Thermodynamics – Yadav" Central Publishers
3) E. Ratha Krishna, Fundamentals of Engineering Thermodynamics, PHI Publishers, New Delhi.

Course Title	MECHANICS OF METERIALS.				B. Tech. ME III Sem		
Course Code	Category	Hours/Week		Credits	Maximum Marks		
2003305	ES	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	--	3	40	60	100
Mid Exam Duration: 2Hrs					End Exam Duration: 3Hrs		

Course Objectives:

. The students completing this course are expected:

- To impart basic principles of solid mechanics and their associated laws.
- To understand the behaviour of engineering materials for different types of loads
- To understand the behaviour of beams under different types of loads
- To understand the nature of stresses developed in material under complex loading system
- To analyse the cylindrical shells under circumferential and radial loading conditions

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Determine the deformations, stresses and strains in members subjected to the axial and thermal load.
CO 2	Evaluate and explain the variations of the shear forces and bending moments along the axis of the beam.
CO 3	Use the bending stress concept to design the machine and tructural components.
CO 4	Evaluate the deflections at various points in the beam and determine the critical buckling loads of columns under different boundary conditions..
CO5	Analyse the principal stresses/strains and visualize the variations of normal and shear stresses in components.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1		1	2				2	2	3	3	1
CO2	3	3	2	3		2	2		1	1	2	3	3	3	2
CO3	3	3	3	2		2	2	2	1	1	1	3	3	3	3
CO4	3	3	3	2		2	2	2	1	1		3	3	3	3
CO5	3	3	3	2		2	2	2	1			3	3	3	3

UNIT- I

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

UNIT –II

SHEAR FORCE AND BENDING MOMENT: Types of beams: Supports and Loads – Shear force and Bending Moment in beams – Cantilever, Simply supported and Overhanging beams subjected to point loads, UDL, Uniformly varying loads and combination of these loads- Point of Contra flexure- Relation between S.F, B.M and rate of loading at a section of a beam.

UNIT –III

FLEXURAL STRESSES: Theory of simple bending- Assumptions- Derivation of bending equation (M/I = f/y = E/R) – Neutral axis- Determination of Bending stresses- section modulus of rectangular and circular sections (Solid and Hollow), I, T, Angle and Channel sections.

UNIT- IV

BEAM DEFLECTION: Elastic curve of Neutral axis of the beam under normal loads – Evaluation of beam deflection and slope: Double integration method, Macaulay Method.

Columns: End conditions – Equivalent length of a column – Euler's equation – Slenderness ratio – Rankin's formula for columns.

UNIT- V

PRINCIPAL STRESSES & STRAINS: Principal stresses and Principal planes, Method of determining stresses on oblique sections, Mohr's circle.

CYLINDERICAL SHELLS: Thin cylindrical shells – Derivation of formula for longitudinal and circumferential stresses –hoop, longitudinal stresses and volumetric strains.

TEXT BOOKS:

1. Mechanics of solids by Timo shenko,TMH Publications.
2. Russell Hibbeler ,Mechanics of Materials, 2016.
3. James M. Gere, Barry J. Goodno, Mechanics of materials, 7th edition, Cengage learning, 2009.

REFERENCES:

1. Nash W.A, Theory and problems in Strength of Materials, Schaum Outline Series, McGraw-Hill Book Co,
2. Strength of materials by Bhavikatti, Lakshmi Publications.
3. Engineering Mechanics of Solids by Popov E.P, Prentice-Hall of India, New Delhi.
4. Singh D.K "Mechanics of Solids" Pearson Education.
5. Beer F. P. and Johnston R, Mechanics of Materials, McGraw-Hill Book Co, Third Edition.

Course Title	FLUID MECHANICS & HYDRAULIC MACHINARY LAB				B. Tech. ME III Sem		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**	
2003306	**ES**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	0	--	3	40	60	100
Mid Exam Duration: 2Hrs					**End Exam Duration: 3Hrs**		

Course Objectives:

. The students completing this course are expected:

This course "Fluid Mechanics and Hydraulic Machines" lab imparts intensive and extensive practical knowledge of the lab so that students can understand the importance of concepts of "Fluid Mechanics and Hydraulic Machines" in the field of engineering. The student should able to develop theoretical / practical capabilities so that they can characterize, transform, use and apply in engineering from the knowledge gained in solving related engineering problem.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Enable the students to use knowledge of Fluid mechanics and hydraulic machines for practical applications.
CO 2	Develop the ability for running hydraulic machines lab.
CO 3	Understand the working function of various devices used in hydraulic power plant.
CO 4	Examine the principle of Bernoulli's theorem.
CO5	Determine the forces for impact of jet on Vanes.

	PO 1	PO 2	PO 3	PO 4	PO5	PO6	PO7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	3	2		2	2					1
CO 2	2	2	1	1		2	1					1
CO 3	3	2	1	2		2	2					2
CO 4	3	1	1	1		1	2					1
CO 5	2	1	3	3		2	1					1

LIST OF EXPERIMENTS:

1. Verification of Bernoulli's Equation
2. Calibration of mouth piece/orifice
3. Calibration of Triangular Notch/Rectangular Notch
4. Calibration of Venturi meter
5. Calibration of Orifice meter
6. Determination of Friction Factor for a given pipe line
7. Impact of Jet on Vanes
8. Performance Test on Pelton Wheel
9. Performance Test on Francis Turbine
10. Performance Test on Kaplan Turbine
11. Performance Test on Single Stage Centrifugal Pump
12. Performance Test on Reciprocating Pump

Note: Conduct Any Ten FROM ABOVE Experiments

Course Title	MANUFACTURING TECHNOLOGY LAB				B. Tech. ME III Sem			
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
2003307	**PC**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	0	--	3	40	60	100
Mid Exam Duration: 2Hrs					**End Exam Duration: 3Hrs**			

Course Objectives:

. The students completing this course are expected:

- ❖ The student should understand the some fundamental aspects and design concepts of manufacturing, pattern and pattern makings for the casting process.
- ❖ To determine the sand Viz., strengths and permeability of a sand materials and moisture percentages of green sand.
- ❖ To teach techniques adopted in welding processes like arc, gas, spot, plasma and brazing processes and also deep drawing process for making a small size parts with the help of blanking, piercing operations.
- ❖ To extrusion operations, bending and processing of plastics like injection moulding and blow moulding.
- ❖ The student should be prepared to continue the study and analysis of the production machine parts.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Develop models like pattern , mold making and Core making
CO 2	Illustrate special casting processes and their applications.
CO 3	Demonstrate the various types of joining processes .
CO 4	Develop models using Hydraulic press..

MAPPING OF POs & COs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	2			1							1	1	3
CO2	1	1	2			1							1	1	3
CO3	2	1	2			1							1	1	3
CO4	1	1	2			1							1	1	3

I. METAL CASTING LAB:

1) Pattern Design and Making : 1 Exercise - for one casting
2) Sand Properties Testing : 2 Exercises - Strength and Permeability
3) Casting : 1 Exercise

II. WELDING LAB:

1) Arc Welding : 3 Exercises (Lap joint, Butt Joint & T- Joint)
2) Spot welding : 1 Exercises
3) Soldering of thin sheets : 1 Exercises

III. MECHANICAL PRESS WORKING:

1) Hydraulic Press: Deep Drawing : 1 Exercise
2) Pipe Bending : 1 Exercise

IV. PROCESSING OF PLASTICS:

1) Injection Moulding : 1 Exercise
2) Blow Moulding : 1 Exercise

Course Title	MECHANICS OF MATERIALS LAB				B. Tech. ME III Sem		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**	
2003308	**ES**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	0	--	3	40	60	100
Mid Exam Duration: 2Hrs					**End Exam Duration: 3Hrs**		

Course Objectives:

. The students completing this course are expected:

1. The student should understand the some fundamental aspects and design concepts of To develop capability to of mount the specimen on the matrix material and able to identify the given metal by observing the micro structure
2. To Distinguish the Ferrous and non-Ferrous structures
3. To study the effect of heat treatment on microstructures
4. To understand the some fundamental aspects and failure modes of engineering materials with the applications of sudden and gradually applied loads.
5. To find out the hardness of the various materials with the help of Brinell‟s & Rockwell hardness testing machines.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Gains the knowledge of preparing the sample for metallurgical observations.
CO 2	Identify the material based on its micro structure and also assess its mechanical properties.
CO 3	Realize the effect of heat treatment on the mechanical properties of the material.
CO 4	Determine the Elastic constants and strength of the given material using Tension compression, torsion & Deflection tests.
CO5	Determine the strain energy stored in the material under impact loads.

MAPPING OF COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	2	1	1	3	1	2		1	1	2
CO2	3	1	1	1		1	1	1	3	1			1	1	2
CO3	3	3	2	2	1	2	1	1	3	1	2		2	1	2
CO4	3	3	2	2	1	2	1	1	1	1	1	1	1	2	1
CO5	3	3	2	2		2	1	1	1	1	1	1	1	1	1

LIST OF EXPERIMENTS:

Note: Conduct any FIVE experiments form each cycle.

Cycle-I: Materials Science Lab

1. Specimen preparation and study of the Microstructure of Low carbon steel, Medium carbon steels and high carbon steels.
2. Study of the Micro Structures of Cast Irons.
3. Study of Micro Structure of Austenitic- stainless steel and High speed steel.
4. Study of the Micro Structures of Non-Ferrous alloys (Al-alloy, Cu-alloy)
5. Determination of hardenability of steels by Jominy End Quench Test.
6. Magna Flux testing method.

Cycle-II: Mechanics of Solids Lab

1. Determination of stress-strain characteristics of Mild steel rod using Universal Testing Machine.
2. Torsion test on mild steel rod.
3. Determination of Impact strength of the metals.
4. Hardness test on metals – using Brinnel & Rockwell hardness testing machine.
5. Determination of modulus of Elasticity and flexural rigidity of beams.
6. Determination of modulus of rigidity of helical springs.

Course Title	CATIA (skill oriented course)				B. Tech. ME III Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks	
2003309	PC	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		1	0	0	2	40	60	100
Mid Exam Duration: 2Hrs					End Exam Duration: 3Hrs		

Course Objectives:

To establish the scientific and regulatory basis of graphical representation in the general context of Industrial Engineering, as a means of expression and communication for the design, creation, definition and development of an industrial installation and/or product making practical use of the current technological means available, consistent with the scientific teaching framework and in response to technological evolution.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Understand the user interface of CATIA software.
CO 2	Analyse the different commands to design the complicated machine parts.
CO 3	Create a assembly of of machine components
CO 4	Examine the assembly of Machine commands.

MAPPING OF COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2		3		3		1	1	2	3	3	3	1	3	3
CO2	2		3		3		1	2	2	3	3	3	2	3	3
CO3	1	2	3	3		1		1	2	1	3	3	2	3	3
CO4	1	2	3	3			1		2	1	3	3	2	3	3

Syllabus

1. INTRODUCTION TO STANDARDISATION: Formats. Scales. Lines. Lettering.
2. ANALYSIS OF CORPOREAL FORMS. Formal definition. Constructive geometry. Main, basic, complementary andauxiliary views. Internal and external visualisation.
3. DIMENSIONING. Defining dimensions. Definition of functional, manufacturing, verification and geometricdimensions.
4. DIMENSIONAL AND GEOMETRIC TOLERANCES. Definition of dimensional and geometric error.Standardised adjustments. Form, position and runout tolerances.
5. MECHANICAL SURFACE STATE. MATERIALS. TREATMENTS. Roughness types.
6. HOLDING SYSTEMS. Disassemble and non-disassemble.
7. MOTION TRANSMISSION AND TRANSFORMATION ELEMENTS. Cogs. Friction and chain wheels. Belts andpulleys. Springs. Bearings. Cams and eccentric cams.
8. MECHANICAL ASSEMBLIES. Areas of Mechanical Engineering, Electrical Engineering, and

Industrial ChemicalEngineering.

Assembly and exploded view drawings. Symbols.

9. INTRODUCTION TO COMPUTER AIDED DESIGN. CAD/CAM/CAE/CIM
10. INTRODUCTION TO A CAD SYSTEM: CATIA. Catia V5 environment.

SOLID 3D MODELLING. OBTAINING 2D DRAWINGS. ASSEMBLY OF MECHANICAL ASSEMBLIES. CADPRACTICE. Catia V5 Sketcher, Part, Generative Drafting, Product and Assembly Modules

REFERENCES:

- Apuntes de Teoría y Prácticas de Expresión Gráfica. Profesores del Departamento de Expresión Gráfica. EscuelaUniversitaria de Ingeniería de Vitoria-Gasteiz. 2010
- FELEZ, Jesús; MARTINEZ M. Luisa. Ingeniería Gráfica y diseño. Madrid. 1st Edition. (Editorial
- Síntesis 2008). 867 pages. ISBN 978-84-975649-9-1
- Normas UNE de Dibujo Técnico (3rd edition) Cd-rom. AENOR. 2005.
- Notes on 3D Modelling and CAD Practice. Teachers of the Department of Graphic Expression. University Collegeof Engineering of Vitoria-Gasteiz. 2010
- DASSAULT SISTEMES Users Guide Part Design / Wireframe and surfaces / / Assembly design / Generativedrafting /CATIA V5 2008

Websites

- www.aenor.es ,
- www.iso.org
- www.abgam.es

	SEMESTER -IV							
Subject Code	**Subject Category**	**Course Name**	**L**	**T**	**P**	**IM**	**EM**	**CR**
2025401	HSS	Humanities Elective- I (Business Economics and Accounting for Engineers)	3	0	0	40	60	3
2021402	BSC	Probability Statistics and Numerical Methods	3	0	0	40	60	3
2003403	PCC	Applied Thermodynamics	3	0	0	40	60	3
2003404	PCC	Kinematics of Machinery	3	0	0	40	60	3
2003405	PCC	Machine tools	3	0	0	40	60	3
2003406	PCC	Applied Thermodynamics lab	0	0	3	40	60	1.5
2003407	PCC	Manufacturing Technology Lab-II	0	0	3	40	60	1.5
2003408	PCC	Computer Aided Machine Drawing.	0	0	3	40	60	1.5
2003409	SOC	Skill Oriented Course – IICNC Programming and simulation.	1	0	2	40	60	2
2024410	HSMC	Universal Human Values	3	0	0	40	60	3
	Total					**360**	**540**	**24.5**

Course Title	NUMERICAL METHODS AND PROBABILITY				B. Tech. ME IV Sem		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**	
2021402		**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	0	--	3	40	60	100
Mid Exam Duration: 2Hrs					**End Exam Duration: 3Hrs**		

Course Objectives:

The students completing this course are expected:

To familiarize the students with the foundations of probability and Numerical methods.

To impart probability concepts and Numerical methods in various applications in Engineering

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Understand various Numerical methods to solve transcendental equations and rate of convergence. Analyze the concept of Interpolation its applications in digital image processing, computer graphics and in many engineering disciplines
CO 2	Understand the concept of Numerical differentiation and integration and its importance in mechanics.
CO 3	Identify various numerical methods to solve linear and non-linear ordinary differential equations and its applications in non-linear analysis.
CO 4	To know the importance of probability, random variables and distributions in solving various mechanical and civil engineering problems.
CO5	To know Random variables, Expectation, Discrete and continuous.

MAPPING OF COs & POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	3	2	-	-	-	-	-	-	-
CO2	3	3	2	2	3	-	-	-	-	-	-	-
CO3	2	3	2	3	2	-	-	-	-	-	-	-
CO4	3	2	3	2	3	-	-	-	-	-	-	-
CO5	2	3	2	3	3	-	-	-	-	-	-	-

UNIT-I

Solution of Algebraic and Transcendental Equations: Introduction – The Bisection Method – The Method of False Position – The Iteration Method – Newton-Raphson Method.

UNIT-II

Interpolation: Introduction – Finite differences – Forward Differences – backward Differences – Newton's forward and backward difference formulae for interpolation – Gauss forward and backward difference formulae for interpolation - Lagrange's Interpolation formula.

UNIT-III

Numerical Differentiation – Numerical Integration – Newton-cote's integration formula – Trapezoidal rule – Simpson's 1/3 Rule – Simpson's 3/8 Rule.

Numerical solution of Ordinary Differential equations: Solution by Taylor's series-Picard's Method of successive Approximations – Euler's Method – Runge – Kutta Method.

UNIT-IV

Curve fitting: Fitting a straight line – Second degree curve – Exponential curve-Power curve by method of least squares.

UNIT-V

Basic concept of probability – Random variables – Expectation – Discrete and continuous distributions.

TEXTBOOKS:

1) Iyengar T.K.V., Krishna Gandhi B., Rangantham S., and Prasad M.V.S.S.N., (2006), "Mathematical Methods", S. Chand & Company, India.
2) Iyengar T.K.V., Krishna Gandhi B., Rangantham S., and Prasad M.V.S.S.N., (2015), "Probability and Statistics", S. Chand & Company, India.

REFERENCES:

1) Erwin kreyszig., (2011), "Advanced Engineering Mathematics", 10th Edition, John Wiley & Sons, United States
2) Ramana B.V., (2010), "Higher Engineering Mathematics", Tata McGraw Hill New Delhi, 11th Reprint, India
3) Kandasamy P., Thilagavathy K., and Gunavathi K., (2012), 2nd Edition, Numerical Methods, S. Chand & Company, Reprint India
4) Sastry S.S., (2005), 4th Edition, "Introductory methods of numerical analysis"., PHI.
5) Grewal B.S., (2010), 35th Edition, "Higher Engineering Mathematics"., Khanna Publishers, India

Course Title	APPLIED THERMODYNAMICS				B. Tech. ME IV Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks	
2003403		L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	--	3	40	60	100
Mid Exam Duration: 2Hrs					End Exam Duration: 3Hrs		

Course Objectives:

. The students completing this course are expected:

- To learn about IC engines and , theory of combustion
- To learn about vapour cycles and their first law and second law efficiencies
- To learn about gas dynamics of steam through nozzles
- To learn the about reciprocating compressors with and without inter cooling

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Analyze the air standard cycles and can explain the working principle of different IC engines.
CO 2	Explain various stages of combustion in SI and CI engines.
CO 3	Evaluate the performance of IC engines and can explain the various engine emissions and their BS norms.
CO 4	Analyze Vapour power cycles and combined gas & vapour power cycles.
CO5	Understand the functionality and working principle of Reciprocating & Rotary compressors, vapour Compression & Vapour Absorption Refrigeration Systems.

MAPPING OF COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	2	2		1						
CO2	2	1	1	2		1						
CO3	2	2	3	2		2						
CO4	2	2	2	2								
CO5	2	2	2	2								

UNIT-I

Air Standard Cycles: Air Standard Otto Cycle, Diesel Cycle, Thermal Efficiency, Comparison of Otto and Diesel. Simple problems on Otto & diesel cycles.

Introduction to IC Engines: Energy conversion, Classification of I.C. Engines, Working principle of two stroke and four stroke engines & application of I.C Engines.

UNIT-II

Combustion in I.C Engines: Stages of combustion in SI & CI Engines - Importance of flame speed and factors influencing the flame speed in SI engines- Importance of ignition delay period and factors affecting the ignition delay period in CI Engines- Abnormal Combustion - pre-ignition- Phenomenon of Knocking SI & CI, Summary of Engine variables affecting the knocking, Comparison of knock in SI & CI Engines.

UNIT-III

Testing and Performance: Engine Performance Parameters - Emissions from Diesel & Petrol Engines, BS-Norms - Simple problems on performance and heat balance sheet.

UNIT-IV

Vapor power cycles: Rankine cycle with superheating, reheating and regeneration. Supercritical and ultra super-critical Rankine cycle. Combined gas and vapor power cycles. Simple problems on Rankine Cycle.

UNIT-V

Steam Nozzles: Introduction - types, Steam flow through nozzles- condition for maximum discharge (critical pressure ratio), Nozzle efficiency - Simple problems.

Air Compressors: Introduction, Classification - Reciprocating compressors, optimal pressure ratio, effect of inter cooling, minimum work for multistage reciprocating compressors- Introduction to rotary compressors.

Refrigeration & Air Conditioning: Working principle of vapor compression & Vapor Absorption refrigeration system, – summer and winter air conditioning system.

TEXT BOOKS:

1) Fundamentals of Thermodynamics, Sonntag, R. E, Borgnakke, C. and Van Wylen.
2) Thermodynamics and Heat Engines, R.Yadav, Central Book Depot.
3) Yunus A Cengel; Michael A Boles , Thermodynamics: An Engineering Approach, 2017.

REFERENCES:

1) Thermal Engineering - M.L.Mathur & Mehta, Jain bros.
2) Thermal Engineering, R.K. Rajput, 7/e, Lakshmi Publications, 2009.
3) Fundamentals of Engineering Thermodynamics, Moran, M. J. and Shapiro

Course Title	KINEMATICS OF MACHINES				B. Tech. ME IV Sem		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**	
2003404		**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	0	--	3	40	60	100
Mid Exam Duration: 2Hrs					**End Exam Duration: 3Hrs**		

Course Objectives:

. The students completing this course are expected:

To study about terms used in kinematics of machinery.

- ❖ To learn how to analyse the motions of link mechanisms and to analyse forces in machines.
- ❖ To analyse the motions of Cam and follower assembly.
- ❖ To locate the instantaneous centre for the given planer mechanism.
- ❖ To determine the velocity and accelerations of the linkages in a planer mechanism.
- ❖ To study about the toothed gears and related terminology.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Classify different types of links and mechanisms used for different purposes in different machines.
CO 2	Solve the forces, velocities and accelerations in different mechanisms and machines components
CO 3	Determine the angular velocities by Instantaneous center method and discover straight-line motion Mechanisms
CO 4	Construct and analyze cam profiles for a specified motion of the follower
CO5	Solve problems on toothed gears, cycloidal and involute profiles.

MAPPING OF COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2							2
CO2	3	3	2	2	2							2
CO3	3	3	2	2	2							2
CO4	3	3	2	2	2							2
CO5	3	3	2	2	2							2

UNIT – I

MECHANISMS : Elements or Links – Classification – Rigid Link, flexible and fluid link – Types of kinematic pairs – sliding, turning, rolling, screw and spherical pairs – lower and higher pairs – closed and open pairs – constrained motion – completely, partially or successfully constrained and incompletely constrained .

MACHINES : Mechanism and machines – classification of machines – kinematic chain – inversion of mechanism – inversions of quadric cycle, chain – single and double slider crank chains.

UNIT - II

KINEMATICS: Velocity and acceleration – Motion of link in machine – Determination of Velocity and acceleration diagrams – Graphical method – Application of relative velocity method four bar chain.

Analysis of Mechanisms: Analysis of slider crank chain for displacement, velocity and acceleration of slider – Acceleration diagram for a given mechanism, Klein's construction.

UNIT-III

PLANE MOTION OF BODY: Instantaneous center of rotation, centroids and axodes – relative motion between two bodies – Three centres in line theorem – Graphical determination of instantaneous centre, diagrams for simple mechanisms and determination of angular velocity of points and links.

Straight Line Motion Mechanisms: Exact and approximate copiers and generated types –Peaucellier, Hart and Scott-Rassul – Grasshopper – Watt T. Chebi-cheff and Robert Mechanisms and straight line motion, Pantograph.

UNIT – IV

CAMS: Definitions of cam and followers – their uses – Types of followers and cams – Terminology – Types of follower motion - Uniform velocity – Simple harmonic motion and uniform acceleration. Maximum velocity and maximum acceleration during outward and return strokes in the above three cases.

UNIT – V

TOOTHED GEARING: Higher pairs, friction wheels and toothed gears – types – law of gearing, condition for constant velocity ratio for transmission of motion, Form of teeth: cycloidal and involute profiles. Velocity of sliding – phenomena of interferences – Methods of interference. Condition for minimum number of teeth to avoid interference, expressions for arc of contact and path of contact.

TEXT BOOKS:

1. Theory of Machines and Mechanisms-S.S.Rattan, Tata McGraw Hill Publishers
2. Theory of Machines by Thomas Bevan/ CBS.
3. Theory of Machines, 5th Edition, Dattaji K Shinde.

REFERENCE BOOKS:

1. Theory of Machines / R.K Bansal, Lakshmi Publications.
2. Theory of machines by Jagadishlal.
3. Mechanism and Machine Theory / JS Rao and RV Dukkipati / New Age
4. The theory of Machines /Shiegley/ Oxford. Theory of machines – PL. Balaney/khanna publishers

Course Title	MACHINE TOOLS				B. Tech. ME IV Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks	
2003405	PCC	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	-	0	3	40	60	100
Mid Exam Duration: 2Hrs					End Exam Duration: 3Hrs		

Course Objectives:

Course Objective:

- The objectives of this course are to introduce to demonstrate the fundamentals of machining processes and machine tools.
- To develop knowledge and importance of metal cutting parameters, tool materials, cutting fluids and tool wear mechanisms.
- To apply knowledge of basic mathematics to calculate the machining parameters for different machining processes and acquire knowledge on advanced manufacturing processes.
- The students will have the knowledge and hands-on experience that will enable them to work in a typical machine shop.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Apply basic knowledge in machining aspects of orthogonal cutting, oblique cutting, mechanism of chip formation and use of engine lathe.
CO 2	Examine the working principle and parts of shaper, planer, slotter and unconventional machining methods.
CO 3	Analyze the basic parts and operations performed on drilling and boring machines.
CO 4	Evaluate the use of milling machines and applications of indexing methods on milling machines.
CO5	Select the abrasives for grinding wheels, lapping , honing and broaching operations.

MAPPING OF COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2					3		2		2	
CO2	3	2	2	2			2		2			
CO3	3	2	2		2						2	
CO4	3	2	3	2	2						2	
CO5	3	2	3	2	2							

UNIT – I

Basic elements of machining – Orthogonal, Oblique Cutting, Classification of cutting tools. Geometry of Single point cutting tool and Angles, Types of Chips, Chip Breakers. Cutting Tool materials, Tool failures.

ENGINE LATHE: Principle of working, Specification of Lathe, Types of Lathes, Operations performed, Workholding devices, Machining Parameters – Cutting Speed, Feed, Depth of Cut and Machining time, Taper turning methods, Thread cutting,

UNIT – II

Shaper– Working principle, Specifications, Classification, Principle parts of a Shaper, Machining time Calculations.

Planer - Working principle, Specifications, Classification, Principle parts of a Planer

Slotter - Working principle, Specifications, Classification, Principle parts of a Slotter

Un conventional Machining methods:EDM,ECM,EBM.

UNIT – III

DRILLING MACHINES: - Specifications, Operations performed, tool holding devices, Twist drill, types of drilling machines – Sensitive drilling machine, Upright drilling machine, radial drilling machine, Gang drilling machine, Multiple Spindle drilling machine.

BORING MACHINES: Types – Horizontal Boring machine, Jig Boring machine.

UNIT – IV

Milling machine – Principles of working – specifications – classifications of milling machines – Principle features of horizontal, vertical and universal milling machines –machining operations,– Up milling and Down milling - Working mechanism of Universal Dividing head, methods of indexing –Direct, Plain, Compound, Differential and Angular.

UNIT –V

GRINDING MACHINES: Classification of grinding machines – Cylindrical and Surface grinding machines – Tool and Cutter Grinders. Grinding wheel – Specification, Selection of grinding wheel, Wheel truing and Wheel dressing.

BROACHING : Types of broaching machines – Horizontal, Vertical, Continuous broaching machines, Elements of broach, broaching operations.Introduction to Lapping and Honing.

TEXT BOOKS:

1. Winston A. Knight , Geoffrey Boothroyd, Fundamentals of Metal Machining and Machine Tools, 2005
2. Production Technology, R.K. Jain and S.C. Gupta.
3. Workshop Technology – Vol II, B.S. Raghuwanshi.

REFERENCES :

1. Machine Tools, C.Elanhezhian and M. Vijayan, Anuradha Agencies Publishers.
2. Manufacturing Technology, Kalpakzian, Pearson
3. Production Technology, H.M.T. (Hindustan Machine Tools).
4. Introduction to Manufacturing Technology, Date, Jaico Publ. House

Course Title	APPLIED THERMODYNAMICS LAB				B. Tech. ME IV Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks	
2003406		L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	--	3	40	60	100
Mid Exam Duration: 2Hrs					End Exam Duration: 3Hrs		

Course Objectives:

. The students completing this course are expected:

- ❖ Imparting intensive and extensive knowledge of the Lab so that students can understand the role of Thermal Engineering in the field of Engineering.
- ❖ Developing theoretical/practical capabilities of students so that they can characterize, transform and use Thermal Engineering in Engineering and Apply knowledge gained in solving related Engineering problems.
- ❖ The student should able to know the use of various air compressors.
- ❖ The student should able to know the use of refrigeration systems.
- ❖ The student should able to know the use of air conditioning systems.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Applying the practical skills in designing and testing the thermal engineering related equipment.
CO 2	How to estimate the performance of a boiler.
CO 3	How to estimate the performance of an air compressor.
CO 4	Conducting and Estimating the performance of a refrigerator and air conditioning systems.

MAPPING OF COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3		2	2	3	2		3		1	3
CO2	3	3		2	2	3	2		3		1	3
CO3	3	3		2	2	3	2		3		1	3
CO4	3	3		2	2	3	2		3		1	3

LIST OF EXPERIMENTS:

(Conduct any Five from each cycle for Record)

CYCLE: I

1) Draw the Actual Valve & Port timing Timing Diagrams of a four stroke Diesel/ two stroke petrol Engines.
2) Performance Test on 4S Single Cylinder/Multi Cylinder Petrol / Diesel Engine test rigs.
3) Performance Test on VCR Computerized Multifuel Research Engine test rig.
4) Determination of Engine friction Power by Morse, retardation & Willan's line test Methods.
5) To draw the HBS/HBC on 4S Single Cylinder/Multi Cylinder Petrol / Diesel Engine test rigs.
6) To draw the HBS/HBC on VCR Computerized Multifuel Research Engine test rig.
7) Measurement of I.C Engine Exhaust Gas Emissions from Petrol/Diesel Engines.

CYCLE: II

1) Determination of Volumetric & Isothermal Efficiency of Multi Stage Reciprocating Air Compressor Test Rig.
2) Performance test on Centrifugal/axial flow air compressor test rig.
3) Determination of COP of a Vapor Compression Refrigeration Test Rig.
4) Determination of COP of a Summer/winter Air Conditioning Test Rig.
5) Determination of Calorific Value of a liquid/gaseous fuels.
6) Determination of Kinematic & Dynamic Viscosities of liquid fuels by using Redwood & Say Bolt Viscometer.
7) Determination of flash & Fire Points of Liquid Fuels by using Cleveland's & Ables apparatus.

STUDY:

1) Study of I.C Engine Parts.

Course Title	MACHINE TOOLS LAB				B. Tech. ME IV Sem		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**	
2003407	**PCC**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		0	-	3	1.5	50	50	100
Mid Exam Duration:					**End Exam Duration: 3Hrs**		

Course Objective:

The students are required to understand the parts of various machine tools and operate them. They are required to understand the different shapes of products that can be produced on these machine tools.

Course outcomes:

CO1	Identify various machine tools used in machine shop
CO2	Illustrate turning, taper turning, knurling &thread cutting on engine lathe
CO3	Ability to use shaper, slotter, drilling & grinding machines
CO4	Able to manufacture a gear on milling machine

MAPPING OF COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	3				2				1	2
CO2	2	1	3				2				1	2
CO3	3	2	2				2				1	2
CO4	3	1	3				2				1	2

LIST OF EXPERIMENTS

1. Demonstration of construction & operations of general purpose machines: Lathe, Drilling machine, Milling machine, Shaper, Planning machine, Slotting machine, Cylindrical Grinder, Surface grinder and Tool &cutter grinder.
2. Job on Step turning and taper turning on lathe machine
3. Job on Thread cutting and knurling on -lathe machine.
4. Job on Drilling and Tapping
5. Job on Shaping
6. Job on Slotting
7. Job on Milling (Gear cutting)
8. Job on Surface Grinding
9. Job on Grinding of Tool angles.

Course Title	COMPUTER AIDED MACHINE DRAWING				B. Tech. ME IV Sem		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**	
2003408	**PC**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		0	-	3	1.5	50	50	100
Mid Exam Duration:					**End Exam Duration: 3Hrs**		

Course Objective:

- Introduce conventional representations of material and machine components.
- Train to use software for 2D and 3D modeling.
- Familiarize with thread profiles, riveted, welded and key joints.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Demonstrate the conventional representations of materials and machine components.
CO 2	Create solid models and sectional views of machine components.
CO 3	Design 3D assemblies into 2D drawings.
CO 4	Create manufacturing drawing with dimensional and geometric tolerances
CO5	Create the part modeling and assembling with limits, fits and tolerances.

MAPPING OF COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3				2						1	3
CO2	3				2						1	2
CO3	2				2						1	3
CO4	3				2						1	3
CO5	3				2						1	3

The following contents are to be done by any 2D software package

Conventional representation of materials and components:

UNIT-I

Detachable joints: Drawing of thread profiles, hexagonal and square-headed bolts and nuts, bolted joint, bolted joint with washer and locknut, stud joint, screw joint.

UNIT-II

Riveted joints: Drawing of rivet, lap joint, butt joint with single strap, single riveted , double riveted double strap joints.

UNIT-III

Welded joints: Lap joint and T joint with fillet, butt joint with conventions.

Keys: Taper key, sunk taper key, round key, saddle key, feather key, woodruff key. Shaft coupling, bushed pin-type flange coupling, universal coupling, Oldhams' coupling.

The following contents to be done by any 3D software package

UNIT-IV

Sectional views

Creating solid models of complex machine parts and create sectional views.

UNIT-V

Assembly drawings: (Any four of the following using solid model software)

Lathe tool post, tool head of shaping machine, tail stock, machine vice, gate valve, carburettor, piston, connecting rod, eccentric, screw jack, plumber block, axle bearing, pipe vice, clamping device, Geneva cam, universal coupling,

Production drawing:

Representation of limits, fits and tolerances for mating parts. Use any four parts of above assembly drawings and prepare production drawing with dimensional and geometric tolerances.

Text Books:

1. K.L.Narayana, P.Kannaiah ,Machine Drawing ,New age international Publications, sixth Edition 2019
2. Dr.R.K Dahwan ,A Text Book of Machine Drawing ,s.chand Publications,2018
3. N.D.Bhatt ,Machine Drawing , charotar publications 2018

Reference Books:

1. Cecil Jensen, Jay Helsel and Donald D.Voisinet, Computer Aided Engineering Drawing, Tata Mcgraw-Hill, NY, 2016
2. James Barclay, Brain Griffiths, Engineering Drawing for Manufacture, Kogan Page Science, 2016.
3. B.Bhattacharya, Machine Drawing, oxford publications 2017.

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course Title	CNC Programming and simulation				B. Tech. ME IV		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**	
2003409	**SC**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		1	0	2	2	40	60	100
Mid Exam Duration:					**End Exam Duration:**		

Course Objectives:

1. To study the basics of NC
2. To study the CNC Part Programming Fundamentals
3. To study the Turning center Programming
4. To study various CNC Turning and simulations
5. To study Various Milling and simulations

Course Outcomes: On successful completion of this course, the students will be able to

CO1	Identify the various Introductory concepts of Computer Numerical Control.
CO2	Develop Knowledge on CNC Codes and their appropriate usage in Coding.
CO3	Determine different Machining Centers and Turning centers, Motion commands, thread and canned. cycles
CO4	Create and simulate different CNC Turning Programs and operations.
CO5	Build and simulate different CNC Milling Programs and operations.

MAPPING OF COs & POs:

CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3		3	2			2			2
CO2	2		1		3	1			1			2
CO3	2			2	3							
CO4	2	1	1	2	2							2
CO5	2	1	1		2							2

UNIT-I- Introduction to Computer Numerical Control, Introduction, Numerical Control, Numerical control Modes, Numerical control elements, NC Machine Tools. Cutting Tool Materials, Turning Tool Geometry, Milling Tooling systems, Tool Presetting, Automatic Tool Changers, Work Holding, cutting process parameter selection

UNIT_II CNC Programming: Part Programming Fundamentals, Manual Part Programming Methods, Preparatory Functions, Miscellaneous Functions, Explanation of G-Codes, Program Number, Tool Length compensation, canned cycles, cutter radius compensation.

UNIT III Turning center Programming: comparison between Machining centers and Turning centers, Tape Formats, Axes System, General Programming Functions, Motion commands, Cut Planning, Thread cutting, canned cycles.

UNIT IV CNC Turning : Plane Turing operation, Step Turing operation, Taper Turing operation, Thread Cutting operation, Multiple Turning operation.

UNIT-V:CNC Milling : Drilling operation, slotting operation**,** Profile Milling Model-I, Profile Milling Model-II, Circular Pocketing

TEXT BOOKS:

1.CAD/CAM Principles and Applications,P.N.Rao,Tata MC Graw Hill Publishing company Limited,New Delhi,publications 2016
2.CAD/CAM Concepts and Applications,Chennakesava R.Alavala,PHI Publishers,newdelhi 2011.
3.CAD/CAM Ibrahim Zeid,second edition Tata Mc Graw Hill

REFERENCES:

1.Fundamentals of computer Aided Manufacturing, khushdeep Goyal. S.K.Kataria & Sons, August 2013.
2.CAD/CAM By Ashok Kumar Singh JBC Publication, New Delhi,2015.
3.CNC Programming by Ashok Kumar Singh ,JBC Publication ,NEW Delhi 2015.

Course Title	UNIVERSAL HUMAN VALUES				B.Tech CSE IV Sem (R20)		
Course Code	Category	Hours/Week			Credits	Maximum Marks	
2024410	HSMC	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 90 Minutes					External Exam Duration: 3Hrs		

Course Objectives:

- Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
- Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence.
- Strengthening of self-reflection.
- Development of commitment and courage to act.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Students are expected to become more aware of themselves, and their surroundings (family, society, nature).
CO 2	They would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.
CO 3	They would have better critical ability.
CO 4	They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society).
CO 5	It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

UNIT- I

Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

- Purpose and motivation for the course, recapitulation from Universal Human Values-I.
- Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration.
- Continuous Happiness and Prosperity- A look at basic Human Aspirations.
- Right understanding, Relationship and Physical Facility- the basic requirements for fulfillment of aspirations of every human being with their correct priority.
- Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario.
- Method to fulfill the above human aspirations: understanding and living in harmony at various levels.

Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking.

UNIT-II

Understanding Harmony in the Human Being - Harmony in Myself!

- Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
- Understanding the needs of Self ('I') and 'Body' - happiness and physical facility
- Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)
- Understanding the characteristics and activities of 'I' and harmony in 'I'
- Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail
- Programs to ensure Sanyam and Health.

Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease

UNIT-III

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

- Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship
- Understanding the meaning of Trust; Difference between intention and competence
- Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship
- Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals
- Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.

UNIT-IV

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

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

Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

UNIT-V

Implications of the above Holistic Understanding of Harmony on Professional Ethics

- Natural acceptance of human values
- Definitiveness of Ethical Human Conduct
- Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
- Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.
- Case studies of typical holistic technologies, management models and production systems
- Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizationsSum up.

Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. To discuss the conduct as an engineer or scientist etc.

Text Books:

1. R R Gaur, R Asthana, G P Bagaria, "A Foundation Course in Human Values and Professional Ethics", 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1
2. R R Gaur, R Asthana, G P Bagaria, "Teachers' Manual for A Foundation Course in Human Values and Professional Ethics", 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2.
3. E. FSchumacher. "Small is Beautiful".
4. Slow is Beautiful –Cecile Andrews

Reference Books:

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amar kantak, 1999.
2. A. N. Tripathi, "Human Values", New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. Mohandas Karamchand Gandhi "The Story of My Experiments with Truth"
5. J C Kumarappa "Economy of Permanence"
6. Pandit Sunderlal "Bharat Mein Angreji Raj"
7. Dharampal, "Rediscovering India"
8. Mohandas K. Gandhi, "Hind Swaraj or Indian Home Rule"
9. India Wins Freedom - Maulana Abdul Kalam Azad
10. Vivekananda - Romain Rolland(English)
11. Gandhi - Romain Rolland (English)

MOE OF CONDUCT (L-T-P-C 2-1-0-2)

Lecture hours are to be used for interactive discussion, placing the proposals about the topics at hand and motivating students to reflect, explore and verify them. Tutorial hours are to be used for practice sessions.

While analyzing and discussing the topic, the faculty mentor's role is in pointing to essential elements to help in sorting them out from the surface elements. In other words, help the students explore the important or critical elements.

In the discussions, particularly during practice sessions (tutorials), the mentor encourages the student to connect with one's own self and do self-observation, self-reflection and self-exploration.

Scenarios may be used to initiate discussion. The student is encouraged to take up "ordinary" situations rather than" extra-ordinary" situations. Such observations and their analyses are shared and discussed with other students and faculty mentor, in a group sitting.

Tutorials (experiments or practical) are important for the course. The difference is that the laboratory is everyday life, and practicals are how you behave and work in real life. Depending on the nature of topics, worksheets, home assignments and/or activities are included. The practice sessions (tutorials) would also provide support to a student in performing actions commensurate to his/her beliefs. It is intended that this would lead to development of commitment, namely behaving and working based on basic human values.

Course Title	**Heat Transfer**				**B. Tech. ME V Sem**		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
2003501	**PCC**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	0	--	3	40	60	100
Mid Exam Duration: 90 MIN					**End Exam Duration: 3Hrs**			

Course Objectives:

- Understand different modes of heat transfer
- Gain knowledge about natural and force convection phenomenon
- Estimate experimental uncertainty in measurements
- Design heat and mass transfer equipment.
- Evaluate no. of stages required for given mass transfer problem.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Apply the Basic laws of Heat transfer.
CO 2	Analyze the use of conductive heat transfer and insulation.
CO 3	Apply the Knowledge of Fluid flow and thermal flow of Convective Heat transfer.
CO 4	Evaluate the loss of thermal radiation.
CO5	Compare different heat exchangers.

MAPPING OF COs & POs:

CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3		3	2			2			2
CO2	2		1		3	1			1			2
CO3	2			2	3							
CO4	2	1	1	2	2							2
CO5	2	1	1		2							2

UNIT I

Introduction: Basic modes of heat transfer- rate equations- generalized heat conduction equation - steady state heat conduction solution for plain and composite slabs - cylinders - critical thickness of insulation- heat conduction through fins of uniform cross section- fin effectiveness and efficiency.

Unsteady State Heat Transfer Conduction- Transient heat conduction- lumped system analysis and use of Heisler charts.

UNIT II

Convection: Basic concepts of convection–heat transfer coefficients - types of convection –forced convection and free convection.

Free Convection -development of hydrodynamic and thermal boundary layer along a vertical plate – use of empirical relations for convective heat transfer on plates and cylinders in horizontal and vertical orientation

Forced convection- external flow–concepts of hydrodynamic and thermal boundary layer- use of empirical correlations for flow over plates and cylinders. Fluid friction – heat transfer analogy, approximate solution to laminar boundary layer equation for external flow.Internal flow – Use of empirical relations for convective heat transfer in horizontal pipe flow.

UNIT III

Radiation: Radiation heat transfer – thermal radiation – laws of radiation - Black and Gray bodies – shape factor-radiation exchange between surfaces - Radiation shields - Greenhouse effect.

DESIGN OF HEAT TRANSFER EQUIPMENTS:

General design of heat exchange equipment, heat exchangers, condensers, boilers, types of evaporators.

UNIT IV

Heat Exchangers: Types of heat exchangers- parallel flow- counter flow- cross flow heat exchangers- overall heat transfer coefficient- LMTD and NTU methods- fouling in heat exchangers.

UNIT V

Boiling and Condensation: Different regimes of boiling- nucleate, transition and film boiling – condensation - filmwise and dropwise condensation.

Mass Transfer: Introduction **of** Conservation laws and constitutive equations - Fick's law of diffusion, isothermal equi-mass - Equimolal diffusion- - diffusion of gases and liquids- mass transfer coefficient.

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TEXT BOOKS:

1. P.K. Nag, Heat Transfer, 3/e, Tata McGraw-Hill, 2011.
2. J.P.Holman, Heat Transfer, 9/e, Tata McGraw-Hill,2008.
3. S. C. Arora& S. Domkundwar , A Course in Heat and Mass Transfer,DhanpatRai& CO.(P) LTD-Delhi , 2007.

REFERENCES:

1. F. P. Incropera and D.P. Dewitt, Fundamentals of Heat and Mass Transfer, 6/e, John Wiley, 2007.
2. Cengel. A.Yunus, Heat Transfer- A Practical Approach, 4/e, Tata McGraw-Hill, 2007.
3. S.P. Sukhatme, A Textbook of Heat Transfer, Universities Press, 2005
4. Lienhard and Lienhard, A Heat and Mass Transfer, Cambridge Press, 2011.
5. C.P. Kothandaraman and S. Subramanyan, Heat and Mass Transfer databook, New Age Publications, 2014.

Course Title	**Design of Machine Members**				**B. Tech. ME V Sem**		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
2003502	**PCC**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	0	--	3	40	60	100
Mid Exam Duration: 90 MIN					**End Exam Duration: 3Hrs**			

Course Objectives:

. The students completing this course are expected:

- Provide an introduction to design of machine elements.
- Familiarize with fundamental approaches to failure prevention for static and dynamic loading.
- Explain design procedures to different types of joints.
- Teach principles of clutches and brakes and design procedures.
- Instruct different types of bearings and design procedures.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Estimate safety factors of machine members subjected to static and dynamic loads.
CO 2	Design fasteners subjected to variety of loads.
CO 3	Select of standard machine elements such as keys, shafts, couplings, springs and bearings.
CO 4	Design clutches, brakes and spur gears.
CO5	Estimate safety factors of machine members subjected to static and dynamic loads.

MAPPING OF COs & POs:

CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	2						1	1	1	1
CO2	1	1	2						1	1	1	1
CO3	2	1	1						1	1	1	1
CO4	1	2	1						1	1	1	1
CO5	1	1	1						1	1	1	1

UNIT I:

Mechanical Engineering Design: Design process, design considerations, codes and standards of designation of materials, selection of materials.

Design for Static Loads: Modes of failure, design of components subjected to axial, bending, torsional and impact loads. Theories of failure for static loads.

Design for Dynamic Loads: Endurance limit, fatigue strength under axial, bending and torsion, stress concentration, notch sensitivity. Types of fluctuating loads, Soderberg, Goodman and modified Goodman criterion for fatigue failure. Fatigue design under combined stresses

UNIT II:

Design of Bolted Joints: Threaded fasteners, preload of bolts, various stresses induced in the bolts. Torque requirement for bolt tightening and eccentrically loaded bolted joints.

Welded Joints: Strength of lap and butt welds, Joints subjected to bending and torsion. eccentrically loaded welded joints.

UNIT III:

Power Transmission Shafts: Design of shafts subjected to bending, torsion and axial loading. Shafts subjected to fluctuating loads using shock factors.

Couplings: Design of flange and bushed pin flexible couplings.

POWER TRANSMISSIONS SYSTEMS, PULLEYS: Transmission of power by Belt and Rope drives, Belts – Flat and V types – Ropes - pulleys for belt and rope drives.

UNIT-IV:

Friction Clutches: Torque transmitting capacity of disc and centrifugal clutches. Uniform wear theory and uniform pressure theory.
Brakes: Different types of brakes. Concept of self-energizing and self-locking of brake. Band and block brakes, disc brakes.
Springs: Design of helical compression, tension, torsion and leaf springs.

UNIT V:
Design of Sliding Contact Bearings: Lubrication modes, bearing modulus, Petroff and McKee's equations, design of journal bearing. Bearing Failures.
Design of Rolling Contact Bearings: Static and dynamic load capacity, equivalent bearing load, load factor, selection of bearings from manufacturer's catalogue.
Design of Gears: Spur gears, beam strength, Lewis equation, design for dynamic and wear loads.

TEXT BOOKS

1. R.L. Norton, Machine Design an Integrated approach, 2/e, Pearson Education, 2004.
2. V.B.Bhandari, Design of Machine Elements, 3/e, Tata McGraw Hill, 2010.
3. Dr. N. C. Pandya&Dr. C. S. Shah, Machine design, 17/e, Charotar Publishing House
4. Pvt. Ltd, 2009.

REFERENCES:

1. 1R.K. Jain, Machine Design, Khanna Publications, 1978.
2. J.E. Shigley, Mechanical Engineering Design, 2/e, Tata McGraw Hill, 1986.
3. M.F.Spotts and T.E.Shoup, Design of Machine Elements, 3/e, Prentice Hall (Pearson Education), 2013.

Course Title	**Metrology and Measurements**				**B. Tech. ME V Sem**		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
2003503	**PCC**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	0	--	3	40	60	100
Mid Exam Duration: 90 MIN					**End Exam Duration: 3Hrs**			

Note: Design data book is permitted.

Course Objectives:

. The students completing this course are expected:

- Introduce the basic concepts of metrology and measurement methods.
- Demonstrate the importance of metrology in manufacturing
- Explain the concepts of. screw thread measurements and gear tooth measurement
- Expose various Principles and working of transducers
- Familiarize in usage of appropriate device for measurements

Course Outcomes:

- List various measuring instruments used in metrology.
- Examine surface and flatness measurements
- Examine geometry of screw threads and gear profiles
- Usage of transducers and gauges
- Understand the types of devices for force and pressure measurement

CO 1	Assess the concept of different types of dimensional tolerances and fits.
CO 2	Explain the basic standards of measurements and application of slip gauges.
CO 3	Analyze the effective diameter of screw and gear tooth thickness, pressure angle by various methods.
CO 4	Evaluate various principles and working of transducers and measurement of displacement and strain.
CO5	Identify the use of appropriate devices for measurement of force and pressure.

MAPPING OF COs & POs:

CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1									
CO2	2	2	1									
CO3	1	1	1									
CO4	2	1	1									
CO5	2	1	1									

UNIT-I

Concept of Measurement: General concept-generalized measurement system, units and standards, measuring instruments, sensitivity, readability, range of accuracy, precision, static and dynamic response, repeatability, systematic and random errors, terminologyoflimits, fits and tolerances, hole basis and shaft basis system, interchangeability, Selective Assembly

Limit Gauges and Gauge Design: Plug, Ring, Snap, Gap, Taper gauges. Taylor's principle.Design of Go and No Go gauges.

Linear and Angular Measurement: Line standards , end standards , Slip gauges , Angular Measurements by using Sine bar , angle gauges .

UNIT-II

Flatness Measurement: Measurement of flatness – straight edges – surface plates, optical flat, interferometers and their applications.

Surface Roughness Measurement: Terminology systems, differences between surface roughness and surface waviness- Numerical assessment of surface finish - CLA, R,M,S Values-Ra , Rz values, Methods of measurement of surface finish-profilograph, talysurf, BIS symbols for indication of surface roughness.

UNIT-III

Screw thread measurements: Elements of threads, errors in screw threads, Measurement of effective diameter- Two wire method ,Three wire metthod

Gear Measurement: Gear tooth terminology, measurement of gear elements-runout, lead, pitch backlash, profile, pressure angle, tooth thickness, diameter of gear, constant chord and base tangent method.

MACHINE TOOL METROLOGY: Alignment test on Lathe and Milling Machines.

UNIT-IV

Measurement of Displacement: Theory and construction of various transducers to measure displacement - Piezo electric, inductive, capacitance, resistance

Measurements of Strain: Requirement of strain gauge, resistance strain gauge, guage factor, strain gauge rosettes.

UNIT-V

Measurement of Force: Direct method - analytical balance, elastic members – load cells and proving rings.

Measurement of Pressure: Basic methods of pressure measurement, dead weight piston gauge, Elastic pressure transducers.

TEXT BOOK:

1. Beckwith, Marangoni, Linehard, Mechanical Measurements, 6/e, PHI, 2013.
2. R.K. Jain, Engineering Metrology, 20/e, Khanna Publishers, 2013.

REFERENCEBOOKS:

1. Mahajan, Engineering Metrology, 2/e, DhanpatRai, 2013.
2. S.Bhaskar, Basic Principles - Measurments and Control Systems, Anuradha Publications, 2014.
3. Anand K Bewoor&Vinay A Kulkarni, Metrology & Measurement, 15/e, McGrawHill, 2015.
4. Ltd.Mumbai, 2020
5. ProductionTechnologybyR.K Jain, 6th edition, 2020.

Course Title	ALTERNATIVE FUELS AND EMISSION CONTROL IN AUTOMOTIVES				B. Tech. ME V Sem		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**	
2003504	**PEC-I**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	0	--	3	40	60	100
Mid Exam Duration: 90 MIN					**End Exam Duration: 3Hrs**		

Course Objectives:

. The objectives of this course are to

- explain various alcohol and gaseous fuels and their use in SI and CI engines.
- explain various vegetable oils and their use in CI engines.
- determine the formation of various emissions from SI engine and control techniques.
- identify various emission measuring instruments and test procedures.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	● **Identify** various emissions from SI and CI engines
CO 2	● **Apply** the properties of alcohol fuels and gaseous fuels.
CO 3	● **Predict** the problems by using vegetable oils in diesel engines
CO 4	● **Choose** the use of various emission measuring instruments
CO5	● **Identify** various emissions from SI and CI engines

MAPPING OF COs & POs:

CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1									
CO2	2	2	1									
CO3	1	1	1									
CO4	2	1	1									
CO5	2	1	1									

UNIT - I

Alcohol fuels and gaseous fuels: Alcohol fuels and gaseous fuels: Properties of alcohols, alcohol – gasoline blends, fuel flexible vehicle, methanol reformed gas engine, dual fuel system, Spark assisted diesel engine, surface ignition engine, ignition accelerators, performance, combustion and emission characteristics in SI and CI engines, Properties of hydrogen, production and storage methods, safety precautions, biogas production and its properties, properties of LPG and CNG, Performance, combustion and emission characteristics of hydrogen, biogas, LPG and CNG in SI and CI engines

UNIT - II

Vegetable oils: Vegetable oils: Various vegetable oils for diesel engines, structure and properties, problems in using vegetable oils in diesel engines, Methods to improve the engine performance using vegetable oils – preheating, Esterification , blending with good secondary fuels, Semi-adiabatic engine, surface ignition engine, ignition accelerators dual fuelling with gaseous and liquid fuels coils, Performance, combustion and emission characteristics of biodiesel fuelled diesel engines

UNIT - III

Emissions from SI engines and their control Emissions from SI engines and their control: Emission formation in SI engines (CO, HC and NOx), Effect of design and operating variables on emission formation, Control techniques – Thermal reactor, exhaust gas recirculation, Three way catalytic convertor and Charcoal canister control for evaporative emission, Positive crank case ventilation for blow by gas control.

UNIT - IV

Emissions from CI engines and their control:

Emissions from CI engines and their control: Emission formation in CI engines (HC, CO, NOx, Aldehydes, smoke and particulates), Effect of design and operating variables on emission formation, Control techniques – Exhaust gas recirculation, NOx selective catalytic reduction, Diesel oxidation catalytic convertor, Diesel particulate filter, NOx versus particulates – Trade off.

UNIT - V

Emission measuring instruments and test procedures Emission measuring instruments and test procedures: Principle of operation of emission measuring instruments used in SI and CI engines, Measurement of CO2 and CO by NDIR, Hydrocarbon emission by FID, Chemiluminescentanalyser for NOx, Liquid and Gas chromatograph Spot sampling and continuous indication type smoke meters (Bosch, AVL and Hartridge smoke meters) emission test procedures – FTP, Euro and Bharat norms.

Textbooks:

Ganesan V, Internal combustion engines, 4th Edition, Tata McGraw Hill Education, 2012
Thipse.S.S, Alternative Fuels: Concepts, Technologies and Developments, Jaico Publishing House, 2010.

Reference Books:

Michael F. Hordeski, Alternative Fuels: The Future of Hydrogen, The Fairmont Press, 2008
R.K.Rajput, A textbook of Internal Combustion Engines, 2nd Edition, Laxmi Publications, 2007
"Society of Automotive Engineers", Alternative Fuels: Fuel Cells and Natural Gas, Society of Automotive Engineers, Incorporated, 2000

Course Title	AUTOMATION AND ROBOTICS				B. Tech. ME V Sem		
Course Code	**Category**	**Hours/Week**		**Credits**	**Maximum Marks**		
2003505	**PEC-I**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	0	--	3	40	60	100
Mid Exam Duration: 90 MIN					**End Exam Duration: 3Hrs**		

Course Objectives:

. The objectives of this course are to

- Describe the basic concepts of automation in manufacturing systems.
- Acquire the fundamental concepts of automated flow lines and their analysis.
- Classify automated material handling, automated storage and retrieval systems.
- Illustrate adaptive control systems and automated inspection methods.
- Define the fundamental concepts of industrial robotics.
- Apply basic mathematics to calculate the robot kinematic and dynamic mechanics
- Understand the robot programming methods and software packages. .

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	**Examine** the types of hardware components of automation and control system
CO 2	**Design** a simple material handling system for low cost manufacturing.
CO 3	**Design** a simple gripper for robot.
CO 4	**Compare** the types of actuators used in robot manipulator
CO5	**Summarize** the requirements and features of robot programming

MAPPING OF COs & POs:

CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

UNIT – I

Introduction

Introduction: Automation in production system, need, types, Principles and Strategies of automation, levels of automation, basic elements of an automated system, hardware components for automation and process control, mechanical feeders, hoppers, orienters, high speed automatic insertion devices.

Automated flow lines & transfer mechanisms, fundamentals of transfer Lines, flow lines with or without buffer storage.

UNIT - II

Assembly Line Balancing and Automated Manufacturing System

Assembly Line Balancing: Assembly process and systems assembly line, line balancing algorithms, ways of improving line balance, flexible assembly lines.

Material handling and Identification Technologies: Overview of automatic material handling systems, principles and design consideration, material transport systems, storage systems, overview of automatic identification methods.

Automated Manufacturing Systems: Components, classification and overview of manufacturing systems, manufacturing cells, GT and cellular manufacturing, FMS and its planning and implementation.

UNIT - III

Introduction to Robotics

Introduction: Brief history of robots, classification of robot, functional line diagram, degrees of freedom. Elements of robot - types and its functions, factors to be considered in the design of grippers.

Robot Actuators And Feedback Components: Actuators, Pneumatic, Hydraulic actuators, Electric & Stepper motors, comparison. Position sensors - potentiometers, resolvers, encoders - velocity sensors, Tactile sensors, Proximity sensors.

UNIT - IV

Kinematics and Dynamics of a Manipulator Manipulator Kinematics

Homogenous transformations as applicable to translation, rotations- D-H notation, Forward and inverse kinematics.

Manipulator Dynamics: Differential transformations, Jacobians, Lagrange - Euler and Newton - Euler formations.

UNIT - V

Robot Programming and Applications

Robot Programming: Methods of programming - requirements and features of programming languages, software packages, problems with programming languages. Motion path control- slew motion, joint integrated motion, straight line motion; avoidance of obstacles.

Robot Application in Manufacturing: Material Transfer - Material handling, loading and unloading; Process - spot and continuous arc welding & spray painting; Assembly and Inspection.

Textbooks:

1. MikellP.Groover, Automation, Production Systems and Computer Integrated Manufacturing- Pearson Education.5/e, 2009.

2. Mikell P. Groover and Mitchell Weiss, Roger N. Nagel, Nicholas G.Odrey , Industrial Robotics — McGraw Hill, 1986.

Reference Books:

1. S. R. Deb &Sankha Deb, Robotics Technology and Flexible Automation, Tata McGraw-Hill Education.

2. R K Mittal and I J Nagrath, Robotics and control, Illustrated Edition, Tata McGraw Hill India 2003.

3. Saeed B. Niku, Introduction to Robotics – Analysis, System, Applications, 2nd Edition, John Wiley & Sons, 2010.

4. Richard D. Klafter, Thomas Robotic Engineering an integrated approach, PHI publications 1988.

Course Title	TOOL DESIGN				B. Tech. ME V Sem		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**	
2003506	**PEC-I**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	0	--	3	40	60	100
Mid Exam Duration: 90 MIN					**End Exam Duration: 3Hrs**		

Course Objectives:

. The objectives of this course are to

- Design Tools that can withstand all forces acting on them.
- Design tools which reduce downtime and hence increase production.
- Select the tool material that increases the tool life.
- Provide simple and smooth, easy operation machine tools to maximize the efficiency.
- To produce the components of high quality that required fewer secondary operations on them.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	**Determine** the cutting tool geometry, mechanism of chip formation and mechanics of orthogonal cutting.
CO 2	**Identify** basic parts and operations of machine tools including lathe, shaper, planer, drilling, boring, milling and grinding machine.
CO 3	**Design** locating and clamping devices to produce a component.
CO 4	**Select** a machining operation and corresponding machine tool for a specific application in real time
CO5	**Select** a measuring instrument to inspect the dimensional and geometric features of a given component

UNIT – I

INTRODUCTION TO TOOL DESIGN

Introduction –Tool Engineering – Tool Classifications– Tool Design Objectives – Tool Design in manufacturing- Challenges and requirements- Standards in tool design-Tool drawings -Surface finish – Fits and Tolerances - Tooling Materials- Ferrous and Non ferrous Tooling Materials- Carbides, Ceramics and Diamond -Non metallic tool materials-Designing with relation to heat treatment.

UNIT - II

DESIGN OF CUTTING TOOLS

Mechanics of Metal cutting –Oblique and orthogonal cutting- Chip formation and shear angle - Single-point cutting tools – Milling cutters – Hole making cutting tools- Broaching Tools - Design of Form relieved and profile relieved cutters-Design of gear and thread milling cutters.

UNIT - III

DESIGN OF JIGS AND FIXTURES

Introduction – Fixed Gages – Gage Tolerances –selection of material for Gauges – Indicating Gages – Automatic gages – Principles of location – Locating methods and devices – Principles of clamping – Drill jigs – General considerations in the design of drill jigs – Drill bushings – Methods of construction –Types of Fixtures – Vice Fixtures – Milling Fixtures – Boring Fixtures – Broaching Fixtures.

UNIT - IV

DESIGN OF PRESS TOOL DIES

Types of Dies –Method of Die operation–Clearance and cutting force calculations- Blanking and Piercing die design – Pilots – Strippers and pressure pads- Presswork materials – Centre of pressure -Strip layout – Short-run tooling for Piercing – Bending dies – Drawing dies-Design and drafting.

UNIT - V

TOOL DESIGN FOR CNC MACHINE TOOLS

Introduction –Tooling requirements for Numerical control systems – Fixture design for CNC machine tools-Sub plate and tombstone fixtures-Universal fixtures– Cutting tools– Tool holding methods– Automatic tool changers and tool positioners – Tool presetting– General explanation of the Brown and Sharp machine.

Text Books:

1.Cyrll Donaldson, George H.LeCain, V.C. Goold, "Tool Design", Tata McGraw Hill Publishing Company Ltd., 2000.

2.E.G.Hoffman," Jig and Fixture Design", Thomson Asia Pvt Ltd, Singapore, 2004.

Reference Books:

1.PrakashHiralal Joshi, "Tooling data", Wheeler Publishing, 2000

2. Venkataraman K., "Design of Jigs, Fixtures and Presstools", TMH, 2005.

3. Haslehurst M., "Manufacturing Technology", The ELBS, 1978.

Online Learning Resources

Course Title	Power Plant Engineering				B. Tech. ME V Sem			
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
2003507	**PE**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	0	--	3	40	60	100
Mid Exam Duration: 90 MIN					**End Exam Duration: 3Hrs**			

Course Objectives:

. The objectives of this course are to

- Familiarize the sources of energy, power plant economics and environmental aspects.
- Outline the working components of different power plant.
- Explain renewable energy sources; characteristics, working principle, classify types, layouts, and plant operations.
- Impart types of nuclear power plants, and outline working principle and advantages and hazards.

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Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Outline sources of energy, power plant economics, and environmental aspects.
CO 2	Describe working of a steam power plant and their components
CO 3	Illustrate the working mechanism of Diesel and Gas turbine power plants.
CO 4	Understand the various elements of hydroelectric power plant and their types
CO 5	Summarize types of renewable energy sources and their working principle.

MAPPING OF COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2					3		2		2	3
CO2	3	2	2	2			2	2	2			3
CO3	3	2	2		2			2			2	3
CO4	3	2	3	2	2						2	3
CO5	3	2	2		2	2				2	2	3

UNIT- I

Introduction to the Sources Of Energy - Resources and Development of Power in India. Layouts of Steam, Hydel, Diesel, MHD, Nuclear and Gas Turbine Power Plants - Combined Power Cycles - Comparison and Selection.

Power Plant Economics and Environmental Considerations: Capital Cost, Investment of Fixed Charges, Operating Costs, General Arrangement of Power Distribution, Load Curves, Load Duration Curve. Definitions of Connected Load, Maximum Demand, Demand Factor, Average Load, Load Factor, Diversity Factor - Tariff - Related Exercises.

UNIT –II

Steam Power Plant : Modern High Pressure and Supercritical Boilers - Analysis of Power Plant Cycles - Modern Trends in Cycle Improvement - Waste Heat Recovery, Fluidized Bed Boilers., Fuel and Handling Equipments, Types of Coals, Coal Handling, Choice of Handling Equipment, Coal Storage, Ash Handling Systems.

Steam Power Plant :Construction- Dust Collectors, Cooling Towers And Heat Rejection. Analysis of Pollution from Thermal Power Plants - Pollution Controls.

UNIT –III

Diesel Power Plant: Diesel Power Plant: Introduction - IC Engines, Types, Construction- Plant Layout with Auxiliaries - Fuel Storage

GAS TURBINE PLANT: Introduction - Classification - Construction - Layout with Auxiliaries - Principles of Working Closed and Open Cycle Gas Turbines. Advantages And Disadvantages Combined Cycle Power Plants.

.

UNIT- IV

Hydro Electric Power Plant: Water Power - Hydrological Cycle / Flow Measurement - Drainage Area Characteristics - Hydrographs - Storage and Pondage - Classification of Dams and Spill Ways.

Hydro Projects & Plant: Classification - Typical Layouts - Plant Auxiliaries - Plant Operation Pumped Storage Plants.

UNIT- V

Power from Non-Conventional Sources: Utilization of Solar Collectors- Principle of its Working, Wind Energy - Types of Turbines - HAWT & VAWT-Tidal Energy. MHD power Generation.

Nuclear Power Station: Nuclear Fuel - Nuclear Fission, Chain Reaction, Breeding and Fertile Materials - Nuclear Reactor -Reactor Operation.

Types Of Reactors: Pressurized Water Reactor, Boiling Water Reactor, Sodium-Graphite Reactor, Fast breeder Reactor, Homogeneous Reactor, Gas Cooled Reactor, Radiation Hazards and Shielding - Radioactive Waste Disposal.

TEXT BOOKS:

1. P.K. Nag, Power Plant Engineering, 3/e, TMH, 2013.
2. Arora and S. Domkundwar, A course in Power Plant Engineering, DhanpatRai& Co (P) Ltd, 2014

REFERENCES:

1. Rajput, A Text Book of Power Plant Engineering, 6/e, Laxmi Publications, 2020.
2. Ramalingam, Power plant Engineering, Scietech Publishers, 2019
3. P.C. Sharma, Power Plant Engineering, S.K. Kataria Publications, 2019.

Course Title	NON-DESTRUCTIVE TESTING				B. Tech. ME V Sem		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**	
2003508	**PEC-I**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	0	--	3	40	60	100
Mid Exam Duration: 90 MIN					**End Exam Duration: 3Hrs**		

Course Objectives:

. The objectives of this course are to

- Introduce basic concepts of non-destructive testing.
- Familiarize with characteristics of ultrasonic test, transducers, rejection and effectiveness.
- Describe concept of liquid Penetrant, eddy current and magnetic particle tests, its applications and limitations.
- Explain the principles of infrared and thermal testing, applications and honey comb and sandwich structures case studies.
- Impart NDE and its applications in pressure vessels, casting and welded constructions.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	● **Predict** various methods of non-destructive testing.
CO 2	● **Apply** relevant non-destructive testing method different applications.
CO 3	● **Explain** the applications of Railways, Nuclear and chemical industries.
CO 4	● **Outline** the limitations and disadvantages of NDE.
CO5	● **Explain** the applications of NDA of pressure vessels, casting and welding constructions

UNIT - I

Introduction to non-destructive testing

Introduction to non-destructive testing: Radiographic test, Sources of X and Gamma Rays and their interaction with Matter, Radiographic equipment, Radiographic Techniques, Safety Aspects of Industrial Radiography.

UNIT – II

Ultrasonic test Ultrasonic test

Principle of Wave Propagation, Reflection, Refraction, Diffraction, Mode Conversion and Attenuation, Sound Field, Piezo-electric Effect , Ultrasonic Transducers and their Characteristics, Ultrasonic Equipment and Variables Affecting Ultrasonic Test, Ultrasonic Testing, Interpretations and Guidelines for Acceptance, Rejection - Effectiveness and Limitations of Ultrasonic Testing.

UNIT - III

Liquid penetrant, Eddy Current & Magnetic Particle Test

Liquid Penetrant Test: Liquid Penetrant Test, Basic Concepts, Liquid Penetrant System, Test Procedure, Effectiveness and Limitations of Liquid Penetrant Testing.

Eddy Current Test: Principle of Eddy Current, Eddy Current Test System, Applications of Eddy Current-Testing Effectiveness of Eddy Current Testing.

Magnetic Particle Test: Magnetic Materials, Magnetization of Materials, Demagnetization of Materials, Principle of Magnetic Particle Test, Magnetic Particle Test Equipment, Magnetic Particle Test Procedure, Standardization and Calibration, Interpretation and Evaluation, Effective Applications and Limitations of the Magnetic Particle Test.

UNIT – IV

Infrared & Thermal Testing Infrared And Thermal Testing

Introduction and fundamentals to infrared and thermal testing–Heat transfer –Active and passive techniques –Lock in and pulse thermography–Contact and non contact thermal inspection methods–Heat sensitive paints –Heat sensitive papers –-thermally quenched phosphors liquid crystals –techniques for applying liquid crystals –other temperature sensitive coatings –Inspection methods –Infrared radiation and infrared detectors–thermo mechanical behavior of materials–IR imaging in aerospace applications, electronic components, Honey comb and sandwich structures–Case studies.

UNIT - V

Industrial Applications of NDE

Industrial Applications of NDE: Span of NDE Activities Railways, Nuclear, Non-nuclear and Chemical Industries, Aircraft and Aerospace Industries, Automotive Industries, Offshore Gas and Petroleum Projects, Coal Mining Industry, NDE of pressure vessels, castings, welded constructions.

Textbooks:

1. J Prasad, GCK Nair , Non destructive test and evaluation of Materials, Tata mcgraw-Hill Education Publishers, 2008.
2. Josef Krautkrämer, Herbert Krautkrämer, Ultrasonic testing of materials, 3/e, Springer-Verlag, 1983.
3. X. P. V. Maldague, Non destructive evaluation of materials by infrared thermography, 1/e, Springer-Verlag, 1993.

Reference Books:

1. Gary L. Workman, Patrick O. Moore, DoronKishoni, Non-destructive, Hand Book, Ultrasonic Testing, 3/e, Amer Society for Nondestructive, 2007.

Course Title	INTRODUCTION TO HYBRID AND ELECTRICAL VEHICLES				B. Tech. ME V Sem		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
20OE509	**OEC-I**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	0	--	3	40	60	100
Mid Exam Duration: 90 MIN					**End Exam Duration: 3Hrs**			

Course Objectives:

. The objectives of this course are to

- Provide good foundation on hybrid and electrical vehicles.
- To address the underlying concepts and methods behind power transmission in hybrid and electrical vehicles.
- Familiarize energy storage systems for electrical and hybrid transportation.
- To design and develop basic schemes of electric vehicles and hybrid electric vehicles.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	● **Use working** of hybrid and electric vehicles.
CO 2	● **Choose** a suitable drive scheme for developing an hybrid and electric vehicles depending on resources.
CO 3	● **Develop** the electric propulsion UNIT and its control for application of electric vehicles
CO 4	● **Choose** proper energy storage systems for vehicle applications.
CO5	● **Design** and develop basic schemes of electric vehicles and hybrid electric vehicles.

UNIT – I

Electric Vehicle Propulsion And Energy Sources

Introduction to electric vehicles, vehicle mechanics - kinetics and dynamics, roadway fundamentals propulsion system design - force velocity characteristics, calculation of tractive power and energy required, electric vehicle power source - battery capacity, state of charge and discharge , specific energy, specific power, Ragone plot. battery modeling - run time battery model, first principle model, battery management system- soc measurement, battery cell balancing. Traction batteries - nickel metal hydride battery, Li-Ion, Lipolymer battery.

UNIT – II

Electric Vehicle Power Plant And Drives

Introduction electric vehicle power plants. Induction machines, permanent magnet machines, switch reluctance machines. Power electronic converters-DC/DC converters - buck boost converter, isolated DC/DC converter. Two quadrant chopper and switching modes. AC drives- PWM, current control method. Switch reluctance machine drives - voltage control, current control.

UNIT – III

Hybrid And Electric Drive Trains

Introduction hybrid electric vehicles, history and social importance, impact of modern drive trains in energy supplies.Hybrid traction and electric traction. Hybrid and electric drive train topologies. Power flow control and energy efficiency analysis, configuration and control of DC motor drives and induction motor drives, permanent magnet motor drives, switch reluctance motor drives, drive system efficiency.

UNIT - IV

Electric And Hybrid Vehicles - Case Studies

Parallel hybrid, series hybrid -charge sustaining, charge depleting.Hybrid vehicle case study –Toyota Prius, Honda Insight, Chevrolet Volt. 42 V system for traction applications. Lightly hybridized vehicles and low voltage systems. Electric vehicle case study - GM EV1, Nissan Leaf, Mitsubishi Miev.Hybrid electric heavy duty vehicles, fuel cell heavy duty vehicles.

UNIT – V

Electric And Hybrid Vehicle Design

Introduction to hybrid vehicle design.Matching the electric machine and the internal combustion engine. Sizing of propulsion motor, power electronics, drive system. Selection of energy storage technology, communications, supporting subsystem.Energy management strategies in hybrid and electric vehicles - energy management strategies- classification, comparison, implementation.

Textbooks:

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, 2/e, CRC Press, 2003.
2. Amir Khajepour, M. Saber Fallah, AvestaGoodarzi, Electric and Hybrid Vehicles: Technologies, Modeling and Control - A Mechatronic Approach, illustrated edition, John Wiley & Sons, 2014.
3. MehrdadEhsani, YimiGao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.

Reference Books:

1. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.
2. John G. Hayes, G. AbasGoodarzi, Electric Powertrain: Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles, 1/e, Wiley-Blackwell, 2018.

Course Title	RAPID PROTOTYPING				B. Tech. ME V Sem		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**	
20OE510	**OEC-I**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	0	--	3	40	60	100
Mid Exam Duration: 90 MIN					**End Exam Duration: 3Hrs**		

Course Objectives:

. The objectives of this course are to

- Familiarize techniques for processing of CAD models for rapid prototyping.
- Explain fundamentals of rapid prototyping techniques.
- Demonstrate appropriate tooling for rapid prototyping process.
- Focus Rapid prototyping techniques for reverse engineering.

Train Various Pre – Processing, Processing and Post Processing errors in RP Processes

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	● **Use** techniques for processing of CAD models for rapid prototyping.
CO 2	● **Implement fundamentals** of rapid prototyping techniques.
CO 3	● **Choose** appropriate tooling for rapid prototyping process.
CO 4	● **Create** rapid prototyping techniques for reverse engineering.
CO5	● **Identify** Various Pre – Processing, Processing and Post Processing errors in RP processes.

UNIT - I

Introduction to RP Introduction

Introduction to Prototyping, Traditional Prototyping Vs. Rapid Prototyping (RP), Need for time compression in product development, Usage of RP parts, Generic RP process, Distinction between RP and CNC, other related technologies, Classification of RP.

RP Software: Need for RP software, MIMICS, Magics, SurgiGuide, 3-matic, 3D-Doctor, Simplant, Velocity2, VoXim, SolidView, 3DView, etc., software, Preparation of CAD models, Problems with STL files, STL file manipulation, RP data formats: SLC, CLI, RPI, LEAF, IGES, HP/GL, CT, STEP.

UNIT - II

Solid and Liquid Based RP Systems

Solid and Liquid Based RP Systems: Stereolithography (SLA): Principle, Process, Materials, Advantages, Limitations and Applications. Solid Ground Curing (SGC): Principle, Process, Materials, Advantages, Limitations, Applications. Fusion Deposition Modeling (FDM): Principle, Process, Materials, Advantages, Limitations, Applications. Laminated Object Manufacturing (LOM): Principle, Process, Materials, Advantages, Limitations, Applications.

UNIT - III

Powder Based RP Systems Powder Based RP Systems

Principle and Process of Selective Laser Sintering (SLS), Advantages, Limitations and Applications of SLS, Principle and Process of Laser Engineered Net Shaping (LENS), Advantages, Limitations and Applications of LENS, Principle and Process of Electron Beam Melting (EBM), Advantages, Limitations and Applications of EBM.

Other RP Systems: Three Dimensional Printing (3DP): Principle, Process, Advantages, Limitations and

Applications. Ballastic Particle Manufacturing (BPM): Principle, Process, Advantages, Limitations, Applications. Shape Deposition Manufacturing (SDM): Principle, Process, Advantages, Limitations, Applications.

UNIT - IV

Rapid Tooling

Rapid Tooling: Conventional Tooling Vs. Rapid Tooling, Classification of Rapid Tooling, Direct and Indirect Tooling Methods, Soft and Hard Tooling methods.

Reverse Engineering (RE): Meaning, Use, RE – The Generic Process, Phases of RE Scanning, Contact Scanners and Noncontact Scanners, Point Processing, Application Geometric Model, Development.

UNIT – V

Errors in RP Processes

Errors in RP Processes: Pre-processing, processing, post-processing errors, Part building errors in SLA, SLS, etc.

RP Applications: Design, Engineering Analysis and planning applications, Rapid Tooling, Reverse Engineering, Medical Applications of RP.

Textbooks:

1. Chee Kai Chua and Kah Fai Leong, "3D Printing and Additive Manufacturing Principles and Applications" Fifth Edition, World Scientific Publications, 2017.

2. Ian Gibson, David W Rosen, Brent Stucker, "Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing", Springer, Second Edition, 2010.

Reference Books:

1. Frank W.Liou, "Rapid Prototyping & Engineering Applications", CRC Press, Taylor & Francis Group, 2011.

2.RafiqNoorani, "Rapid Prototyping: Principles and Applications in Manufacturing", John Wiley&Sons,

Course Title	DESIGN FOR MANUFACTURING AND ASSEMBLY				B. Tech. ME V Sem		
Course Code	**Category**	**Hours/Week**		**Credits**	**Maximum Marks**		
20OE511	**OEC-I**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	0	--	3	40	60	100
Mid Exam Duration: 90 MIN					**End Exam Duration: 3Hrs**		

Course Objectives:

. The objectives of this course are to

- Discuss various factors influencing the manufacturability of components and use of tolerance s in manufacturing
- Explain various considerations in casting, welding, forging and machining processes.
- Demonstrate on the design factors dependent on the assembly methods.
- Teach the principles and rules of design for assembly.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	• **Apply** the importance of Design for Manufacturing and Assembly.
CO 2	• **Examine the** form design factors with the help of Case study.
CO 3	• **Evaluate** how the factor of redesign affects the product life cycle.
CO 4	• **Make use** of DFA methods proposed by Boothroyd and Dewhurst.
CO5	• **Analyse** the importance of Design for Manufacturing and Assembly.

UNIT - I

Introduction to DFM

Significance of design, qualities of a designer and Design factors, Systematic working plan, The engineering problem to be solved, The basic design, Factors influencing choice of materials and the factors influencing manufacturing Process Capability Mean, Median, Variance, Mode, Standard Deviation, Normal Distribution and Process capability metrics, Process Capability, Tolerances-symbols and definition, Tolerances relevant to manufacturing, assembly and material condition, Tolerance stack- effects on assembly with examples, Methods of eliminating tolerance stack with examples.

UNIT - II

Form Design-Casting and Welding

Influence of loading, Materials, Production methods on form design, Casting considerations, Grey iron castings, Steel castings, Aluminum Casting Requirements and rules for casting, Form design of pressure die castings, Welding considerations welding Processes, Requirements and rules for welding, Redesign of components for casting-pattern-mould- Parting Line, Redesign of components for welding, Case studies in form design-simple problems in form design.

UNIT – III

Form Design-Forging and Machining

Forging considerations hammer forging drop forging, Requirements and rules for forging, Choice between casting, forging and welding, Machining considerations Drills, Milling-Keyways, Dwells and Dwelling Procedure Countersunk Head screws Requirements and rules for Machining considerations and Reduction of machined areas Redesign of components for Forging, Redesign of components for Machining, Simplification by separation and Simplification by amalgamation, Case studies.

UNIT - IV

Introduction to DFA

DFA, Introduction, Distinction between assembly methods and processes, Factors Determining assembly methods and processes, Success and failure-Causes of failure, Product Design factors independent of methods and processes , Introduction-Number of operations in the product, Assembly Precedence, Standardization, Design factors dependent on Assembly methods , Introduction-Single Station Assembly Line Assembly, Hybrid Systems, Manual Assembly lines, Flexible Assembly lines, Design factors dependent on Assembly processes, Factors Influencing Production rate to Facility Ratio- Parts Presentation, Manual Assembly, Dedicated Assembly, Transportation, Separation and Orientation-Flexible Assembly, Gripping, Transferring, Part Insertion, Failures and Error Recovery.

UNIT - V

Design For Assembly Methods

Approaches to design for assembly and Introduction, Approaches based on design principles and rules, Example DFA method using Design Principles, DFA Systems employing Quantitative evaluation procedures, IPA Stuttgart Method, DFA Methods employing a Knowledge based approach, Knowledge representation Computer Aided DFA methods, Part model, Feature, Processing. Assembly measures like Qualitative and Quantitative measures, Boothroyd and Dewhurst DFA method. Redesign of a simple product , Small consumer product and Fastener solution redesign using symmetry, Case Studies Designing of a disposal valve, Design of a lever-arch file mechanism

Textbooks:

1. Harry Peck., “Design for Manufacture”, Pittman Publications, 1983.
2. Alan Redford and chal, “Design for Assembly-Principles and Procedures”, McGraw Hill International Europe, London, 1994.

Reference Books:

1.RobertMatousek, “Engineering Design A Systematic Approach”, Blackie &sons Ltd., 1963.
2. James G.Bralla, “Hand Book of Product design for Manufacturing”, McGraw Hill Co., 1986.
3. Swift, K.G., “Knowledge Based Design for Manufacture”, Kogan Page Ltd., 1987

Course Title	Energy systems in Engineering				B. Tech. ME V Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks	
20OE512	OEC-I	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	--	3	40	60	100
Mid Exam Duration: 90 MIN					End Exam Duration: 3Hrs		

Course Objectives:

. The objectives of this course are to

- Familiarize the sources of energy, power plant economics and environmental aspects.
- Outline the working components of different power plant.
- Explain renewable energy sources; characteristics, working principle, classify types, layouts, and plant operations.
- Impart types of nuclear power plants, and outline working principle and advantages and hazards.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Describe working components of a steam power plant.
CO 2	understand the various elements of hydroelectric power plant and their types.
CO 3	Illustrate the working mechanism of Nuclear and Gas turbine power plants.
CO 4	Summarize types of renewable energy sources and their working principle.
CO5	Analize power plant economics, and environmental aspects.

MAPPING OF COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	3			2	2	3	1			1
CO2	3	2					2	2				1
CO3	3					2	2	3	2	2		
CO4	3	2				2	3					
CO5	3			2	1						2	

UNIT – I

Introduction to different Sources of Energy.

STEAM POWER PLANT: Layout of Modern Steam Power Plant, working of different circuits-selection of site- Coal Storage- Classification of coal handling and Ash handling systems.

UNIT – II

HYDRO ELECTRIC POWER PLANT: Selection of Site for Hydro Electric Power Plant – Hydrologicalcycle – Hydrographs - flow duration curve - mass curve – classification of dams, spill ways and surge tanks.

HYDRO PROJECTS AND PLANT: Classification of Hydro Electric Power Plants – Typical layout – plantauxiliaries – plant operation - pumped storage plants.

UNIT – III

NUCLEAR POWER PLANT: Nuclear fuel – breeding and fertile materials – Nuclear reactor – reactoroperation.

TYPES OF REACTORS: Pressurized Water Reactor, Boiling Water Reactor, Sodium-Graphite Reactor, FastBreeder Reactor, Homogeneous Reactor and Gas Cooled Reactor - Radiation hazards and shielding – radioactive waste disposal

GAS TURBINE POWER PLANT: Introduction – Plant Layout – Classification – Working of Simple GasTurbine Power Plant– Constant pressure and constant volume Gas Turbine Power Plants –Combination of GasTurbine Cycles.

UNIT IV

POWER FROM NON-CONVENTIONAL SOURCES: Utilization of Solar- Collectors-Principle of Working, Wind Energy– types – HAWT, VAWT -Tidal Energy.

Direct energy conversion: Solar energy, Fuel cells, MHD generation.

UNIT – V

POWER PLANT ECONOMICS: Definitions of connected load, Maximum demand, demand factor, averageload, load factor, diversity factor, utilization factor, Plant capacity factor and plant use factor - Types of loads -Load curve and load duration curve - general arrangement of power distribution Different types of tariff forElectrical energy –Cost of generation and fixed cost, semi fixed cost, running cost ,depreciation methods ,straight line methods Simple problems .

TEXT BOOKS:

1. P.K. Nag, Power Plant Engineering, 3/e, TMH, 2013.
2. Arora and S. Domkundwar, A course in Power Plant Engineering, DhanpatRai& Co (P) Ltd, 2014

REFERENCES:

1. Rajput, A Text Book of Power Plant Engineering, 4/e, Laxmi Publications, 2012.
2. Ramalingam, Power plant Engineering, Scietech Publishers, 2013
   P.C. Sharma, Power Plant Engineering, S.K. Kataria Publications, 2012

Course Title	SMART MATERIALS				B. Tech. ME V Sem		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**	
20OE513	**OEC-I**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	0	--	3	40	60	100
Mid Exam Duration: 90 MIN					**End Exam Duration: 3Hrs**		

Course Objectives:

. The objectives of this course are to

- Introduce the students with HBLS and LBHS smart materials.
- Expose the students in smart systems development and uses.
- Understand the working principle of smart actuators and smart sensors

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	● **Analyse** the role of smart materials in development of intelligent systems and adaptive structures
CO 2	● **compare** polycrystalline and single crystal piezoelectric materials
CO 3	● **Identify** the influence of stress on characteristic temperatures in SMA and EAP
CO4	● **Evaluate** the role of smart materials in development of intelligent systems and adaptive structures
CO5	● **Develop** of various sensors.

UNIT - I

Introduction to Smart Materials

Introduction to Smart Materials: What is Intelligence? Artificial intelligence Vs. embedded Intelligence, Definition of smart material, need for smart materials, classifications of smart systems, components of a smart systems, smart system applications, the role of Smart Materials in developing Intelligent Systems and Adaptive Structures.

UNIT - II

High bandwidth - Low strain generating (HBLS) Smart Materials

Piezoelectric Materials – constitutive relationship, electromechanical coupling coefficients, piezoelectric constants, piezoceramic materials, variation of coupling coefficients in hard and soft piezoceramics, polycrystalline vs single crystal piezoelectric materials, polyvinyldene fluoride, piezoelectric composites.

Magnetostrictive Materials – constitutive relationship, magneto-mechanical coupling coefficients, Joule Effect, Villari Effect, Matteuci Effect, Wiedemann effect, Giant magnetostriction in Terfenol-D, Terfenol-D particulate composites, Galfenol and Metglas materials.

UNIT - III

Low bandwidth - High strain generating (LBHS) materials

Low bandwidth - High strain generating (LBHS) materials: Shape Memory Alloys (SMA) – Introduction, Phenomenology, Influence of stress on characteristic temperatures, Modelling of shape memory effect. Vibration control through shape memory alloys. Design considerations, multiplexing embedded NiTiNOL actuators. Electro-active Polymers (EAP)- Introduction, Phenomenology, Influence of stress on characteristic temperatures.

UNIT - IV

Smart actuators

Based on HBLS smart materials: Piezoelectric Actuators – Induced Strain actuation model, Unimorph and Bimorph Actuators, Actuators embedded in composite laminate, Impedance matching in actuator design, Feedback Control, Pulse Drive, Resonance Drive. Magnetostrictive Actuators – Magnetostrictive Mini Actuators, Thermal instabilities, Discretely distributed actuation, Manetostrictive Composites.

Based on LBHS Smart Materials - Shape Memory Alloy based actuators for Shape Control, Electro-active Polymers for Work-Volume Generation.

UNIT - V

Smart sensors:

Sensors based on HBLS Smart Materials - Piezoelectric Sensors Magnetostrictive Sensors Techniques of Self Sensing MEMS Sensors.

Sensors based on LBHS Smart Materials - EAP based sensors, SMA based encoders, Optical Fibre based Sensing.

Textbooks:

1. M.V. Gandhi, B.D. Thompson" Smart Materials and Structures" Springer Science & Business Media, 31-May-1992.

Reference Books:

1. Brian Culshaw, Smart Structures and Materials, Artech House, 2000.
2. Gauenzi, P., Smart Structures, Wiley, 2009.
3. Cady, W. G., Piezoelectricity, Dover Publication

Course Title	Metrology and Measurements Laboratory				B. Tech. ME V Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks	
2003514	PCC	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		0	0	3	1.5	40	60	100
					End Exam Duration: 3Hrs		

Course Objectives:

. The objectives of this course are to

- To experiment with measuring equipments used for linear and angular measurements.
- To find common types of errors in measurement equipment.
- To experiment with different types of sensors, transducers and strain gauges equipment.

To make use of thermocouples for measurement of temperature

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	● **Apply** different instruments to measure length, width, depth, bore diameters, internal and external tapers, tool angles, and surface roughness.
CO 2	● **Measure** effective diameter of thread profile.
CO 3	● **Conduct different** machine alignment tests.
CO 4	● **Evaluate** temperature, displacement, and pressure.
CO5	● **Illustrate** different instruments to measure length, width, depth, bore diameters, internal and external tapers, tool angles, and surface roughness.

Section A:

1. Measurement of bores by internal micrometres and dial bore indicators.
2. Use of gear teeth vernier callipers and checking the chordal addendum and chordal height of spur gear.
3. Alignment test on milling machine using dial indicators
4. Study of Tool makers microscope and its application
5. Angle and taper measurements by Bevel protractor, Sine bars, spirit level etc.
6. Thread measurement by Two wire/Three wire method.
7. Alignment test on the lathe using dial indicators
8. Use of straight edge and sprit level in finding the flatness of surface plate.

Section B:

1. Calibration of Pressure Gauges
2. Study and calibration of vacuum gauge for low pressure.
3. Calibration of transducer or thermocouple for temperature measurement.
4. Calibration of LVDT transducer for displacement measurement.
5. Calibration of capacitive transducer for angular measurement.
6. Calibration of photo and magnetic speed pickups for the measurement of speed.
7. Calibration of discharge by using rota meter

Course Title	Heat Transfer Laboratory				B. Tech. ME V Sem			
Course Code	Category	Hours/Week			Credits	Maximum Marks		
2003515	PCC	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		0	0	3	1.5	40	60	100
					End Exam Duration: 3Hrs			

Course Objectives:

. The objectives of this course are to

- Understand different modes of heat transfer
- Gain knowledge about natural and force convection phenomenon
- Estimate experimental uncertainty in measurements

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	● **Demonstrate** different modes of heat transfer
CO 2	● **Develop** parameters for measurement for calculating heat transfer
CO 3	● **Determine** effectiveness of heat exchanger
CO 4	● **Design** new equipment related to heat transfer
CO5	**Use** principles of heat transfer in wide application in industries

LIST OF EXPERIMENTS:

1. Determine the overall heat transfer coefficient across the width of composite wall
2. Determine the thermal conductivity of a metal rod
3. Determine the thermal conductivity of insulating powder material through concentric sphere apparatus
4. Determine the thermal conductivity of insulating material through lagged pipe apparatus
5. Determine the efficiency of a pin fin.
6. Determine the heat transfer coefficient for a vertical cylinder in natural convection
7. Determine the heat transfer coefficient in forced convection of air in a horizontal tube.
8. Determine the heat transfer coefficients on film and drop wise condensation apparatus.
9. Determine the effectiveness of a parallel and counter flow heat exchanger.
10. Determine the emissivity of the test plate surface.
11. Experiment on Stefan-Boltzmann apparatus

Course Title	ANSYS (Skill oriented course– III				B. Tech. ME V Sem		
Course Code	Category	Hours/Week		Credits	Maximum Marks		
Certification course	SC	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		1	0	2	2	40	60	100
					End Exam Duration: 3Hrs		

Course Objectives:

. The objectives of this course are to

- This is an introductory course on Finite element Analysis
- using ANSYS and is specially meant for
- ANSYS is a popular and well recognised general purpose
- finite element modelling package for numerically solving a large range of problems including static, dynamic
- mechanical, structural analysis

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Can able to understand the considerations that are important in the planning of a useful an appropriate analysis model.
CO 2	Analyse the Various Machine Techniques and Methods
CO3	Construct a Geometry for Analysis.
CO4	Solve the Engineering Design Problems.

MAPPING OF COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1		1		2			2		3
CO2		2		1			2		1		1	
CO3	2	3		1		3	1	1		2		2
CO4		2	3		1		2			1		

LIST OF EXPERIMENTS:

- Structural analysis of simply supported beam
- Structural analysis Cantilever Beam
- Structural analysis of Bars of constant cross sectional area
- Stress analysis of a rectangular plate with a circular hole
- Stress analysis of a corner angle Bracket
- Thermal Analysis of Composite wall
- Dynamic analysis of bar subjected to forcing function

PART-B

- Static structural analysis of screw jack using ANSYS WORK BENCH
- Steady state analysis of simple plate using ANSYS WORK BENCH

Course Title	Socially Relevant Projects (community based project)					B. Tech. V Semester		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
2003517	PROJ	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		--	--	-	1.5	100	--	100
Course Objective: The objective of the project is to enable the student to take up investigative study in rural areas in the field of MECHANICAL Engineering								
On successful completion of this course, the students will be able to								
CO 1	**Understand** core concepts and research findings relative to human development, socialization, group dynamics and life course processes.							
CO 2	**Illustrate** and transfer existing ideas into new contexts and applications							
CO 3	**Apply** and transfer academic knowledge into the real-world							
CO 4	**Design** a component or a product applying all the relevant standards and with realistic constraints							

The following are the rules and regulation for Socially Relevant Projects:

1. The student has to spend 50 to 60 Hrs in the semester on any socially relevant project and submit a report for evaluation.
2. The project is evaluated for 100 marks in the semester by a committee consisting of head of the department, project mentor and one senior faculty member of the department.
3. A student shall acquire 1.5 credits assigned, when he/she secures 50% or more marks from the total of 100 marks.
4. In case, if a student fails, he/she shall resubmit the report.
5. There is no external evaluation for the socially relevant project.

Course Title	Constitution of India (Mandatory Course)					B.Tech. V Sem (ME,CSE & EEE)		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
20MC509	Humanities & Social Sciences (HSMC)	L	T	P	C	Continuous Internal Assessment	EndExam	Total
		2	0	0	0	40	00	40
Mid Exam Duration: 2Hrs						External Exam Duration: –		

Course Objectives: The main objective of the course to learn

- To realize the significance of the constitution of India to students from all walks of life and help them to understand the basic concepts of Indian constitution.
- To identify the importance of fundamental rights as well as fundamental duties.
- To understand the functioning of Union, State and Local Governments in the Indian federal system.
- To learn procedure and effects of emergency, composition and activities of election commission and amendment procedure.

Course Outcomes: On success Completion Thiscourse,thestudentswillbeableto

CO1	Describe the historical background of the constitution making and its importance for building a democratic India.
CO2	Explain the functioning of three wings of the government i.e., executive, legislative and judiciary.
CO3	Explain the value of the fundamental rights and duties for becoming good citizen of India.
CO4	Analyze the decentralization of power between central, state and local self-government.
CO5	Apply the knowledge in strengthening of the constitutional institutions like CAG, Election Commission and UPSC for sustaining democracy

UNIT - I:

Introduction to Indian Constitution: Constitution meaning of the term, Indian Constitution – Sources and constitutional history, Features – Citizenship, Fundamental Rights and Duties, Directive Principles of State Policy.

UNIT - II:

Union Government and its Administration Structure of the Indian Union: Center- State relationship, President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, LokSabha, RajyaSabha, The Supreme Court and High Court: Powers and Functions.

UNIT - III:

State Government and its Administration Governor – Role and Position – CM and Council of ministers, State Secretariat: Organization, Structure and Functions.

UNIT - IV:

Local Administration: District's Administration Head – Role and Importance, Municipalities – Mayor and role of Elected Representative – ZillaPanchayat, Elected officials and their roles, CEO ZilaPanchayat: Block level Organizational Hierarchy – (Different departments), Village level – Role of Elected and Appointed officials.

UNIT - V:

Election Commission: Election Commission- Role of Chief Election Commissioner and Election Commissioner State Election Commission:, Functions of Commissions for the welfare of SC/ST/OBC and women.

Textbooks

1. M.V.Pylee, "Introduction to the Constitution of India",4th Edition, Vikas publication,2005.

2. Durga Das Basu(DD Basu) , "Introduction to the constitution of India",(Student Edition),19th edition,Prentice-Hall EEE, 2008.

Reference Books:

- Durga Das Basu, Introduction to the Constitution of India, Prentice – Hall of India Pvt. Ltd.. New Delhi
- Subhash Kashyap, Indian Constitution, National Book Trust
- J.A. Siwach, Dynamics of Indian Government & Politics
- D.C. Gupta, Indian Government and Politics
- H.M.Seervai, Constitutional Law of India, 4th edition in 3 volumes (Universal Law Publication)
- J.C. Johari, Indian Government andPolitics Hans
- J. Raj IndianGovernment and Politics
- M.V. Pylee, Indian Constitution Durga Das Basu, Human Rights in Constitutional Law, Prentice – Hall of India Pvt. Ltd.. New Delhi
- Noorani, A.G., (South Asia Human Rights Documentation Centre), Challenges to Civil Right), Challenges to Civil Rights Guarantees in India, Oxford University Press 2012.

E-Resources:

- nptel.ac.in/courses/109104074/8
- nptel.ac.in/courses/109104045/
- nptel.ac.in/courses/101104065/
- www.hss.iitb.ac.in/en/lecture-details
- www.iitb.ac.in/en/event/2nd-lecture-institute-lecture-series-indian-constitution

B.TECH VI SEM (R20 UG)

Course Title	**OPERATION RESEARCH**					**B. Tech. ME VI Sem**		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
2003601	**PCC**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	0	--	3	40	60	100
Mid Exam Duration: 90 MIN					**End Exam Duration: 3Hrs**			

Course Objectives:

. The objectives of this course are to

- To impart the basic concepts of modelling, models and statements of the operations research.
- Formulate and solve linear programming problem/situations.
- Model strategic behaviour in different economic situations.
- To solve transportation problems to minimize cost.
- Apply Queuing theory to solve problems of traffic congestion, counters in banks, railway bookings etc.
- Explain scheduling and sequencing of production runs and develop proper replacement policies.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Develop mathematical models for practical problems.
CO 2	Apply linear programming to transportation & Assignment problems.
CO 3	Solve game theory & Sequencing using various techniques.
CO 4	Solve Queuing and inventory problems.
CO 5	Apply replacement models to real life problems.

MAPPING OF COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	3		1				2	2
CO2	2	1	2	1	3		1				2	2
CO3	2	1	2	1	3		1				2	2
CO4	2	1	2	1	3		1				2	2
CO5	2	1	2	1	3		1				2	2

UNIT - I

Introduction to OR

Introduction to Operations Research (OR): OR definition - Classification of Models, modeling – Methods of solving OR Models, limitations and applications of OR models

Linear Programming (LP): Problem Formulation, Graphical Method, Simplex Method, Big-M Method, Two–Phase Simplex Method, - Degeneracy, Optimal Solutions; Concept of dual theorem

UNIT - II

Transportation and Assignment Problems

Transportation and Assignment Problems: Transportation Problem – Formulation; Different Methods of Obtaining Initial Basic Feasible Solution –North West Corner Rule, Least Cost Method, Vogel's Approximation Method; Optimality Method – Modified Distribution (MODI) Method; Special Cases – Unbalanced Transportation Problem, Degenerate Problem. Assignment Problem – Formulation, Hungarian Method for Solving Assignment Problems, Traveling Salesman problem.

UNIT – III

Game theory & Job Sequencing:

Game theory: Optimal solution of two person zero sum games, the max min and min max principle. Games without saddle points, mixed strategies. Reduction by principles of dominance, arithmetic, algebraic method and graphical method.

Job Sequencing: Introduction to Job shop Scheduling and flow shop scheduling, Solution of Job Sequencing Problem, Processing of n Jobs through two machines, Processing of n Jobs through m machines, graphical method.

UNIT - IV

Queuing Theory & Inventory Control

Queuing Theory: Introduction – Terminology, Arrival Pattern, Service Channel, Population, Departure Pattern, Queue Discipline, Single Channel Models with Poisson Arrivals, Exponential Service Times with infinite and finite queue length; Multichannel Models with Poisson Arrivals, Exponential Service Times with infinite queue length.

Inventory Control: Introduction, Deterministic models – EOQ model with and without shortages, Production model, Buffer stock and discount inventory models with single price breaks. Selective inventory control.

UNIT - V

Replacement and Maintenance Analysis & DP

Replacement and Maintenance Analysis: Introduction – Types of Maintenance, Make or buy decision. Types of Replacement Problems, Determination of Economic Life of an Asset, and Simple Probabilistic Model for Items which completely fail-Individual Replacement Model, Group Replacement Model.

Dynamic Programming (DP): Introduction –Bellman's Principle of Optimality – Applications of Dynamic Programming, Solution of Linear Programming Problem by DP.

Textbooks:

1. Sharma S.D., Operations Research: Theory, Methods and Applications, 15th Edition, KedarNath Ram Nath, 2018.
2. Taha H.A., Operations Research, 9th Edition, Prentice Hall of India, New Delhi, 2020.

Reference Books:

1.Hiller F.S., and Liberman G.J., Introduction to Operations Research, 7th Edition, Tata McGraw Hill, 2010.
2.Sharma J.K., Operations Research: Theory and Applications, 4th Edition, Laxmi Publications, 2009.
3.Prem kumar Gupta and Hira, Operations Research, 3rd Edition, S Chand Company Ltd., New Delhi, 2003.
4.Pannerselvam R., Operations Research, 2nd Edition, Pentice Hall of India, New Delhi, 2006.
5.Sundaresan.V, and GanapathySubramanian.K.S, Resource Management Techniques: Operations Research, A.R Publications, 2015.

Course Title	FINITE ELEMENT METHODS				B. Tech. ME VI Sem		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**	
2003602	**PCC**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	0	--	3	40	60	100
Mid Exam Duration: 90 MIN					**End Exam Duration: 3Hrs**		

Course Objectives:

. The objectives of this course are to

- Familiarize basic principles of finite element analysis procedure.
- Explain theory and characteristics of finite elements that represent engineering structures.
- Apply finite element solutions to structural, thermal, dynamic problem.
- Learn to model complex geometry problems and solution techniques.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Understand the concepts of variational methods and weighted residual methods in FEM. Frmulatiuon of I-D Bar Elements.
CO 2	Identify the application and characteristics of FEA elements such as Formuaion and Analysis to solve Trusses, beams
CO 3	Develop element characteristic equation procedure and generation of global stiffness equation will be applied for Modelling of 2D stress Analysis of CST Elements. stress-strain Relation matrics[D], Strain-Displacement matrics[B]
CO 4	Understand the concept of Iso peramatric Formulation and its classification,1-D Heat transfer problems of Composite slab, Fin problems and Numerical Integrations.
CO5	Able to identify how the finite element method expands beyond the structural domain, for problems involving formulations of dynamic Analysis.

MAPPING OF COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3		2			2		3		2	1
CO2	3	3		2								
CO3	3	2		2	3		3	2		3		
CO4	3	3	1	2		2			2			2
CO5	3	3	2	2	3	2	3	2		2	2	3

UNIT - I

Introduction to finite element methods

Introduction to finite element methods, Basic steps for solving field problems, applications, Stress and equilibrium, Boundary conditions, Strain-Displacement relations, Stress- strain relations for 2D and 3D Elastic problems. Variation Methods, Potential energy Method, Rayleigh-Ritz method,Galerkin's and Weighted Residual Methods.Formulation of Finite Element Equations.

One dimensional Problem: Finite element modeling of ID bar elements coordinates and shape functions. Requirements for Convergence and Interpolation functions, Assembly of global stiffness matrix and load vector. Finite element equations, Treatment of boundary conditions, Quadratic shape functions.

UNIT - II Analysis of Trusses and Beams

Analysis of trusses: Stiffness Matrix for 1D truss element, Assembling of Global Stiffness Matrix and Calculations of Reactions, Displacements and Stresses .Problems with maximum of three elements.

Analysis of beams: Element Stiffness Matrix and Load vector for 1-D beam element, Hermite shape functions and Solutions for Displacements, Reactions and Stresses ofsimple problems.

UNIT - III

Finite element modeling Finite element modeling of two dimensional stress analysis with constant strain triangles (CST), Shape functions of CST Elements and Stress Strain Relation Matrix (D) and Strain Displacement Matrix (B). Estimation of load Vector, Stresses.

Finite element modeling of Axi-symmetric problems subjected to axi-symmetric loading with triangle elements.

UNIT - IV

Quadrilateral Elements

Quadrilateral Elements: Isoparametric, Sub parametric and Super parametric elements, modeling of 4 noded and 8 noded quadrilateral elements and simple problems. Numerical Integration.Steady state heat transfer analysis: One dimensional analysis of composite slab and fin.

UNIT - V

Dynamic analysis

Dynamic analysis: Formulation of finite element model, element – mass matrices, evaluation of Eigen values and Eigen vectors for a bar and shaft.

Textbooks:

1. Chandraputla, Ashok &Belegundu, Introduction to Finite Element in Engineering, Prentice Hall.
2. S.S.Rao, The Finite Element Methods in Engineering, Elsevier Butterworth -Heinemann 2nd Edition, 2011.
3. O C Zienkiewicz and R L Taylor, the Finite Element Method, 3rd Edition. McGraw-Hill, 1989.

Reference Books:

1.J N Reddy, An introduction to the Finite Element Method, McGraw – Hill, New York, 1999.
2. S.Md.Jalaludeen, Finite Element Analysis in Engineering, 2nd Edition, Anuradha Publications, 2018.
3. R D Cook, D S Malkus and M E Plesha, Concepts and Applications of Finite Element Analysis, 3rd Edition, John Wiley, New York, 1989.
4. K J Bathe, Finite Element Procedures in Engineering Analysis, Prentice-Hall, Englewood Cliffs,1982.
5. G.Lakshmi Narasaiah, Finite Element Analysis, 1st Edition, B.S. Publications, 2008.

Course Title	Introduction to CAD/ CAM				B. Tech. ME VI Sem		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**	
2003603	**PCC**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	0	--	3	40	60	100
Mid Exam Duration: 90 MIN					**End Exam Duration: 3Hrs**		

COURSE OBJECTIVE:

- The course examines the area that is commonly referred
. to as CAD/CAM
- The general objectives of the course are to enable the students
Model the 3-D geometric information of machine components including assemblies, and automatically generate 2-D production drawings,
- Understand the basic analytical fundamentals that are used to create and manipulate
- Understand the possible applications of the CAD/CAM systems in motion analysis, structure analysis, optimization, rapid prototyping, reverse engineering and virtual engineering.
- Understand concept of Group Technology, FMS and CIM

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Understand Fundamentals,Computer peripherals,Applications and benefits of CAD .
CO 2	Solve various Line generation,transformations,windowing and clipping concepts
CO 3	Analyze various curve generation concepts.wireframe,surface, solid modelling,CSG,B-rep,CSG,Bezier curve and surface representations
CO 4	Understand GT,FMS,Applications of robots in manufacturing and material handling
CO 5	Identify Various CAPP.MRP.capacity planning.automatic identification methods,barcode technology concepts

MAPPING OF COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3		2			2		3		2	
CO2	3	3		2	3	2	3			3		
CO3	3	2	1	2				2	2			2
CO4	3	3	2	2								2
CO5	3	3	2	2								3

UNIT-I

Fundamentals of CAD - design process - Applications of computers for design benefits of CAD - Computer peripherals for CAD - Design work station

COMPUTER GRAPHICS:

Raster scan graphics coordinate system, database structure for graphics modeling, transformation of geometry, 3D transformations, mathematics of projections, clipping, hidden surface removal.

UNIT-II

Geometry and line generation, Computer graphics: Transformations-
Points and lines transformation - Translation, rotation, Scaling, Mirror Reflection;
2D and 3D transformations -Windowing and Clipping.

UNIT-III

Curve generation - Plane curves - Space curves - Surface description and generation; modeling concepts: 2D and 3D modeling - Wire frame, Surface and Solid modeling. B-rep solid modeling and constructive solid geometry, Bezier curve and surface representations

UNIT-IV

CAM - Definition, Divisions of CIM: Group technology - Introduction, concepts of GT, Analysis of GT, Classification and coding system, Advances of GT, Flexible manufacturing systems (FMS) - Definition, Different flexibilities Need of FMS, Components of FMS, system and FMS, Advantages of FMS. Applications of robots in manufacturing and material handling

UNIT V

Computer Aided Process Planning- Variant and Generative CAPP Systems. MRP- Inputs and outputs of MRP, Capacity Planning Basic concepts of Shop floor data- Types of factory data and collection systems- concepts of automatic identification methods- Bar code technology-Concepts and uses.

TEXT BOOKS:

1. CAD/CAM, A Zimmers& P.Groover, PE, PHI ,2012
2. Computer-Aided Design and Manufacturing 1st Edition (English, Paperback, E. Zimmers, M. Groover). 2010
3. Introduction to Automated Process Planning" by T C Chang and R A Wysk. 2012
4. 3.CAD/CAM By Ibrahim Zeid ,R.siva subramanyam ,Mcgraw Higher Ed

REFERENCE BOOKS:

1. Computer Graphics :PlastockSchaum Series,2006
2. Interactive Computer Graphics: Newman &Sproul,2012
3. Computer Graphics: Steven Hamington

Course Title	DYNAMICS OF MACHINERY				B. Tech. ME VI Sem		
Course Code	Category	Hours/Week		Credits	Maximum Marks		
2003604	PEC-II	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	--	3	40	60	100
Mid Exam Duration: 90 MIN					End Exam Duration: 3Hrs		

Course Objectives:

. The objectives of this course are to

- To introduce the laws of precession.
- To learn about the working of different types of brakes and dynamometers,
- To able to design the fly wheel for an IC engine,
- To introduce different types of Governors,
- To analyze the unbalanced forces acting in rotating and reciprocating system and to know the balancing methods of different mechanical systems..

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	**Solv**e thenumericalproblemsonbrakesandunderstandtheworkingofDynamometers
CO 2	**Apply** gyroscopicprinciplesonaeroplanes,ships,fourwheelandtwowheelvehicles.
CO 3	**Analyze** the basics of Governors and forces acting on various governors.
CO 4	**Evaluate** thenumericalproblemsonBalancingofRotatingmassesandreciprocatingmasses.
CO5	**Design** theresponseofsingledegreefreedomsystemswithfreeandforcedvibration,andcan Evaluate the critical speed of the shaft.

MAPPING OF COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

UNIT -I:

BALANCING: Balancing of rotating masses- single and multiple masses- single and different planesBalancing of Reciprocating masses- Primary and secondary balancing of reciprocating masses-graphicalmethods.Unbalancedforcesandcouples-V-engine, multicylinderinlineandradialengineforprimaryandsecondarybalancing.

UNIT-II:

TURNING MOMENT DIAGRAMS AND FLYWHEELS: Turning moment diagrams for IC engine and multicylinder engine. Crank effort- coefficient of fluctuation of energy, coefficient of fluctuation of speed-Flywheelsandtheirdesign,flywheelsforpunchingmachines.

UNIT -III:

GOVERNORS: Watt, Porter and Proell governors. Spring loaded governors- Hartnell and Hartunggovernors with auxiliary springs. Sensitiveness, isochronism and hunting.Effort and power of agovernor.

UNIT -IV:

BRAKES AND DYNAMOMETERS:

Simple block brakes, Band brake, internal expanding brake, braking ofvehicle. Dynamometers- absorption and transmission types.General description and methods ofoperation.

PRECESSION:Gyroscopes,effects ofprecessionmotiononthestabilityofmovingvehiclessuchasmotorcar,motorcycle,aeroplanes

UNIT-V:

VIBRATION: Free and forced vibration of single degree of freedom system, Role of damping, Whirling ofshaftsandcriticalspeeds.Simpleproblemsonfree,forcedanddampedvibrations.Vibrationisolation&Transmissibility. Transverse vibrations of beams with concentrated and distributed loads. Dunkerly'smethod.Torsionalvibrations-twoandthreerotorsystems.

TEXT BOOKS :

1. Thoery of Machines, S.S Ratan, MGH
2. Theory of machines, Khurmi, S.Chand.
3. Kinematics and Dynamics of machinery-R.L.NORTON,TATA MC GRAW HILL
4. . Theory of machines- J.E.SHIEGLEY, MC GRAW HILL

REFERENCE BOOKS :

1. Theory of machines,THOMOS BEVAN, PEARSON PUBL, 3RD EDITION
2. Mechanism and mechanics :Mchal.M.StanisicCengageindia publishers 1st edition
3. Theory of Machines and Mechanism ,JOHN VICKY J.VR,GORDON R.PENNOK JOSEPH 5TH EDITION OXFORD PUBLICATION
4. Design of machine elments , M.F.SPOTS ,TE,SOUP 8TH EDITION PEARSON

Course Title	SOLAR AND WIND ENERGY SYSTEMS				B. Tech. ME VI Sem		
Course Code	Category	Hours/Week		Credits	Maximum Marks		
2003605	PEC-II	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	--	3	40	60	100
Mid Exam Duration: 90 MIN					End Exam Duration: 3Hrs		

Course Objectives:

. The objectives of this course are to

- Familiarize with basics of solar radiation, available solar energy and its measurement.
- Familiarize with solar collectors, construction and operation of solar collectors.
- Understand solar energy conversion systems, applications and power generation.
- Familiarize the wind energy sources assessment
- Explain basics of designing aerofoil

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	● **Determine** the basic concepts of solar radiation and solar collectors
CO 2	● **Design** the solar photo voltaic systems for different applications
CO 3	● **Identify** wind energy as alternative form of energy and to know how it can be tapped
CO 4	● **Use** the application of wind energy and wind energy conversion systems
CO5	● **Utilize** different wind parameters for design of rotors

UNIT - I

Solar radiation and collectors

Solar radiation and collectors: Solar angles – Sun path diagrams – Radiation - extra terrestrial characteristics - measurement and estimation on horizontal and tilted surfaces - flat plate collector thermal analysis - testing methods-evacuated tubular collectors - concentrator collectors – classification - design and performance parameters - tracking systems - compound parabolic concentrators - parabolic trough concentrators - concentrators with point focus - Heliostats – performance of the collectors.

Solar thermal technologies: Principle of working, types, design and operation of - Solar heating and cooling systems - Thermal Energy storage systems – Solar Desalination – Solar cooker : domestic, community – Solar pond – Solar drying.

UNIT - II

Solar PV fundamentals

Solar PV fundamentals: Semiconductor – properties - energy levels - basic equations of semiconductor devices physics. Solar cells - p-n junction: homo and hetro junctions - metal-semiconductor interface - dark and illumination characteristics - figure of merits of solar cell - efficiency limits - variation of efficiency with band-gap and temperature - efficiency measurements - high efficiency cells – Solar thermo-photovoltaics.

SPV system design and applications: Solar cell array system analysis and performance prediction- Shadow analysis: reliability - solar cell array design concepts - PV system design - design process and optimization - detailed array design - storage autonomy - voltage regulation - maximum tracking - centralized and decentralized SPV systems - standalone - hybrid and grid connected system - System installation - operation and maintenances - field experience - PV market analysis and economics of SPV systems.

UNIT - III

Introduction to wind energy

Introduction: Historical Perspectives on Wind Turbines- Indian Energy Scenario - Global Energy Scenario - Introduction to Indian Wind Industry - Wind Energy potential of India and Global Wind Installations. Basics of Wind Resource Assessment: Power in the wind –Wind Characteristics - Measurement of wind using anemometers (cup anemometer, propeller anemometer, pressure plate anemometer, pressure tube anemometer, sonic anemometer and other remote wind speed sensing techniques) –Turbulence-Wind Power Density –Average wind speed calculation - Statistical models for wind data analysis (Weibull and Rayleigh distribution). Energy estimation of wind regimes – Wind Rose, Wind Monitoring Station Siting and Instrumentation.

UNIT - IV

Wind Energy Conversion Systems

Wind Energy Conversion Systems: Types - Components of Modern Wind Turbine (HAWT and VAWT) - Fixed and Variable Speed operations - Power Control (Passive stall, Active pitch, Passive pitch and Active stall) - Electrical aspects of wind turbine, Safety of wind turbines.

UNIT - V

Wind Farm Design and Health (Condition) Monitoring

Wind Farm Design and Health (Condition) Monitoring: Planning of wind farm, Site selection, Micro siting, Grid Integration, Power evacuation, Wind Farm Feasibility Studies, Preparation of DPR, Environmental Benefits and Impacts.

Small Wind Turbines: Water pumping wind mills, offshore wind energy, Wind turbine testing, future developments.

Textbooks:

1. Goswami D.Y., Kreider, J. F. and Francis., "Principles of Solar Engineering', Taylor and Francis, 2000.
2. Chetan Singh Solanki, "Solar Photovoltaics – Fundamentals, Technologies and Applications", PHI Learning Private limited, 2011.
3. Satyajit Mathew, Wind Energy Fundamentals, Resource Analysis and Economics, Springer Publications, (2006).

Reference Books:

1.Sukhatme S.P..Nayak.J.P, 'Solar Energy – Principle of Thermal Storage and collection", Tata McGraw Hill, 2008.
2. Satyajit Mathew, Wind Energy Fundamentals, Resource Analysis and Economics, Springer Publications, (2006).
Sathyajith Mathew, Wind Energy Fundamentals, Resource Analysis and Economics, Springer Publications, (2006).
Wei Tong, Wind Power Generation and Wind Turbine Design, WIT Press, (2010.
Wind Power, Revised Edition: Renewable Energy for Home, Farm, and Business, Paul Gipe, 2004, Chelsea Green Publishing.
A. R. Jha, Wind Turbine Technology, CRC Press, (2010).

Course Title	COMPUTATIONAL FLUID DYNAMICS				B. Tech. ME VI Sem		
Course Code	Category	Hours/Week		Credits	Maximum Marks		
2003606	PEC-II	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	--	3	40	60	100
Mid Exam Duration: 90 MIN					End Exam Duration: 3Hrs		

Course Objectives:

. The objectives of this course are to

- Teach the basics of the major theories, approaches and methodologies used in CFD.
- Familiar with the differential equations for flow phenomena and numerical methods for their solutions.
- Introduce explicit and implicit schemes in hyperbolic equations.
- Expose the students to solve the problems through finite volume method.
- Understand the concepts of linear fluid flow problems, steady state problems and transient problems.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	• **Examine** the major theories, approaches and methodologies used in CFD.
CO 2	• **Formulate** finite volume method for two and three dimensional fluid flow problems.
CO 3	• **Apply** numerical models to fluid flow and heat transfer calculations.
CO 4	• **Demonstrate** the ability to communicate the results of this detailed fluid-flow study in a written format.
CO5	• **Outline** the ability to describe various flow features in terms of appropriate fluid mechanical principles and force balances.

UNIT - I

Introduction

Introduction: Finite difference method, finite volume method, finite element method, governing equations and boundary conditions, Derivation of finite difference equations.

Solution methods: Solution methods of elliptical equations — finite difference formulations, interactive solution methods, direct method with Gaussian elimination. Parabolic equations-explicit schemes and Von Neumann stability analysis, implicit schemes, alternating direction implicit schemes, approximate factorization, fractional step methods, direct method with tridiagonal matrix algorithm.

UNIT - II

Hyperbolic equations

Hyperbolic equations: explicit schemes and Von Neumann stability analysis, implicit schemes, multi step methods, nonlinear problems, second order one-dimensional wave equations. Burgers equations: Explicit and implicit schemes, Runge-Kutta method.

UNIT - III

Formulations Of Incompressible Viscous Flows

Formulations Of Incompressible Viscous Flows: Formulations of incompressible viscous flows by finite difference methods, pressure correction methods, vortex methods.

Treatment of compressible flows: potential equation, Euler equations, Navier-stokes system of equations, flow field-dependent variation methods, boundary conditions, example problems.

UNIT - IV

Finite Volume Method

Finite Volume Method: Finite volume method via finite difference method, formulations for two and three-dimensional problems.

UNIT – V

Standard Variational Methods

Standard Variational Methods: Linear fluid flow problems, steady state problems, Transient problems.

Textbooks:

1.Computational fluid dynamics/ T. J. C'hung/ Cambridge University press,2002.
2.Computational Fluid Dynamics: Basics with applications/John D. Anderson/ McGraw Hill.

Reference Books:

1.Text book of fluid dynamics/ Frank Choriton/ CBS Publishers & distributors, 1985.
2. Numerical heat transfer and fluid flow / Suhas V. Patankar/ Hemashava Publishers corporation&McGraw Hill.
3. Computational Fluid Flow and Heat Transfer/ Muralidaran/ Narosa Publications.
4. Fundamentals of Computational Fluid Dynamics/Tapan K. Sengupta / Universities Press.
5.Introduction to Theoretical and Computational Fluid Dynamics/C. Pozrikidis / Oxford.

Course Title	SIX SIGMA AND LEAN MANUFACTURING				B. Tech. ME VI Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks	
2003607	PEC-II	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	--	3	40	60	100
Mid Exam Duration: 90 MIN					End Exam Duration: 3Hrs		

Course Objectives:

. The objectives of this course are to

- Introduce the students, the basic concepts of six sigma and lean manufacturing.
- Expose with various quality issues in Inspection.
- Gain Knowledge on quality control and its applications to real time.
- Know the extent of cellular manufacturing and 5S.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	• **Demonstrate** various techniques that are related to the six-sigma and lean manufacturing.
CO 2	• **Outline** the concepts of cellular manufacturing, JIT and TPM
CO 3	• **Illustrate** the principles and implementation of 5S techniques.
CO 4	• **Select** procedure and principles of value stream mapping
CO 5	• **Determine** the reliability function using six-sigma

UNIT - I

Introduction to Six-Sigma

Introduction to Six-Sigma-Probabilistic models-Six Sigma measures-Yield-DPMO-Quality level-Reliability function using Six-Sigma-MTTF using Six Sigma-Maintenance free operating period- Availability using Six-Sigma-Point availability-Achieved availability-Operational Availability-Examples

UNIT - II

The Elements of Six Sigma and their Determination

The Elements of Six Sigma and their Determination-The Quality Measurement Techniques: SQC, Six Sigma, Cp and Cpk- The Statistical quality control (SQC) methods-The relationship of control charts and six sigma-The process capability index (Cp)-Six sigma approach-Six sigma and the 1.5 σ shift-The Cpk Approach Versus Six Sigma-Cpk and process average shift- Negative Cpk-Choosing six sigma or Cpk-Setting the process capability index-Examples.

UNIT - III

Introduction To Lean Manufacturing:

Introduction To Lean Manufacturing: Conventional Manufacturing versus Lean Manufacturing – Principles of Lean Manufacturing – Basic elements of lean manufacturing – Introduction to LM Tools.

UNIT - IV

Cellular Manufacturing, JIT, TPM

Cellular Manufacturing, JIT, TPM :Cellular Manufacturing – Types of Layout, Principles of Cell layout, Implementation. JIT – Principles of JIT and Implementation of Kanban. TPM – Pillars of TPM, Principles and implementation of TPM.

UNIT - V **Set Up Time Reduction**, TQM, 5S, VSM 10,Set up time reduction – Definition, philosophies and reduction approaches. TQM – Principles and implementation. 5S Principles and implementation - Value stream mapping - Procedure and principles.

Textbooks:

1. U Dinesh Kumar, Crocker, Chitra and HaritheSaranga, Reliability and Six Sigma, Springer Publishers.
2. Sung H. Park, Six Sigma for Quality and Productivity Promotion, Asian Productivity Organization
3. Rother M. and Shook J, 1999 _Learning to See: Value Stream Mapping to Add Value and Eliminate Muda‘ , Lean Enterprise Institute, Brookline, MA.

Reference Books:

1. Sammy G. Shina, Six Sigma for Electronics Design and Manufacturing, McGraw-Hill.
2. Design and Analysis of Lean Production Systems, Ronald G. Askin& Jeffrey B. Goldberg, John Wiley & Sons, 2003.
3. Mikell P. Groover (2002) _Automation, Production Systems and CIM.

Course Title	ENERGY AUDITING				B. Tech. ME VI Sem		
Course Code	Category	Hours/Week		Credits	Maximum Marks		
2003608	PEC-II	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	--	3	40	60	100
Mid Exam Duration: 90 MIN					End Exam Duration: 3Hrs		

Course Objectives:

. The objectives of this course are to

- Introduce the concepts of energy scenario and need for energy policy for industries in India.
- Familiarize with the Energy Audit concepts and its approaches.
- Teach the principles and objectives of the Energy management.
- Discuss the Thermal and Electrical Energy management

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	• **Summarise** the fundamental aspects of energy scenario in India
CO 2	• **Analyse** the various national and state level energy policy
CO 3	• **Develop** the concepts of energy conservation in boilers
CO 4	• **Select** the thermal energy components.
CO 5	• **Illustrate** the concepts of supply methods to minimize supply.

UNIT - I

General Aspects:

Review of energy scenario in India, General Philosophy and need of Energy Audit and Management, Basic elements and measurements - Mass and energy balances – Scope of energy auditing industries - Evaluation of energy conserving opportUNITies, Energy performance contracts, Fuel and Energy substitution, Need for Energy Policy for Industries, National & State level energy Policies.

UNIT - II

Energy Audit Concepts:

Need of Energy audit - Types of energy audit – Energy management (audit) approach - understanding energy costs - Bench marking – Energy performance - Matching energy use to requirement - Maximizing system efficiencies -Optimizing the input energy requirements - Duties and responsibilities of energy auditors- Energy audit instruments - Procedures and Techniques.

UNIT - III

Principles and Objectives of Energy Management:

Design of Energy Management Programmes - Development of energy management systems – Importance - Indian need of Energy Management - Duties of Energy Manager - Preparation and presentation of energy audit reports - Monitoring and targeting, some case study and potential energy savings.

UNIT - IV

Thermal Energy Management:

Energy conservation in boilers - steam turbines and industrial heating systems - Application of FBC - Cogeneration and waste heat recovery -Thermal insulation - Heat exchangers and heat pumps –HVC industries-Building Energy Management.

UNIT - V

Electrical Energy Management:

Supply side Methods to minimize supply-demand gap- Renovation and modernization of power plants - Reactive power management – HVDC- FACTS - Demand side - Conservation in motors - Pumps and fan systems – Energy efficient motors.

Textbooks:

1. Murphy, W. R., Energy Management, Elsevier, 2007.
2. Smith, C. B., Energy Management Principles, Pergamum, 2007
3. Handbook of Energy Audit, Sonal Desai, Mcgraw Hill Education Private Ltd.,

Reference Books:

1. Turner, W. C., Doty, S. and Truner, W. C., Energy Management Hand book, 7th edition, Fairmont Press, 2009.
2. De, B. K., Energy Management audit & Conservation, 2nd Edition, Vrinda Publication, 2010.
3. Energy Management Handbook – W.C. Turner (John Wiley and Sons, A Wiley a. Interscience publication)
4. Industrial Energy Management and Utilisation –L.C. Witte, P.S. Schmidt, D.R. Brown (Hemisphere Publication, Washington, 1988)
5. Industrial Energy Conservation Manuals, MIT Press, Mass, 1982
6. Energy Conservation guide book Patrick/Patrick/Fardo (Prentice hall1993)

Course Title	AUTOMOTIVE ELECTRONICS, SENSORS & DRIVES				B. Tech. ME VI Sem		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**	
20OE306	**OEC-II**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	0	--	3	40	60	100
Mid Exam Duration: 90 MIN					**End Exam Duration: 3Hrs**		

Course Objectives:

. The objectives of this course are to

- Explain the use of electronics in the automobile.
- Explain the importance of various types of sensors and actuators in automotive electronics.
- Demonstrate the various control elements in Engine Management system.
- Familiarize with Vehicle management systems
- Identify various electronic and the instrumentation systems used in automobile

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	• **Obtain** an overview of automotive components, like sensors, actuators, communication protocols and safety systems employed in today's automotive industry.
CO 2	• **Interface** automotive sensors and actuators with microcontrollers.
CO 3	• **Know**, the various display devices that are used in automobiles
CO 4	• **Identify** the elements in the engine management and vehicle management system.
CO 5	• **Summarise** an overview of automotive components, like sensors, actuators, communication protocols and safety systems employed in today's automotive industry.

UNIT - I

Introduction to microcomputer

Introduction to microcomputer: Microcomputer: Buses, memory, timing, CPU registers; Microprocessor architecture: Initialization, operation codes, program counter, branch and jump instructions, subroutine. Analog to digital converters and Digital to analog converters, sampling, polling and interrupts, digital filters, lookup table.

UNIT - II

Sensors and actuators

Sensors and actuators: Speed sensors, Pressure sensors: Manifold Absolute Pressure sensor, knock sensor, Temperature sensors: Coolant and Exhaust gas temperature, Exhaust Oxygen level sensor, Position sensors: Throttle position sensor, accelerator pedal position sensor and crankshaft position sensor, Air mass flow sensor. Solenoids, stepper motors and relays.

UNIT - III

Electronic engine management system

Electronic engine management system: Electronic engine control: Input, output and control strategies, electronic fuel control system, fuel control modes: open loop and closed loop control at various modes, EGR control, Electronic ignition systems – Spark advance correction schemes, fuel injection timing control.

UNIT - IV

Electronic vehicle management system

Electronic vehicle management system: Cruise control system, Antilock braking system, electronic suspension system, electronic steering control, traction control system, Transmission control, Safety: Airbags, collision avoiding system, low tire pressure warning system.

UNIT - V

Automotive instrumentation system

Automotive instrumentation system: Input and output signal conversion, multiplexing, fuel quantity measurement, coolant temperature and oil pressure measurement, display devices- LED, LCD, VFD and CRT, Onboard diagnostics(OBD), OBD-II, off board diagnostics.

Textbooks:

1. Understanding Automotive Electronics, William B Ribbens, Newne Butterworth-Heinermann, 6th edition 2003.
2. Crouse W H, Automobile Elctrical Equipment, McGraw Hill Book Co.Inc, Newyork 2005.

Reference Books:

1. Bechhold "Understanding Automotive Electronics", SAE, 1998.
2. Robert Bosch "Automotive Hand Book", SAE (5th Edition), 2000.
3. Tom Denton,"Automobile Electrical and Electronic Systems" 3rd edition- Edward Arnold, London - 2004.
4. Eric Chowanietz - 'Automotive Electronics' - SAE International USA – 1995.

Course Title	ROBOTICS AND APPLICATIONS IN MANUFACTURING				B. Tech. ME VI Sem		
Course Code	Category	Hours/Week		Credits	Maximum Marks		
20OE307	OEC-II	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	--	3	40	60	100
Mid Exam Duration: 90 MIN					End Exam Duration: 3Hrs		

Course Objectives:

. The objectives of this course are to

- Learn the fundamental concepts of industrial robotic technology.
- Apply the basic mathematics to calculate kinematic and dynamic forces in robot manipulator.
- Understand the robot controlling and programming methods.
- Describe concept of robot vision system .

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	● **Illustrate** the industrial applications of robot vision system
CO 2	● **Use** concepts of robot controlling systems
CO 3	● **Evaluate** D-H notations for simple robot manipulator
CO 4	● **Define** a robot and homogeneous transformations
CO5	● **Apply** the concepts of robot.

UNIT - I

Fundamentals of Robots

Fundamentals of Robots: Introduction, definition, classification and history of robotics, robot characteristics and precision of motion, advantages, disadvantages and applications of robots. Introduction to matrix representation of a point in a space a vector in space, a frame in space, Homogeneous transformation matrices, representation of a pure translation, pure rotation about an axis.

UNIT - II

Kinematics of robot, Differential motions and Velocities

Kinematics of robot: Forward and inverse kinematics of robots- forward and inverse kinematic equations for position and orientation, Denavit-Hartenberg(D-H) representation of forward kinematic equations of robots, The inverse kinematic of robots, Degeneracy and Dexterity, simple problems with D-H representation.

Differential motions and Velocities: Introduction, differential relationship, Jacobian, differential motions of a frame-translations, rotation, rotating about a general axis, differential transformations of a frame. Differential changes between frames, differential motions of a robot and its hand frame, calculation of Jacobian, relation between Jacobian and the differential operator, Inverse Jacobian.

UNIT - III

Control of Manipulators

Control of Manipulators: Open- and Close-Loop Control, the manipulator control problem, linear control schemes, characteristics of second-order linear systems, linear second-order SISO model of a manipulator joint, joint actuators, partitioned PD control scheme, PID Control Scheme, computer Torque control, force control of robotic manipulators, description of force-control tasks, force control strategies, hybrid position/force control, impedance force/torque control.

UNIT - IV

Robot Vision

Robot Vision: Introduction, architecture of robotic vision system, image processing, image acquisition camera, image enhancement, image segmentation, imaging transformation, Camera transformation and calibrations, industrial applications of robot vision.

UNIT - V

Robot Application In Manufacturing

Robot Application In Manufacturing: Material Transfer - Material handling, loading and unloading - Process - spot and continuous arc welding & spray painting - Assembly and Inspection.

Textbooks:

1. Mikell P. Groover and Mitchell Weiss, Roger N. Nagel,NicholasG.Odrey , Industrial Robotics — McGraw Hill, 1986.
2.R K Mittal and I J Nagrath, Robotics and control, Illustrated Edition, Tata McGraw Hill India 2003.
3.John.J.Craig Addison, Introduction to Robotics: Mechanics and Control, Wesley, 1

Reference Books:

1. Saeed B. Niku, Introduction to Robotics – Analysis, System, Applications, 2nd Edition, John Wiley & Sons, 2010.
2. H. Asada and J.J.E. Slotine, Robot Analysis and Control, 1st Edition Wiley- Interscience, 1986.
3. Robert J. Schillin, Fundamentals of Robotics: Analysis and control, Prentice-Hall Of India Pvt. Limited, 1996.
4. Mohsen shahinpoor, A robot Engineering text book, Harper & Row Publishers,1987.

Course Title	SENSORS IN INTELLIGENT MANUFACTURING				B. Tech. ME VI Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks	
20OE308	OEC-II	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	--	3	40	60	100
Mid Exam Duration: 90 MIN					End Exam Duration: 3Hrs		

Course Objectives:

. The objectives of this course are to

- Familiarize the sensors used in intelligent manufacturing.
- Illustrate sensors used in precision manufacturing and CNC machine tools.
- Explain sensors for monitoring of manufacturing systems.
  Outline advanced sensors used in intelligent manufacturing

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	● **Classify** various sensors used in intelligent manufacturing.
CO 2	● **Summarise** sensors used in computer integrated manufacturing and machine sensors
CO 3	● **Apply** sensors used in precision manufacturing.
CO 4	● **Identify** reasons behind machinery faults.
CO 5	● **Develop** the Important role in making the products intelligent and highly automatic.

UNIT - I

Introduction

Introduction –Principles, classifications and characteristics of sensors – Electrical, magnetic, optical, acoustic, pneumatic, magnetic, electro-optical and vision sensors, role of sensors in intelligent manufacturing.

UNIT - II

Sensors and control in CIM and FMS:

Sensors and control in CIM and FMS: Design of CIM, decision support system for CIM, analysis of CIM, development of CIM strategy with sensors and control. FMS-Robot control with machine vision sensors-Architecture of robotic vision system, image processing, image acquisition, enhancement, segmentation, transformation, industrial application of robot vision, multi Sensor controlled robots, measurement of robot density, robot programming.

UNIT - III

Sensors in Precision Manufacturing:

Sensors in Precision Manufacturing: Testing of manufacturing components, principles and applications of digital Encoders, opto-electronic colour sensors, control applications in robotics. Sensors for CNC machine tools– linear, position and velocity sensors. Automatic identification techniques for shop floor control.

UNIT - IV

Sensors for Monitoring of Manufacturing Systems

Sensors for Monitoring of Manufacturing Systems: Principles – sensors for monitoring temperature, force, vibration and noise. Sensors to detect machinery faults.Selection of sensors and monitoring techniques.

UNIT - V

Smart / Intelligent sensors

Smart / Intelligent sensors: Integrated sensors, micro sensors, nano sensors. Manufacturing of semi conductor sensors.Fibre optic sensors – Fibre optic parameters, configurations, photoelectric sensor for long distance, sensor alignment techniques.

Textbooks:

1. SabrieSoloman, Sensors and Control systems in Manufacturing, McGraw-Hill, 2/e, 2010.
2. H.K Tonshoff and I.Inasaki, Sensor Applications Vol 1: Sensors in Manufacturing, Wiley-VCH Publications, 2001.

Reference Books:

1. SabrieSoloman, Sensors Handbook, McGraw-Hill, 2/e, 2010.
2. MikellP.Groover, Mitchell Weiss, Roger N.Nagel, Nicholas G.Odrey, Industrial Robotics, Tata McGraw-Hill, 2008.

Course Title	NON-CONVENTIONAL ENERGY SOURCES				B. Tech. ME VI Sem		
Course Code	Category	Hours/Week		Credits	Maximum Marks		
20OE309	OEC-II	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	--	3	40	60	100
Mid Exam Duration: 90 MIN					End Exam Duration: 3Hrs		

Course Objectives:

. The objectives of this course are to

- To get exposure on solar radiation and its environmental impact to power production
- To know about the various collectors used for storing solar energy and their applications
- To learn about the wind energy and biomass and its economic aspects
- To know about geothermal, Ocean and Wave energy sources
- To know about direct energy conversion systems

.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	**Determine** the physics of solar radiation and its measurement techniques.
CO 2	**Classify** the solar energy collectors, methodologies of storing solar energy and
CO 3	**Apply** knowledge to develop Wind and Bio-energy systems.
CO 4	**Categorize** the Geothermal, Tidal, OTEC and hydelenergy, its mechanism of production and its applications
CO 5	**Illustrate** the concepts of Direct Energy Conversion systems and their applications

UNIT - I

Principles of Solar Radiation

Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power, physics of the sun, the solar constant, extra-terrestrial and terrestrial solar radiation, solar radiation on titled surfaces, instruments for measuring solar radiation and Sunshine Recorder, solar radiation data.

UNIT - II

Solar Energy Collection, Storage& Applications

Solar Energy Collection: Flat plate and concentrating collectors, classification of concentrating collectors, Advantages and disadvantages of concentrating collectors over Flat plate collectors

Solar Energy Storage:

Different methods of solar Thermal Energy Storage Sensible, latent heat and stratified storage, solar ponds.

Applications of Solar Energy:

solar water heating, solar distillation and drying, photovoltaic energy conversion.

UNIT – III

Wind Energy & Bio-Mass Energy

Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Betz criteria

Bio-Mass: Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, I.C. Engineoperation and economic aspects.

UNIT – IV

Geothermal Energy &Energy from Oceans

Geothermal sources, types of wells, methods of harnessing the energy, potential in India.
Ocean Energy: OTEC, Basic Principles utilization, setting of OTEC plants, thermodynamic cycles.
Tidal and Wave energy: Potential and conversion techniques, mini-hydel power plants

UNIT – V

Direct Energy Conversion Systems:

Need for DEC, principles of DEC, Thermo-electricpower generation – Basic Principle, materials, applications, MHD Power Generation-Principle, MHD systems, Fuel cells- principle and operation, types of fuel cells and their applications

Textbooks:

1. Mehmet Kanoglu, YunusA. Cengel, John M. Cimbala, Fundamental and Applications of Renewable Energy, First Edition, McGraw Hill, 2020
2. John Twidell and Tony Weir, Renewable Energy Resources, Third Edition, Routledge, 2015
3. G.D. Rai, Non-Conventional Energy Sources, Sixth Edition, Khanna Publications,
4. 2017

Reference Books:

1. Wendell H. Wiser, Energy Resources: Occurrence,
2. Sukhatme S.P. Nayak.J. P, 'Solar Energy – Principle of Thermal Storage and Collection", Tata McGraw Hill, 2008.
3. Wei Tong, Wind Power Generation and Wind Turbine Design, WIT Press,2010.

Course Title	SUPPLY CHAIN MANAGEMENT					B. Tech. ME VI Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
20OE310	OEC-II	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	--	3	40	60	100
Mid Exam Duration: 90 MIN					End Exam Duration: 3Hrs			

Course Objectives:

. The objectives of this course are to

- Explain the basics of supply chain management.
- Familiarize inventory management techniques and models to ensure EOQ batch size under risk management.
- Demonstrate various distribution strategies for shipment of products.
- Focus on evaluating of strategic alliance partners and understanding of RDBMS.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	● **Apply** the concepts of supply chain management for demand forecasting.
CO 2	● **Use** of SCM and inventory management for procurement
CO 3	● **Analyse** the shipment activities and related issues
CO 4	● **Build** third party alliances.
CO 5	● **Adapt** the RDBMS data for communications and analyzing future challenges and understand e-commerce strategies

UNIT - I

Understanding the supply chain

Understanding the supply chain: What is SCM? Why SCM? The Complexity, Key issues in SCM Logistics network - Introduction, Data Collection, Transportation, Ware house Management, Demand forecasting, Role of aggregate planning, MRP, ERP.

UNIT - II

Inventory management

Inventory management: Concepts of Materials Management, Economic lot size model, Effect of Demand uncertainly, Fixed order costs, Variable lead frames, Inventory under certainly & uncertainty,

UNIT - III

Distribution strategies

Distribution strategies: Introduction, Centralized vs Decentralized control, Direct shipment, Cross Docking, Push based vs Pull based supply chain.

UNIT - IV

Strategic alliances

Strategic alliances: Third party Logistics (3PL), Retailer – supplier relationship issues, requirements, success & failures, Distributor integration Types & issues.

UNIT - V

MIS & SCM

MIS & SCM: Relational Data Base Management (RDBMS), System Architecture, Communications, and Implementation of ERP, Decision support systems for SCM:
e-Commerce strategies and world class supply chain management.

Textbooks:

1. Sunil Chopra, Peter Meindl, Supply Chain Management: Strategy, Planning, and Operation, 4/e, Pearson, 2010.
2. David N. Burt, Donald W. Dobler , World Class Supply Management: The Key to Supply Chain Management, 2/e, McGraw-Hill/Irwin, 2003.
3. Nabil Abu el Ata, Rudolf Schmandt , Essentials of Supply chain management; Westland Publications. (2016),

Reference Books:

1. John Joseph Coyle, Edward J. Bardi, C. John Langley, The Management of Business Logistics: A Supply Chain Perspective, South-Western/Thomson Learning, 2003.
2. UpendraKachru ,Logistics and Supply Chain Management, Excel Books, 2009.
3. D. K .Agarwal, Supply Chain Management with efficient Logistics , MACMILAN 2019.

Course Title	Computer Aided Machining Laboratory					B. Tech. ME VISem		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
2003609	**PCC**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		0	0	3	1.5	40	60	100
					End Exam Duration: 3Hrs			

- **COURSE OBJECTIVE**: To get practical knowledge on manual part programming of CNC lathe machine by using G codes and M codes.
- To get practical knowledge on manual part programming of CNC milling and drilling machine by using G codes and M codes.
- To get the practical knowledge on APT language.
- To get practical application of Industrial Robots

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Use and understanding of Preparatory and Miscellaneous (G& M) codes to generate or edit a program which will seprate a CNC Lathe/ Milling and Drilling.
CO 2	Apply mathematical methods to calculate World/ Joint/ Tool coordinates in robotics.
CO 3	Apply the programming concepts of Robots for simple applications in material handling and assembly.
CO 4	Use and understanding of Preparatory and Miscellaneous (G& M) codes to generate or edit a program which will operate a CNC Lathe/ Milling and Drilling.

MAPPING OF COs & POs:

CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3		3		3	2	1		3			3
CO2	3		3		3	2			3		1	3
CO3	3	2	3		3			1	3			3
CO4	3		3	2	3	2			3	1		3

List of Experiments:

1. Manual part programming (using G and M codes) in CNC Lathe Machine:

a. Part programming for linear interpolation, circular interpolation, chamfering and grooving.

b. Part programming by using standard Canned cycles for facing, turning, taper turning and thread cutting, Chess Bishop profile

c. Multiple turning operations which cover all lathe operations covering maximum G codes and M codes

2.Manual part programming (using G and M codes) in CNC Milling Machine:

a. Part programming for linear interpolation, circular interpolation and contour motions.

b. Part programming involving Canned cycles for drilling,Peckdrilling and boring and pocketing & Mirroring.

c. Part programming for Gear cutting profile

3. APT (Automatically Programmed Tools) Language-Cutting tool path generation by using any CAM simulationpackage / Experimentfor different machining operations.

a. APTLatheProgramming's – 2 Experiments

b. APTMilling Programming's - 2 Experiments

4. Robotics: By using 5 or 6 – Axis robot

a. Pick and Place with palletizing/ de-palletizing of components

b. Nut,Bolt and WasherAssembly with robot.

References:

1. Computer Numerical Control (CNC) Machines by P Radhakrishnan, New Central Book agency,2013.
2. Robotics Technology and Flexible Automation- S.R.DEB, McGraw Hill Education, 2017.
3.NC Machine Programming and software Design – CHAO- HWA CHANG and MICHEL. A. MELKANOFF- Prentice Hall Pub.

Online Learning Resources/Virtual Labs:

- https://www.youtube.com/watch?v=NCEHRvFQqMo
- https://www.youtube.com/watch?v=Gwy_Vh46fCM
- https://www.youtube.com/watch?v=0sxLwytzT2Y
- https://www.youtube.com/watch?v=rgZT3RtfUqA
- https://www.youtube.com/watch?v=osqX7iQEnuI
- https://www.youtube.com/watch?v=-F0i1LDk2XI
- https://www.youtube.com/watch?v=i-PgeWbDgq4
- https://www.youtube.com/watch?v=sJm1Nyb-AkE

Course Title	COMPUTER AIDED DRAFTING LABORATORY				B. Tech. ME VI Sem		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**	
2003610	**PCC**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		0	0	3	1.5	40	60	100
					End Exam Duration: 3Hrs		

- To train the students with CAD packages.
- To impart the 2D and 3D modeling skills to the students.
- To import and export different IGES files from one software to another
- Apply basic concepts to develop construction (drawing) techniques
- Ability to manipulate drawings through editing and plotting techniques

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Design different parts of mechanical equipment's.
CO 2	**Apply** their skills in various designing and Manufacturing Industries.
CO 3	**Analyze** different parts of mechanical equipment's
CO 4	**Illustrate** the skills in various designing and Manufacturing Industries.

MAPPING OF COs & POs:

CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3				2						1	3
CO2	3				2						1	2
CO3	2				2						1	3
CO4	3				2						1	3

List of Experiments:

1. Generation of the following curves using "C"/ Python language

a) Bezier curves

2. Generation of the following surfaces using "C"/Python language

a) B-Spine surfaces

3. Typical tasks of Modeling using any solid modeling packages such as PRO/E, IDEAS, CATIA, etc.,

a) Solid Boolean algebra - 1 Exercise

b) Wireframe &Surface Modelling – 3 Exercises

c) 3D – Drafting in detail – 1 Exercise

d) Production Drawing with Geometric Dimensioning and Tolerances– 3 Exercises

(Preferably for the assembly drawings drawn in Computer Aided Machine Drawing in previous semester)

References:

1. James D Meadows "Geometric Dimensioning and Tolerancing-Applications, Analysis & Measurement ASME Y14.5-2018.
2. KL Narayana, P Kannaiah and K.Venkat Reddy, Production Drawing, New Age publishers, 2014.
3. Ibrahim Zeid, Tata McGraw hill, CAD/CAM Theory and Practice.

Online Learning Resources/Virtual Labs:

1. https://www.youtube.com/watch?v=77EIAPpoe5k
2. https://www.youtube.com/watch?v=YkxPwpqTyjE
https://www.youtube.com/watch?v=er7xJFKv5k&list=PL5w7L_xR0pu2wLbJtOuK49WxJJVjiyKks&index=2
3. https://www.youtube.com/watch?v=Gy0MKabzDa8&list=PLrOFa8sDv6jccqLnN7UDa1YW4s_hR6YX
4. https://www.youtube.com/watch?v=k3kFC9uTdUk&list=PLM5xm8DJKViImdv5ZXxQ2NyIdSlid_jCB

Course Title	Solid works				B. Tech. ME VI Sem		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**	
2003611	**PCC**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		0	0	3	1.5	40	60	100
					End Exam Duration: 3Hrs		

- To train the students with solid works packages.
- To impart the 2D and 3D modeling skills to the students.
- To import and export different IGES files from one software to another
- Apply basic concepts to develop construction (drawing) techniques
- Ability to manipulate drawings through editing and plotting techniques

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Design the 3 D modelling by understanding the underlying concepts.
CO 2	Analyse the working simulation of 3D assemblies.
CO 3	Apply the basic commands to create solid models.
CO 4	Illustrate the assembly of multiple parts.

MAPPING OF COs & POs:

CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3				2						1	3
CO2	2				3						2	2
CO3	2				2						1	3
CO4	3				3						1	3

Introduction : SolidWorks Graphical User Interface - Feature manager design tree, Callouts, Handles Sketch Entities – Inference line, Centerline line, Line, Circle, Arc, Ellipse, Rectangle, Slots, Polygon, Ellipse, Partial Ellipse, Spline, Points, Text, Construction geometry

1.Study of solid works using cad
2.Draw 2D profile using solid works using Sketecher Mode.
3. Draw 3D profile using solid works using Extrude.
4. Draw 3D profile using solid works using Draft ,loft.
5. Draw 3D profile using Edit commands
6. Draw 3D profile In assembly mode
EX-1
EX-2
7. 3D Modelling of Machine elementslike flanged coupling.

References:
1. James D Meadows "Geometric Dimensioning and Tolerancing-Applications, Analysis & Measurement ASME Y14.5-2018.
2. KL Narayana, P Kannaiah and K.Venkat Reddy, Production Drawing, New Age publishers, 2014.
3. Ibrahim Zeid, Tata McGraw hill, CAD/CAM Theory and Practice.
Online Learning Resources/Virtual Labs:
1. https://www.youtube.com/watch?v=77EIAPpoe5k
2.
https://www.youtube.com/watch?v=YkxPwpqTyjEhttps://www.youtube.com/watch?v=er7xJFKv5k&list=PL5w7L_xR0pu2wLbJtOuK49WxJJVjiyKks&index=2
3.https://www.youtube.com/watch?v=Gy0MKabzDa8&list=PLrOFa8sDv6jccqLnN7UDa1YW4s_hR6YX
4.https://www.youtube.com/watch?v=k3kFC9uTdUk&list=PLM5xm8DJKViImdv5ZXxQ2NyIdSlid_jCB

K.S.RM COLLEGE OF ENGINEERING (AUTONOMOUS): : KADAPA

B.Tech – V/VI SEM (R20)

L	T	P	C
1	0	3	2

SOFTSKILLS Lab
(Common to all branches)

code:20246S4

Course Objectives: The objectives of this course are to make the students

- Encourage all round development of the students by focusing on soft skills
- Outline the required skills such as interpersonal skills, communication skills.
- Aware of critical thinking and problem solving skills
- Develop leadership skills and organizing skills through group activities
- Function effectively with heterogeneous teams

Syllabus:

UNIT – I: Soft Skills

Introduction, meaning, Listing Soft Skills, significance of soft skills – Discussion on essential soft skills, methods to inculcate soft skills.

UNIT – II: Team Player Attitude

What is an Attitude – Attitude towards others – Importance of 'Can Do' Attitude – Openness to New Ideas – Work Behaviour.

UNIT – III: Problem Solving & Decision Making

Meaning & Features of Problem Solving - Managing Conflict – Conflict Resolution – Methods of Decision Making – Effective Decision Making in Teams – Methods and Styles.

UNIT – IV: Leadership Skills

Team Building – Decision Making – Accountability – Planning – Public Speaking – Motivation – Risk Taking – Time Management

UNIT – V: Work Ethics

Definition – Important work Ethics – Developing A Strong Work Ethic Nature in an Organization - Role and Importance of Working Ethics in a Workplace**.**

Course Outcomes: By the end of this course, the students will be able to

- Memorize various elements of effective communicative skills
- Interpret the required skills such as **interpersonal** skills, communication skills.
- Apply critical thinking and problem solving skills
- Develop leadership skills and organizing skills through group activities
- Function effectively with heterogeneous teams

Suggested Software: Walden

Textbooks:

- Personality Development and Softskills (English, Paperback, Mitra Barun K.) Publisher : Oxford University Press; Pap/Cdr edition (July 22, 2012)
- Soft Skills by Alex K. Published by S. Chand
- Soft Skills: An Integrated Approach to Maximize Personality, Gajendra Singh Chauhan
- Communication Skills and Soft Skills (Hardcover, A. Sharma) Publisher: Yking books
- Soft Skills for a BIG IMPACT (English, Paperback, RenuShorrey) Publisher: Notion Press

Books Recommended:

1. Peggy Klaus, The Hard Truth about Soft Skills

2. The Ace of Soft Skills, Gopalswamy Ramesh, Mahadevan Ramesh, Pearson Education India.

3. Eric Garner – Team Building.

4. Carnegie Dale, How to Win Friends and Influence People, New York, Fireside Publishers, 1998

5. Soft Skills, 2015, Career Development Centre, Green Pearl Publications.

6. Convey Sean, Seven Habit of Highly Effective Teens, New York, Fireside Publishers,1998.

Course Title	MANAGEMENT & ORGANIZATIONAL BEHAVIOR (MC)					B.Tech. VI Sem (ME , EEE , CSE,)		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
20MC612	Humanities & Social Sciences(HSMC)	L	T	P	C	Continuous internal Assessment	End Exam	Total
		2	0	0	0	40	0	40
Mid Exam Duration: 2Hrs						External Exam Duration: 3Hrs		

Course Objectives: The main objective of the course is to learn

- To aid students in understanding human behavior in organizations,
- To provide students with a comprehensive exposure to organizational behavior theories, research and workplace issues.
- The course also provides an overview of the theories and practices of management in organizational contexts.

Course Outcomes: On success Completion This course, the students will be able to

CO1	Explain the Importance & Role of Management in the Organizations.
CO2	Evaluate the different aspects related to Decision Making and Controlling Process
CO3	Describe the different theories related to Individual behavior in the Organization
CO4	Analyze Group Behavioral influence in the Organization.
CO5	Evaluate the process and climate effects in Organization Behavior.

MANAGEMENT & ORGANIZATIONAL BEHAVIOR (MC)

UNIT-I

Role of Management:

Concept – Significance – Functions – Principles of Management - Patterns of Management: Scientific – Behavioural – Systems – Contingency.

UNIT-II

Decision Making & Controlling – Process – Techniques. Planning – Process – Problems — Making It Effective. Controlling - System of Controlling – Controlling Techniques – Making Controlling Effective

UNIT-III

Individual Behaviour& Motivation – Understanding Individual Behaviour – Perception – Learning – Personality Types – Johari window- Transactional Analysis- Motivation – Concept of Motivation - Motivational Theories of Maslow, Herzberg, David McClelland, and Porter and Lawler

UNIT-IV

Group Behavior & Leadership: Benefits of Groups – Types of Groups – Group Formation and Development. Leadership and Organizational Culture and Climate: Leadership – Traits Theory – Managerial Grid – Transactional Vs Transformational Leadership – Qualities of good leader- Women Leadership in India.

UNIT-V

OrganisationalBehaviour: Organizing Process – Departmentation Types – Making Organizing Effective – Organisational culture- Types of culture – Organisational Culture VsOrganisational climate - Conflict management - Change Management

Textbooks:

1. OrganisationalBehaviour, Stephen P. Robbins, Pearson Education
2. Management and OrganisationalBehaviour, Subbarao P, Himalaya Publishing House
3. Principles of Management, Koonz,Weihrich and Aryasri, Tata McGraw Hill.

References:

1. OrganisationalBehaviour ,S.S.Khanka, S.Chand
2. OrganisationalBehaviour , Mishra .M.N ,Vikas
3. Management and Organisationalbehaviour, Pierce Gordner, Cengage.
4. Behaviour in Organizations, Hiriyappa .B.New Age Publications
5. OrganisationalBehaviour, Sarma, Jaico Publications.
6. Principles of Management ,Murugesan ,Laxmi Publications

Web Links:

www.esl-lab.com
www.englishmedialab.com
www.englishinteractive.net

KSRMCOLLEGE OF ENGINEERING
Department of Mechanical Engineering
B. Tech. – VII&VIII Semester (R20UG) FOR ME STUDENTS

S.NO	Course Code	Category	Course title	Hours / Week			IM	EM	C R
				L	T	P			
			Professional Elective course -III						
1	2003701	PEC	Modern manufacturing methods	3	0	0	40	60	3
	2003702	PEC	Design for manufacturing	3	0	0	40	60	3
	2003703	PEC	Solar and wind energy systems	3	0	0	40	60	3
	2003704	PEC	Mechanical behavior of materials	3	0	0	40	60	3
	2003705	PEC	Total quality management	3	0	0	40	60	3
2		PEC	**Professional Elective course -IV**						
	2003706		1.Automobile engineering	3	0	0	40	60	3
	2003707	PEC	2.Additive manufacturing	3	0	0	40	60	3
	2003708	PEC	3.Mechanical vibrations	3	0	0	40	60	3
	2003709	PEC	4.Matearial characterization	3	0	0	40	60	3
	2003710	PEC	5.Production and operations management	3	0	0	40	60	3
3		PEC	**Professional Elective course - V**						
	2003711		1.Vehicle diagnosis and control	3	0	0	40	60	3
	2003712	PEC	2.Mechatronics&MEMS	3	0	0	40	60	3
	2003713	PEC	3.Design of oil Hydraulics and pneumatics	3	0	0	40	60	3
	2003714	PEC	4.Refrigeration&air conditioning	3	0	0	40	60	3
	2003715	PEC	5.Geometric dimension and tolerances	3	0	0	40	60	3
4			**Open elective course- III**						
	20OE311	OEC	Entrepreneurship	3	0	0	40	60	3
	20OE312	OEC	Solar Energy Systems	3	0	0	40	60	3
	20OE313	OEC	Internal combustion engine	3	0	0	40	60	3
5			**Open elective course- IV**						
	20OE314	OEC	Energy Auditing	3	0	0	40	60	3
	20OE315	OEC	Sustainable engineering	3	0	0	40	60	3
	20OE316	OEC	Industrial engineering & management	3	0	0	40	60	3
			Humanities Elective course						
	2006701	HSS	Human resourses and development	3	0	0	40	60	3
	2006702	HSS	Digital marketing	3	0	0	40	60	3
	2006703	HSS	Project management	3	0	0	40	60	3
7	2003716	PROJ	Internship	0	0	0	100	--	3
8	20246SC	SC	**Skill course –V** Advanced English communication skills	1	0	2	40	60	2
			Total				**380**	**420**	**23**

Course Title	MODERN MANUFACTURING METHODS				B. Tech. ME VII Sem		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**	
2003701	**PEC**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	0	0	3	40	60	100
Mid Exam Duration: 90 MIN					**End Exam Duration: 3Hrs**		

Course Objectives:

- Define various Modern Machining Processes.
- Acquire knowledge in the elementary mechanism and machinability of materials with different Modern Machining Processes.
- Determine basic principles of operation for each process and their applications.
- State various parameters influencing MRR in Non – Traditional Machining Process.
- Classify and understand the working of Additive Manufacturing Processes.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Illustrate advanced machining processes, cutting tools and cutting fluids for a specific material and part features.
CO 2	Classify the mechanism of Mechanical Energy based machining processes, its applications and limitations.
CO 3	Differentiate Electrical Energy Based machining processes, mechanism of metal removal, machine tool selection.
CO 4	Interpret Electro Chemical machining process, economic aspects of ECM and problems on estimation of metal removal rate.
CO5	Illustrate advanced machining processes, cutting tools and cutting fluids for a specific material and part features.

UNIT -I

NEED FOR MODERN MANUFACTURING METHODS

Non-traditional machining methods and rapid prototyping methods - their relevance for precision and lean manufacturing.Classification of non-traditional processes - their selection for processing of different materials and the range of applications. Introduction to rapid prototyping - Classification of rapid prototyping methods - sterolithography, fused deposition methods - materials, principle of prototyping and various applications.

UNIT – II

Electrical Energy Based Processes

Electric Discharge Machining – Working Principles, Description of Equipment, Process Parameters, Surface Finish and MRR, Electrode / Tool, Power and Control Circuits, Tool Wear, Dielectric Fluid, Flushing, Advantages, Limitations and Applications. Wire cut EDM – Working Principle and Applications.

UNIT-III

Chemical and Electro Chemical Energy Based Processes

Chemical Machining and Electro Chemical Machining – Working Principle, Description of Equipment, Etchants, Maskants, Techniques of Applying Maskants, Process Parameters, Surface Finish and MRR, Electro Chemical Grinding, Electro Chemical Honing, Applications, Advantages and Limitations.

UNIT-IV

Thermal Energy Based Processes

Laser Beam Machining and Drilling, Plasma Arc Machining, Electron Beam Machining – Working Principle, Description of Equipment, Process Parameters, Applications, Advantages and Limitations.

UNIT-V

ELECTRON BEAM MACHINING

Generation and control of electron beam for machining, theory of electron beam machining, comparison of thermal and non-thermal processes - process mechanics, parameters, applications and limitations.

LASER BEAM MACHINING

Process description, Mechanism of material removal, process parameters, capabilities and limitations, features of machining, applications and limitations

Textbooks:

1. Jain V.K., Advanced Machining Processes, 1st Edition, Allied Publishers Pvt. Ltd., New Delhi, 2007.
2. Pandey P.C and Shan H.S., Modern Machining Processes, 1st Edition, McGraw Hill, New Delhi, 2007.
3. Ian Gibson, David W. Rosen, Brent Stucker, Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, 1st Edition, Springer, 2010.

Reference Books:

1. Chua C.K., Leong K.F. and Lim C.S., Rapid Prototyping: Principles and Applications, 2nd Edition, World Scientific Publishers, 2003.
2. Benedict G.F., Nontraditional Manufacturing Processes, 1st Edition, CRC Press, 1987.
3. Mishra P.K., Nonconventional Manufacturing, 1st Edition, Narosa Publishing House, New Delhi, 2014.
4. McGeough J.A., Advanced Methods of Machining, 1st Edition, Springer, 1988.

Course Title	DESIGN FOR MANUFACTURING				B. Tech. ME VII Sem		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**	
2003702	**PEC**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	0	0	3	40	60	100
Mid Exam Duration: 90 MIN					**End Exam Duration: 3Hrs**		

Course Objectives:

- Explain the product development cycle and manufacturing issues to be considered in design.
- Familiarize manufacturing consideration in cast, forged, and weld components.
- Describe the manufacture of sheet metal components.
- Impart knowledge plastics as substitution to metallic parts.
- Integrate the knowledge of manufacturing and assembly method in plastics

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	● Design mechanical components with economical consideration.
CO 2	● Select materials and machining processes.
CO 3	● Identify the necessity for redesigning components out of manufacturing considerations.
CO 4	● Consider the manufacturing considerations while designing cast, forged weld and sheet metal components.
CO5	● Integrate the knowledge of compliance analysis and interference analysis for assembly and also use visco-elastic and creep in plastics.

UNIT-I

Introduction

Design philosophy – steps in design process – general design rules for manufacturability – basic principles of designing for economical production – creativity in design, application of linear & non-linear optimization techniques.

Materials: Selection of materials for design – developments in material technology – criteria for material selection – material selection interrelationship with process selection – process selection charts.

UNIT – II

Machining processes

Overview of various machining processes-general design rules for machining-dimensional tolerance and surface roughness-Design for machining – ease –redesigning of components for machining ease with suitable examples. General design recommendations for machined parts.

UNIT – III

Metal Casting and Joining:Metal casting

Appraisal of various casting processes, selection of casting process,-general design considerations for casting-casting tolerance-use of solidification, simulation in casting design-product design rules for sand casting.

Metal joining: Appraisal of various welding processes, factors in design of weldments – general design guidelines-pre and post treatment of welds-effects of thermal stresses in weld joints-design of brazed joints.

UNIT – IV

Forging, Extrusion & Sheet metal work:Forging

Design factors for forging – closed die forging design – parting lines of dies – drop forging die design – general design recommendations.

Extrusion & Sheet metal work

Design guide lines extruded sections-design principles for punching, blanking, bending, deep drawing-Keeler Goodman forging line diagram – component design for blanking.

UNIT-V

Assembly: Compliance analysis and interference analysis for the design of assembly – design and development of features for automatic assembly – liaison diagrams. Environment: Introduction to environment; motivations for environment principles of environment- eco-efficiency, product life cycle perspective, environment tools and processes, environment design guidelines.

Textbooks:

1. George E Dieter and Linda Schmidt, Engineering Design, 4th Edition, McGraw Hill (2015)
2. A.K.Chitale and R.C.Gupta, Product Design and Manufacturing, 5th Edition, PHI Learning (2011)
3. David M Anderson, Design for Manufacturability, CRC Press (2013)

Reference Books:

1. James G Bralla, Design For Manufacturability Handbook, 2nd Edition, McGraw Hill (2004).
2. Dr.P.C.Sharma, Production Technology, S.Chand& Company (2009).

Course Title	SOLAR AND WIND ENERGY SYSTEMS				B. Tech. ME VII Sem		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**	
2003703	**PEC**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	0	0	3	40	60	100
Mid Exam Duration: 90 MIN					**End Exam Duration: 3Hrs**		

Course Objectives:

- Familiarize with basics of solar radiation, available solar energy and its measurement.
- Familiarize with solar collectors, construction and operation of solar collectors.
- Understand solar energy conversion systems, applications and power generation.
- Familiarize the wind energy sources assessment
- Explain basics of designing aerofoil

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	● Explain the basic concepts of solar radiation and solar collectors
CO 2	● Develop sun path diagrams
CO 3	● Explain the properties of a semiconductor
CO 4	● Apply the principles of solar thermo photo voltaics
CO5	● Utilize different wind parameters for design of rotor

UNIT-I

Energy conservation and storage

Energy- Energy Sources & their Availability - Importance of Renewable Energy Resources - Principles of energy conservation- Energy storage- Necessity of energy storage-Energy storage methods- Mechanical Energy storage -Pumped storage-Compressed air storage Electrical Storage -Lead Acid Battery -Chemical Storage -Energy storage via hydrogen - Electromagnetic energy storage

Solar radiation and collectors Solar angles – Sun path diagrams – Radiation - extra terrestrial characteristics - measurement and estimation on horizontal and tilted surfaces - flat plate collector thermal analysis - testing methods-evacuated tubular collectors - concentrator collectors – classification - design and performance parameters - tracking systems - compound parabolic concentrators - parabolic trough concentrators - concentrators with point focus - Heliostats – performance of the collectors.

UNIT-II

Solar PV fundamentals

Semiconductor – properties - energy levels - basic equations of semiconductor devices physics. Solar cells - p-n junction: homo and hetro junctions - metal-semiconductor interface - dark and illumination characteristics - figure of merits of solar cell - efficiency limits - variation of efficiency with band-gap and temperature - efficiency measurements - high efficiency cells – Solar thermo-photo voltaics.

SPV system design and applications

Solar cell array system analysis and performance prediction- Shadow analysis: reliability - solar cell array design concepts - PV system design - design process and optimization - detailed array design - storage autonomy - voltage regulation - maximum tracking - centralized and decentralized SPV systems - stand alone - hybrid and grid connected system - System installation - operation and maintenances - field experience - PV market analysis and economics of SPV systems.

UNIT-III

Introduction to wind energy

Historical Perspectives on Wind Turbines- Indian Energy Scenario - Global Energy Scenario - Introduction to Indian Wind Industry - Wind Energy potential of India and Global Wind Installations.

Basics of Wind Resource Assessment

Power in the wind –Wind Characteristics - Measurement of wind using anemometers (cup anemometer, propeller anemometer, pressure plate anemometer, pressure tube anemometer, sonic anemometer and other remote wind speed sensing techniques) –Turbulence-Wind Power Density –Average wind speed calculation - Statistical models for wind data analysis (Weibull and Rayleigh distribution). Energy estimation of wind regimes – Wind Rose, Wind Monitoring Station Siting and Instrumentation

UNIT-IV

Wind Energy Conversion Systems

Types - Components of Modern Wind Turbine (HAWT and VAWT) - Fixed and Variable Speed operations - Power Control (Passive stall, Active pitch, Passive pitch and Active stall) - Electrical aspects of wind turbine, Safety of wind turbines.

UNIT-V

Wind Farm Design and Health (Condition) Monitoring

Planning of wind farm, Site selection, Micro siting, Grid Integration, Power evacuation, Wind Farm Feasibility Studies, Preparation of DPR, Environmental Benefits and Impacts. Water pumping wind mills, offshore wind energy, Wind turbine testing, future developments.

Textbooks:

1. Goswami D.Y., Kreider, J. F. and Francis., "Principles of Solar Engineering', Taylor and Francis, 2000.
2. Chetan Singh Solanki, "Solar Photo voltatics – Fundamentals, Technologies and Applications", PHI Learning Private limited, 2011.

Reference Books:

1. Sukhatme S.P.,.Nayak.J.P, 'Solar Energy – Principle of Thermal Storage and collection", Tata McGraw Hill, 2008.
2. Sathyajith Mathew, Wind Energy Fundamentals, Resource Analysis and Economics, Springer Publications, (2006).
3. Wei Tong, Wind Power Generation and Wind Turbine Design, WIT Press, (2010.
4. Wind Power, Revised Edition: Renewable Energy for Home, Farm, and Business, Paul Gipe, 2004, Chelsea Green Publishing.

5.A. R. Jha, Wind Turbine Technology, CRC Press, (2010).

Course Title	MECHANICAL BEHAVIOR OF MATEARIALS				B. Tech. ME VII Sem		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**	
2003704	**PEC**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	0	0	3	40	60	100
Mid Exam Duration: 90 MIN					**End Exam Duration: 3Hrs**		

Course Objectives:

- explain the structure of material over the effects of mechanical properties.
- familiarize the defects inside the structure and their effects on the mechanical properties.
- train the methods for characterization of the mechanical behavior of materials.
- impart knowledge about strengthening mechanisms of materials.
- teach mechanisms of failures of materials (fracture, fatigue and creep) and their relationship with the different types of stress.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	● Determine dislocation reaction, cross slip and climb of dislocations.
CO 2	● Characterize materials using different machines
CO 3	● Summarize the various strengthening mechanisms with suitable examples
CO 4	● Identify the creep in different materials and its influence in selection of materials.
CO5	● Predict the metallurgical factors affecting creep. e Demonstrate various creep testing machines

UNIT-I

Dislocation

Dislocation Theory: Introduction, dislocation reaction, cross slip and climb of dislocations, dislocation sources and dislocation multiplication, dislocation pile ups. Tensile Behaviours of Metals:

Elastic and plastic behaviour: Elastic behaviour of materials – Hooke's law, plastic behavior: dislocation theory – Burger's vectors and dislocation loops, dislocations in FCC, HCP and BCC lattice, stress fields and energies of dislocations, forces on and between dislocations, slip and twinning.

UNIT – II

Strengthening mechanisms

Cold Working, Grain Size Strengthening, Solid Solution Strengthening, Martensitic Strengthening, Precipitation Strengthening, Dispersion Strengthening, Fibre Strengthening, Examples. Yield Point Phenomenon, Strain aging and Dynamic strain aging.

UNIT – III

Fracture and fracture mechanics

Fracture and fracture mechanics: Types of Fracture, Basic Mechanism of Ductile and Brittle Fracture, Griffith's Theory Of Brittle Fracture, Ductile to Brittle Transition Temperature (DBTT), Factors Affecting DBTT, Determination of DBTT. Fracture Mechanics-Introduction, Modes of Fracture, Stress Intensity Factor, Strain Energy Release Rate, Fracture Toughness and Determination of K_{IC}.

UNIT – IV

Fatigue behaviour and testing

Stress Cycles, S-N Curves, Effect of Mean Stress, Factors Affecting Fatigue, Structural Changes Accompanying Fatigue, Cumulative Damage, HCF / LCF, Thermo-mechanical Fatigue, Application of Fracture Mechanics to Fatigue Crack Propagation, Fatigue Testing Machines

UNIT-V

Mechanical testing of materials

destructive testing, hardness testing, tensile testing, compression, bending, impact, torsion, creep and fatigue testing procedures. nondestructive testing, die-penetration test, ultrasonic tests, X-ray test, magnetic particles test eddy current testing.

Textbooks:

1. Dieter, G.E., "Mechanical Metallurgy", McGraw-Hill, SI Edition, 1995.
2. Davis. H. E., Troxell G.E., Hauck.G. E. W., "The Testing Of Engineering Materials", McGraw-Hill, 1982.

Reference Books:

1. Wulff, The Structure and Properties of Materials, Vol. III "Mechanical Behavior of Materials", John Wiley and Sons, 1983.
2. Honey Combe R. W. K., "Plastic Deformation of Materials", Edward Arnold Publishers, 1984.
3. Suryanarayana, A. V. K., "Testing of Metallic Materials", Prentice Hall India, 1979.

Course Title	TOTAL QUALITY MANAGEMENT				B. Tech. ME VII Sem		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**	
2003705	**PEC**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	0	0	3	40	60	100
Mid Exam Duration: 90 MIN					**End Exam Duration: 3Hrs**		

Course Objectives:

- Introduce the students, the basic concepts of Total Quality Management.
- Expose with various quality issues in Inspection.
- Gain Knowledge on quality control and its applications to real time.
- Know the extent of customer satisfaction by the application of various quality concepts. Understand the importance of Quality standards in Production.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Develop an understanding on quality Management philosophies and frameworks
CO 2	Adopt TQM methodologies for continuous improvement of quality
CO 3	Measure the cost of poor quality, process effectiveness and efficiency to identify areas for improvement
CO 4	Apply benchmarking and business process reengineering to improve management processes.
CO5	Determine the set of indications to evaluate performance excellence of an organization.

UNIT-I

Introduction to quality management

Definitions – TOM framework, benefits, awareness and obstacles. Quality – vision, mission and policy statements. Customer Focus – customer perception of quality, Translating needs into requirements, customer retention. Dimensions of product and service quality. Cost of quality.

UNIT-II

Historical Review

Quality council, Quality statements, Strategic Planning, Deming Philosophy, Barriers of TQM Implementation, Benefits of TQM, Characteristics of successful quality leader, Contributions of Gurus of TQM, Case studies

UNIT-III

TQM Principles

Customer Satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement – Motivation, Empowerment teams, Continuous Process Improvement – Juran Trilogy, PDSA Cycle, Kaizen, Supplier Partnership – Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures – Basic Concepts, Strategy, Performance Measure Case studies.

UNIT-IV

TQM Tools

Benchmarking – Reasons to Benchmark, Benchmarking Process, Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM) – Concept, Improvement Needs, FMEA – Stages of FMEA, The seven tools of quality, Process capability, Concept of Six Sigma, New Seven management tools, Case studie

UNIT-V

Quality Systems Organizing And Implementation

Introduction to IS/ISO 9004:2000 – quality management systems – guidelines for performance improvements.Quality Audits.TQM culture, Leadership – quality council, employee involvement, motivation, empowerment, recognition and reward- Introduction to software quality**.**

Text Books:

1. Dale H Besterfield, Total Quality Management, Fourth Edition, Pearson Education, 2015.
2. SubburajRamaswamy, Total Quality Management, Tata Mcgraw Hill Publishing Company Ltd., 2005.
3. Joel E.Ross , Total Quality Management, Third Eition, CRC Press, 2017.

Reference Books:

1. Narayana V and Sreenivasan N.S, Quality Management – Concepts and Tasks, New Age International, 1996.
2. Robert L.Flood, Beyond TQM, First Edition, John Wiley & Sons Ltd, 1993.
3. Richard S. Leavenworth & Eugene Lodewick Grant, Statistical Quality Control, Seventh Edition, Tata Mcgraw Hill, 2015
4. Samuel Ho , TQM – An Integrated Approach, Kogan Page Ltd, USA, 1995.

Course Title	Automobile engineering				B. Tech. ME VII Sem		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**	
2003706	**PEC-IV**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	0	0	3	40	60	100
Mid Exam Duration: 90 MIN					**End Exam Duration: 3Hrs**		

Course Objectives:

- Impart the knowledge of vehicle structure and its components.
- Demonstrate various components of petrol engines and diesel engines.
- Trains about the various electrical system, circuits, and testing of automobiles.
- Explain the concepts of steering, suspension and braking system in automobile.
- The functioning of the engine and its accessories, gear box, clutch,brakes, steering, axles and wheels

.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	● Identify different parts of automobile.
CO 2	● Explain the working of various parts like engine and brakes.
CO 3	● Describe the working of steeringand the suspension systems.
CO 4	● Summarize the wheels and tires.
CO5	● Outline the future developments in the automobile industry.

MAPPING OF COs & POs:

CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												

UNIT-I

Introduction: Components of a Four Wheeler Automobile - Chassis and Body - Power Unit
Power Transmission - Rear Wheel Drive, Front Wheel Drive, Four Wheel Drive - Types of Automobile Engines, Engine Construction, Turbo Charging and Super Charging - Oil Filters, Oil Pumps - Crank Case Ventilation.

UNIT-II

Ignition and fuel supply

Ignition system - Coil and Magneto - Spark plug - Distributor – Electronic ignition system - Fuel system - Carburetor - Fuel pumps - Fuel injection systems - Mono point and Multi point – Unit Injector – Nozzle types - Electronic Fuel Injection system (EFI) – GDI, MPFI, DTSI.

UNIT-III

Steering and suspension system

Principle of steering - Steering Geometry and wheel alignment - Steering linkages – Steering gearboxes - Power steering - front axle - Suspension system - Independent and Solid axle – coil, leaf spring and air suspensions - torsion bar - shock absorbers.

UNIT-IV

Wheels, Tires and Braking System

Wheels and Tires - Construction - Type and specification - Tire wear and causes - Brakes - Needs – Classification –Drum and Disc Mechanical - Hydraulic and pneumatic - Vacuum assist – Retarders – Anti-lock Braking System(ABS)

UNIT-V

Emissions From Automobiles

Pollution Standards National and International Pollution Control- Techniques - Multipoint Fuel Injection for Sl Engines- Common Rail Diesel Injection, Emissions from Alternative Energy Sources- Hydrogen, Biomass, Alcohols, LPG, CNG - Their Merits And Demerits.

Electrical System: Charging Circuit, Generator, Current - Voltage Regulator - Starting System, BendixDrive, Mechanism of Solenoid Switch, Lighting Systems, Horn, Wiper, Fuel Gauge - Oil Pressure Gauge, Engine Temperature Indicator.

Textbooks:

1. Kirpal Singh, Automobile Engineering, Vol.1&2, Standard Publications year.
2. William.H.Crouse, Automotive Mechanics, 10/e Edition, McGraw-Hill, (2006).
3. David A. Corolla, Automotive Engineering: Powertrain, Chassis System and Vehicle Body, Butterworth-Heinemann Publishing Ltd, (2009).
4. Richard Stone, Jeffrey K. Ball, Automotive Engineering Fundamentals" SAE International (2004).

Reference Books:

1. Bosch, Automotive Hand Book, (2007), 6/e SAE Publications year.
2. K. Newton and W. Steeds, The motor vehicle, 13/e Butterworth-Heinemann Publishing Ltd. (year).
3. Joseph Heitner, Automotive Mechanics Principles and Practices, 2/e, CBS publishing 2004.

Course Title	ADDITIVE MANUFACTURING				B. Tech. ME VII Sem		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**	
2003707	**PEC-IV**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	0	0	3	40	60	100
Mid Exam Duration: 90 MIN					**End Exam Duration: 3Hrs**		

Course Objectives:

- Familiarize of additive manufacturing / rapid prototyping and its applications in various fields.
- Impart reverse engineering techniques.
- Explain different processes available in additive manufacturing.
- Bring awareness on mechanical properties of materials and geometric issues related to additive manufacturing applications.
- To create physical objects that facilitates product development/prototyping requirements.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	● Demonstrate various additive manufacturing and rapid prototyping techniques
CO 2	● Describe different additive manufacturing processes.
CO 3	● Apply methods in rapid prototyping.
CO 4	● Use powder based AM system.
CO5	● Model 3D printing using SDM and BPM methods.

UNIT-I

INTRODUCTION:

Introduction to layered manufacturing, Importance of Additive Manufacturing Additive Manufacturing in Product Development Classification of additive manufacturing processes, Common additive manufacturing technologies; Fused Deposition Modeling(FDM), Selective Laser Sintering(SLS), Stereo Lithography(SLA), Selection Laser Melting (SLM), Jetting, 3D Printing, Laser Engineering Net Shaping (LENS), Laminated Object Manufacturing (LOM), Electron Beam Melting (EBM) Capabilities, materials, costs, advantages and limitations of different systems.

UNIT-II

CAD & Reverse Engineering:

Basic Concept, Digitization techniques, Model Reconstruction, Data Processing for Additive Manufacturing Technology: CAD model preparation, Part Orientation and support generation, Model Slicing, Tool path Generation, Software's for Additive Manufacturing Technology: MIMICS, MAGICS. Reverse Engineering (RE) –Meaning, Use, RE – The Generic Process, Phase of RE Scanning, Contact Scanners, Noncontact Scanners, Point Processing, Application Geometric Model, Development.

UNIT-III

Solid and Liquid Based AM Systems:

Stereolithography (SLA): Principle, Process, Materials, Advantages, Limitations and Applications. Solid Ground Curing (SGC): Principle, Process, Materials, Advantages, Limitations, Applications. Fusion Deposition Modeling (FDM): Principle, Process, Materials, Advantages, Limitations, Applications. Laminated Object Manufacturing (LOM): Principle, Process, Materials, Advantages, Limitations, Applications

UNIT-IV

Powder Based AM Systems:

Principle and Process of Selective Laser Sintering (SLS), Advantages, Limitations and Applications of SLS, Principle and Process of Laser Engineered Net Shaping (LENS), Advantages, Limitations and Applications of LENS, Principle and Process of Electron Beam Melting (EBM), Advantages, Limitations and Applications of EBM.

UNIT-V

RP Applications:

Application – Material Relationship, Application in Design, Application in Engineering, Analysis and Planning, Aerospace Industry, Automotive Industry, Jewelry Industry, Coin Industry, GIS application, Arts and Architecture. RP Medical and Bioengineering Applications: Planning and simulation of complex surgery, Customized Implants & Prosthesis, Design and Production of Medical Devices, Forensic Science and Anthropology, Visualization of Biomolecules.

Textbooks:

1. Ian Gibson, David W. Rosen, Brent Stucker, Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, 1/e Springer, 2010.
2. Chua C.K., Leong K.F. and Lim C.S., Rapid Prototyping: Principles and Applications, 2/e World Scientific Publishers, 2003.
3. Liou W. Liou, Frank W., Liou, Rapid Prototyping and Engineering Applications: A Tool Box for Prototype Development, CRC Press, 2007.

Reference Books:

1. Pham D.T. and Dimov S.S., Rapid Manufacturing; The Technologies and Application of RPT and Rapid Tooling, Springer, London 2001.
2. Gebhardt A., Rapid prototyping, Hanser Gardener Publications, 2003.
3. Hilton P.D. and Jacobs P.F., Rapid Tooling: Technologies and Industrial Applications, CRC Press, 2005.
4. RafiqNoorani, Rapid Prototyping: Principles and Applications in Manufacturing, John Wiley & Sons, 2006.

Course Title	MECHANICAL VIBRATIONS				B. Tech. ME VII Sem		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**	
2003708	**PEC-IV**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	0	0	3	40	60	100
Mid Exam Duration: 90 MIN					**End Exam Duration: 3Hrs**		

Course Objectives:

- Demonstrate basic concepts and definitions of mechanical vibrations. To write equation of motion for discrete spring-mass systems with different configuration using classical and energy methods.
- To train the students about basic concepts of forced vibrations, vibration transmissibility and isolation and seismic instruments. Further to understand about various vibration control methods.
- To familiarize the students about two degree freedom system and various types of vibration absorbers.
- To analyze the two degree and multi degree of freedom systems.
- Determine the numerical methods to determine natural frequencies ofthe beam and rotor systems.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	● Find natural frequency of un-damped single degree freedom systems
CO 2	● Analyze the two degree freedom systems with and without damping.
CO 3	● Calculate transmissibility and isolation.
CO 4	● Solve problems on vibration absorber.
CO5	● Calculate natural frequencies of multi degree freedom system.

UNIT-I

Transverse vibrations

single concentrated load, uniformly distributed load, several loads, Dunkerley‘s method, energy method, whirling of shafts. Torsional vibrations – single rotor, two-rotor, three-rotor systems, torsionally equivalent shaft, geared system.

UNIT-II

Forced vibrations of Single Degree Freedom Systems

Steady state forced vibration, sources of excitation, impressed harmonic force, resonance impressed force due to unbalance, motion excitation, transmissibility and isolation, performance of different type of isolators, power absorbed by viscous damping.

UNIT-III

Two Degree Freedom Systems

Formulation of Equation of motion, Natural frequencies and modes of vibration by classical method, coupled pendulum, forced vibration, dynamic vibration absorber.

UNIT-IV

Multi Degree Freedom Systems

Lagrangian method for formulation of equation of motion Influence co- efficient method, Lumped mass and distributed mass systems, Stodola method, Holzer's method, model analysis of free and forced vibrations.

UNIT – V

Continuous systems

vibration of strings – longitudinal vibrations of bars – torsional vibrations of circular shafts - lateral vibration of beams Critical speeds of shafts – Critical speed of a light shaft having a single disc – without damping and with damping. Critical speed of a shaft having multiple discs – secondary critical speed

Textbooks:

1. Singrasu S. Rao, Mechanical Vibrations, 6/e, Pearson Education, 2018.
2. G.K.Groover, Mechanical Vibrations, 8/e, 2009

Reference Books:

1. L. Meirovich, Elements of Vibrations Analysis, Tata McGraw Hill, 1986
2. S. Graham Kelly, Mechanical Vibrations, Tata McGraw Hill, 1996
3. William Thomson, Theory of Vibrations with Applications, 5/e, Pearson, 2008
4. William Weaver, Timeoshenko, and Young, Vibration Problems in Engineering, 5/e, John Wiley, 2013.
5. C. Nataraj, Vibration of Mechanical Systems, 1/e, Cenage Learning, 2012.

Course Title	MATEARIAL CHARECTERISATION				B. Tech. ME VII Sem		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**	
2003709	**PEC-IV**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	0	0	3	40	60	100
Mid Exam Duration: 90 MIN					**End Exam Duration: 3Hrs**		

Course Objectives:

- Familiarize the fundamentals in material characterization.
- Explain principles in X-ray diffraction and Stereographic projections.
- Describe the fundamental principles of characterization.
- Evaluate the uncertainty of observations and results from the different methods.
- Impart the methods of characterization for different material problems.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	● Explain the production of characteristic x-rays.
CO 2	● Use the principles of diffraction (Bragg's Law) in determination of crystal structure determination.
CO 3	● Interpret the properties of electrons and the affect of accelerating potential.
CO 4	● Apply basic operational modes of a SEM and TEM.
CO5	● Explain the formation of diffraction patterns in the electron microscopes.

UNIT-I

Diffraction Methods

Fundamental crystallography, Generation and detection of X-rays, Diffraction of X-rays, X-ray diffraction techniques, Electron diffraction.

Spectroscopy

Atomic absorption spectroscopy, UV/Visible spectroscopy, Fourier transform infrared spectroscopy, Raman spectroscopy.

UNIT-II

Diffraction and Imaging

Phenomena of diffraction; Radiation-matter Interactions and response signals; X-ray diffraction: powder diffraction, phase identification, Scherrer formula, strain and grain size determination; Fundamentals of Imaging: magnification, resolution, depth of field and depth of focus aberration and astigmatism; X-Ray reflectivity

UNIT-III

Optical microscopic Techniques

Special microscopy techniques and applications: Bright field and dark field imaging; confocal microscopy; interference microscopy; polarized light microscopy; phase contrast microscopy. Scanning near field laser microscopy; Image processing and quantification.

Optical Spectroscopic Techniques - Principle, Working and Result Analysis of Fourier Transformation Infra-Red Spectroscopy; Raman Spectroscopy; UV-Vis Absorption Spectroscopy; Photoluminescence Spectroscopy - Ellipsometer Spectroscopy.

UNIT-IV

Electron Microscopic Techniques

Basics of Electron Microscopy - Introduction - Principle of SEM, Instrumentation, Contrast formation, Operational variables, Specimen preparation, imaging modes, Applications, Limitations – FE-SEM , FIB, EDAX. TEM - Introduction, Instrumentation, Specimen preparation: Mechanical thinning, electrochemical thinning, ion milling, sputter coating and carbon coating, replica methods. Image modes - mass density contrast, diffraction contrast, phase contrast, Applications, Limitations.

UNIT-V

Surface Analysis

Atomic force microscopy, scanning tunneling microscopy, X-ray photoelectron spectroscopy.

Thermal analysis

Instrumentation, experimental parameters, Differential thermal analysis, Differential Scanning Calorimetry, Thermogravimetry, Dilatometry, Dynamic mechanical analysis- Basic principles, Instrumentation, working principles, Applications, Limitations.

Textbooks:

1. Yang Leng, Materials Characterization: Introduction to Microscopic and Spectroscopic Methods, 2/e, Wiley Publications, 2013.

Reference Books:

1. D. Brandon and W.D. Kaplan, Microstructural Characterization of Materials, John Wiley and Sons, 2008.
2. S. Zhang, Lin Li and Ashok Kumar, Materials Characterisation Techniques, CRC Press, 2009.
3. B.D.Williams and C.B.Carter, Transmission Electron Microscopy –Springer, 2009.
4. E.J. Mittemeijer, Fundamentals of Materials Science - the microstructure-property relationship using metals as model systems, Springer, 2010

Course Title	Production and operations management				B. Tech. ME VII Sem		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**	
2003710	**PEC-IV**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	0	0	3	40	60	100
Mid Exam Duration: 90 MIN					**End Exam Duration: 3Hrs**		

Course Objectives:

- Introduction to the technical design and manufacturing operations and supply management to the sustainability of an enterprise.
- Need for forecasting and types of forecasting.
- Import the basic principles of project management and other business functions such as value engineering, purchasing, marketing, finance etc.
- Analyze the new demands of the globally competitive business environment that supply chain managers face today.
- Knowledge on various scheduling algorithms applicable to single machine, parallel machines, flow shop and job shop models.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	• Demonstrate the operations and supply management to the sustainability of an enterprise.
CO 2	• Identify the need for forecasting and understand different forecasting methods.
CO 3	• Identify various production and plant layouts.
CO 4	• Examine the quality control of the production.
CO5	• Apply Just in Time (JIT) basic principles and applications.

UNIT-I

Introduction

Nature and Scope of Production/Operations Management, POM Relationship with other Systems in the Organisation, Factors that affect System and Concept of Production and Operation Management. Facility Location, Types of Manufacturing Systems, Lean Manufacturing, Student Planning and Analysis**.**

UNIT-II

Forecasting

Introduction, Statistical Forecasting Techniques, Moving Average, Exponential Smoothing Technique, Errors in Forecasting and Evaluation of Forecasting Techniques.

UNIT-III

Value Engineering and Plant Layout

Value Engineering – Objectives, Types of Values, Function and Cost, Product Life Cycle, Steps in Value Engineering, Methodology in Value Engineering, FAST Diagram and Matrix Method. Facility Location and Layout – Factor Considerations in Plant Location, Comparative Study of Rural and Urban Sites, Methods of Selection of Plant Layout, Objectives of Good layout, Principles, Types of Layout, Line Balancing

UNIT-IV

Aggregate Planning and MRP

Aggregate Planning – Definition, Different Strategies, Various Models of Aggregate Planning-Transportation and Graphical Models, Master scheduling, Material Requirement Planning(MRP)-Terminology, Types of Demands, Inputs to MRP, Techniques of MRP, Lot Sizing Methods, Benefits and Drawbacks of MRP, Manufacturing Resources Planning (MRP II), Just in Time (JIT) Philosophy, Kanban System, Calculation of Number of Kanbans, Pull Systems vs. Push Systems, Requirements for Implementation of JIT, JIT Production Process, Benefits of JIT.

UNIT-V

Quality in Production & Operations Management

Quality Assurance, Accepting Sampling, Statistical Process Control, Total Quality Management, QMS and ISO Standards

Textbooks

1. Buffa E.S. and Sarin R.K., Modern Production / Operations Management, 8th Edition, Wiley India Pvt. Ltd., New Delhi, 2009.
2. Joseph G. Monks, Operations Management-Theory and Problems, 3rd Edition, McGraw Hill Education, 1987.

Reference Books

1. James L. Riggs, Jim Rigs, Production Systems: Planning, Analysis and Control, 4th Edition, Wave Land Press, 1992.
2. Chary S.N., Production and Operations Management, 5th Edition, McGraw Hill Education, 2017.
3. Richard B.Chase, Ravi Shankar, Robert Jacobs F., Operations and Supply Chain Management, 15th Edition, McGraw Hill Education, 2018.
4. Pannerselvam R., Production and Operations Management, 3rd Edition, PHI Learning Pvt. Ltd., New Delhi, 2012.
5. Steven Nahmias, Tava Lennon Olsen, Production and Operation Analysis: Strategy – Quality – Analytics – Applications, 7th Edition, Waveland Press Inc., 2015.

Course Title	Vehicle diagnosis and control				B. Tech. ME VII Sem		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**	
2003711	**PEC- V**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	0	0	3	40	60	100
Mid Exam Duration: 90 MIN					**End Exam Duration: 3Hrs**		

Course Objectives:

- Introduce various techniques in Vehicle Diagnosis.
- Familiarize sensors and actuators associated with Oscilloscope Diagnostics.
- Identify various faults in the engine system.
- Discuss the concepts of engine system and vehicle systems diagnosis.
- To provide knowledge on, diagnostic procedure and instrumentation.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	● Perform vehicle diagnosis and apply the fault finding techniques practically.
CO 2	● Understand the basic concepts of On board and off board diagnosis
CO 3	● Recall the concepts of Exhaust, Cooling and Lubrication systems.
CO 4	● List various faults in the electrical system diagnosis
CO5	• Summarize the principles of traction control system diagnosis and transmission system diagnosis

UNIT-I

INTRODUCTION

Diagnostic process, Mechanical techniques, Electrical techniques, Fault codes, Datasources, Basic equipments, Piecoscope oscilloscope, Scanners, Emission testing, pressure testing, Automotive pressure oscilloscope transducer.

UNIT – II

On and off Board Diagnostics

Introduction to oscilloscope Diagnostics. Sensors And Actuators Associated With Oscilloscope Diagnostics. On-Board Diagnostics Various Perspectives.Petrol/Gasoline On-Board Diagnostics. On-Board Sensors And Actuators. Sensors And Actuators Comparative Case Study

UNIT-III

Engine System Diagnosis

Introduction Engine Systems Diagnostics. Engine Operation And Fuel System. Ignition System And Emission System. Fuel Injection, Starting And Charging System. Power Flow Control And Energy Efficiency Analysis. Engine Management and Fault finding Information. Air Supply, Exhaust System, Cooling and Lubrication System.

UNIT – IV

Chassis and Brake System Diagnosis: Introduction to Vehicle System Diagnostics, Anti-Lock Braking System Diagnostics. Traction Control System Diagnostics, Steering And Tires. Transmission Systems Diagnostics

UNIT – V

Electrical And Electronic Systems

Diagnosis of Electronic components and circuits, Multiplexing, Diagnosis of lighting and electrical system and components, Instruments, Auxiliaries**.**Diagnosis of Electronic components and circuits, Multiplexing, Diagnosis of lighting and electrical system and components, Instruments, Auxiliaries.

Textbooks

1. Richard.C.Dorf and Robert.H.Bishop , "Modern Control System" 12th edition Pearson Prentice Hall,2013.
2. Benjamin.C.Kuo, "Automatic control systems", Prentice Hall of India, 7th Edition, 1995.
3. Tom denton "Advanced automotive fault diagnosis", Elsevier butterworth-heinemannlinacre house, jordan hill, oxford ox2 8dp, uk - isbn-10: 0-75-066991-8.
4. Tom Denton "Automotive Electronics Handbook", - - McGraw-Hill Publishing Co.; 2nd Revised edition 1999, ISBN10:0070344531

Reference Books

1. J.Nagrath and M.Gopal, "Control System Engineering", New Age International Publishers, 5th Edition, 2007.
2. Routledge "Automobile Electrical and Electronic Systems", 4th edition 2012, ISBN10: 0080969429.

Course Title	MECHATRONICS&MEMS				B. Tech. ME VII Sem		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**	
2003712	**PEC- V**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	0	0	3	40	60	100
Mid Exam Duration: 90 MIN					**End Exam Duration: 3Hrs**		

Course Objectives:

- Familiarize the technologies behind modern mechatronic systems.
- Explain fundamentals for the development of fully automated system.
- Develop a robotic or automated systems focusing on the hardware and software integration.
- Demonstrate the development of mechatronic system and MEMS.
- . To study the various sensors and actuators, applications of MEMS.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	• Demonstrate the knowledge of MEMS.
CO 2	• Classifying different fabrication techniques of MEMS.
CO 3	• Illustrate the application of MEMS in industry.
CO 4	• Describe the techniques are of used to design a mechatronics process.
CO5	• Suggest possible design solutions.

UNIT-I

Introduction

Definition of Mechatronics, Mechatronics in manufacturing, Products, and design.Comparison between Traditional and Mechatronics approach.Computer numerical control (CNC) machines, Tool monitoring systems, Flexible manufacturing system (FMS), Industrial Robots, Automatic packaging systems, Automatic inspection systems.

UNIT-II

Sensors

Static characteristics of sensors, Displacement, Position and Proximity sensors, Force and torque sensors, Pressure sensors, Flow sensors, Temperature sensors, Acceleration sensors, Level sensors, Light sensors, Smart material sensors, Micro and Nano sensors, Selection criteria for sensors.

UNIT-III

Actuators

Mechanical, Electrical, Hydraulic and Pneumatic Actuation systems, Characteristics and their limitations, Design of Hydraulic and Pneumatic circuits, Piezoelectric actuators, Shape memory alloys, Selection criteria for actuators.

UNIT-IV

Microprocessors, Microcontrollers and Programmable Logic Controllers

Architecture of Microprocessor, Microcontroller and Programmable Logic Controller, PLC Programming using ladder diagrams, logics, latching, sequencing, timers relays and counters, data handling, Analog input/output, selection of controllers.

UNIT-V

Hydraulic systems

flow, pressure and direction control valves, actuators, and supporting elements, hydraulic power packs, pumps. Design of hydraulic circuits. Pneumatics: production, distribution and conditioning of compressed air, system components and graphic representations, design of systems, Description.

Textbooks

1. Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering ,WBolton, 3/e Pearson Education Press, 2005.
2. DevadasShetty and Richard A Kolk, Mechatronic System Design, 2/e, Cengage learning, 2010.

Reference Books

1. Clarence W. de Silva, Mechatronics an Integrated Approach, CRC Press, 2004.
2. James J Allen, Micro Electro Mechanical Systems Design, CRC Press Taylor & Francis group, 2005.
3. Ganesh S Hedge, Mechatronics, Jones & Bartlett Learning, 2010.

Course Title	DESIGN OF OIL HYDRAULICS AND PNEUAMATICS				B. Tech. ME VII Sem		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**	
2003713	**PEC- V**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	0	0	3	40	60	100
Mid Exam Duration: 90 MIN					**End Exam Duration: 3Hrs**		

Course Objectives:

- Familiarize on Fluid Power Engineering and Power Transmission System.
- Introduce the students, the basic concepts of hydraulic and pneumatic systems.
- Expose the students with various hydraulic and pneumatic actuators.
- Familiarize on fluid power systems and its applications to real time.
- Know the problem, which occur in fluid power systems and take necessary troubleshooting/ maintenance activities.
- Get practiced in designing hydraulic and pneumatic systems.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	● Compare the differences between hydraulic and pneumatic systems.
CO 2	● Identify the practical applications in automation.
CO 3	● Build the circuits for a given applications.
CO 4	● Develop hydraulic and pneumatic power packs.
CO5	• Discuss the importance of PLC and microprocessor in hydraulic and pneumatic systems.

UNIIT-I

Introduction To Hydraulics

Fluid- Concept and classification of fluid-Newton's law viscosity-Properties of fluidDensity, Specific gravity, Specific Weight, Specific Volume- Dynamic Viscosity, Kinematic Viscosity, Surface tension, Capillarity, Vapour Pressure, Compressibility-Fluid pressure, Pressure head, Pressure intensity-Concept of absolute vacuum, gauge pressure, atmospheric Pressure-pressure,- Simple and differential manometers, Bourdon pressure gauge**.**

UNIT-II

Oil Hydraulic Pumps, Actuators

Types of hydraulic pumps - construction and working principle - design considerations, selection, specifications and characteristics of pumps. Types of actuators-construction and working principle - design considerations, selection, specifications and characteristics of actuators.

Control And Regulation Elements: Direction control valves, Pressure control valves, Flow control valves, Non-return valves, Reservoirs, Accumulators, Heating & cooling devices, Hoses. Selection of valves for hydraulic circuits.

UNIT-III

Design Of Hydraulic Circuits

Speed control circuits - Regenerative circuits- Accumulators and Intensifiers: Types of accumulators – Accumulators circuits, sizing of accumulators, intensifier – Applications of Intensifier–Intensifier circuit. - Reservoir design - Selection of components. Hydraulic circuits - Reciprocating - Quick return - Sequencing synchronizing - Safety circuits - Industrial circuits - Press - Milling Machine - Planner - Fork Lift.

UNIT-IV

Pneumatic Systems

Pneumatic fundamentals - Properties of air – Compressors – Filter, Regulator, and Lubricator unit – Air control valves, Quick exhaust valves, and pneumatic actuators. Control Elements - Logic Circuits -Position - Pressure Sensing - Switching – Electro Pneumatic - Electro Hydraulic Circuits - Robotic Circuits.

UNIT-V

Design Of Pneumatic Circuits

Classic-Cascade-Step counter - Combination -Methods - PLC-Microprocessors -Uses - Selection criteria for Pneumatic components - Installation and Maintenance of Hydraulic and Pneumatic power packs - Fault finding - Principles of Low Cost Automation - Case studies

Textbooks

1.Anthony Esposito, "Fluid Power with Applications", Pearson Education 2000.
2.Majumdar S.R, "Oil Hydraulics", Tata McGraw Hill, 2000.
3.Majumdar S.R, "Pneumatic Systems – Principles and Maintenance", Tata McGraw Hill, 2001.
4.Dudelyt, A. Pease and John T. Pippenger, "Basic Fluid Power", Prentice Hall, 1987.

Reference Books

1. Andrew Parr, Hydraulic & Pneumatics, 2/e, Jaico Publishing House Elsevier, 1999.
2. Harry L. Stevart D.B, "Practical Guide to Fluid Power", Taraoeala Sons and Port Ltd. Broadey, 1976.

Course Title	REFRIGERATION &AIR CONDITIONING				B. Tech. ME VII Sem		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**	
2003714	**PEC- V**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	0	0	3	40	60	100
Mid Exam Duration: 90 MIN					**End Exam Duration: 3Hrs**		

Course Objectives:

- Provides insights in how thermodynamic principles are applied within the refrigeration and air conditioning industry.
- Introduce the students how real systems used in commercial, industrial refrigeration and air conditioning industries are built-up.
- Expose the students on various refrigeration methods like VCR, VAR and latest developments.
- Know the various air conditioning methods like summer, winter and year round air conditioning and to make the student to understand the practical applications of refrigeration and air conditioning systems.
- Understand the basic air conditioning processes on psychometric charts, calculate cooling load for its applications in comfort and industrial air conditioning

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	• Appraise the importance of humidifiers and dehumidifiers.
CO 2	• Select the requirements of temperature and humidity for human comfort.
CO 3	• Demonstrate the heat pump working and its components.
CO 4	• List the various air conditioning equipment's.
CO5	• Present the properties, applications and environmental issues of different refrigerants

UNIT-I

Introduction to Air refrigeration system

Refrigeration machine, heat pump, coefficient of performance, ideal refrigeration cycle, Bell – Coleman, refrigeration cycle, open and closed systems, application of air- refrigeration in air-crafts

Special refrigeration system

absorption, cascade, vortex, thermoelectric and steam jet refrigeration system

UNIT-II

Vapour Compression Refrigeration (VCR) System

Vapour Compression Refrigeration (VCR) System - Basic Cycle - Working Principle and Essential Components of the Plant - COP - Representation of Cycle On T-S and P-h Charts - Expander Vs. Throttling, Effect of Sub Cooling and Super Heating - Cycle Analysis - Actual Cycle- Influence of Various Parameters on System Performance - Construction and Use of P-h Charts - Numerical Problems. Refrigerants - Desirable Properties

UNIT-III

Vapor Absorption Refrigeration (VAR) System

Vapor Absorption Refrigeration (VAR) System- Description and Working of NH_3 - Water System and Li Br -Water (Two Shell & Four Shell) System -Calculation of Max COP, Principle of Operation of Three Fluid Absorption System

STEAM JET REFRIGERATION SYSTEM: Working Principle and Basic Components-Estimation of Motive Steam Required Principle and Operation of: (I) Thermo-Electric Refrigerator (ii) Vortex Tube or Hilsch Tube.

UNIT-IV

Introduction to Air Conditioning

Psychrometric Properties & Processes - Characterization of Sensible and Latent Heat Loads - Need For Ventilation, Consideration of Infiltrated Air - Heat Load Concepts. Air Cooler (Evaporative Cooling) ,Window, Split, Summer , Winter, Year Round, Central Air Conditioning Systems.

UNIT-V

Air Conditioning Equipment

Air Conditioning Equipment - Humidifiers - Dehumidifiers - Air Filters, Fans and Blowers.
Human Comfort: Requirements of Temperature, Humidity And Concept of Effective Temperature, Comfort Chart. Heat Pump - Heat Sources - Different Heat Pump Circuits.

Textbooks

1. Refrigeration and Air Conditioning ,CPArora,TMH, 15th edition, 2013.
2. A Course in Refrigeration and Air conditioning,S.CArora&Domkundwar, Dhanpatrai

Reference Books

1. Refrigeration and Air Conditioning / Manohar Prasad / New Age, 2nd edition, 2013
2. Principles of Refrigeration - Dossat / Pearson Education, 4th edition, 2007
3. Refrigeration and Air Conditioning-P.L.Ballaney, 2nd edition, 2012.
4. Basic Refrigeration and Air-Conditioning - P.N.Ananthanarayanan / TMH, 4th edition, 2013.

Course Title	GEOMETRIC DIMENSION AND TOLERENCES				B. Tech. ME VII Sem		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**	
2003715	**PEC- V**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	0	0	3	40	60	100
Mid Exam Duration: 90 MIN					**End Exam Duration: 3Hrs**		

Course Objectives:

- Teach the basics of the geometric dimensioning and tolerances.
- Familiar with five groups of GD&T tolerances, form, orientation, location, runout and profile tolerances.
- Introduce tolerances of profiles of lines and surfaces with or without datums.
- Expose the students to various surface roughness parameters and their measurements in two dimensions.
- Understand the concepts of dimensional chains and inspection techniques

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	• Contrast between conventional and GD&T tolerance zones
CO 2	• Explain MMC, LMC and RFS concepts
CO 3	• Explain Taylor's principle of gauging
CO 4	• Assess the significance of selection of datum & datum features
CO5	• Point out form, orientation, profile, runout and orientation controls

UNIT-I

Introduction

Geometric product definition principles; verification of position with open setup; geometric characteristic symbols Geometric Dimensioning and Tolerancing: an explanation of tolerance zone conversion; surfaces, features, features of size, datum features, datum features of size, and datum's; tolerances; components common to geometrically dimensioned&toleranced drawing; fits & allowances, advantages of GD&T

UNIT-II

Form and Orientation Tolerances

Principles of dimensioning - Introduction to geometric dimensioning and tolerancing (GD&T); Form tolerances: types, specifications and interpretations - measurement and evaluation of straightness, flatness and roundness - Orientation tolerances: types, specifications and interpretations, and verification of orientation tolerances. Exercises on each group.RFS, MMC and LMC concepts.

UNIT-III

Location, Runout and Profile Tolerances

Tolerances of location: types, specifications and interpretations - verification techniques - Tolerances of profiles of lines and surfaces with or without datums - Tolerances of runout - Tolerancing of angles and cones. Exercises on each group.RFS, MMC and LMC concepts.

UNIT-IV

Surface Roughness

Various parameters and their measurements in two dimensions - filtering and filtering techniques - areal parameters.symbology

Inspection of GD&T call-outs

Vectorial dimensioning and tolerancing - Statistical tolerancing of mechanical assemblies - Dimensional chains - Measurement uncertainty - Computer-aided tolerancing and verification. Inspection techniques-conventional and CMM

UNIT-V

Datum Feature of Size Representation

Modes of datum feature representation; angular orientation. Form Controls: flatness; straightness: circularity; free state variation; circularity Orientation Controls: orientation characteristics; angularity; perpendicularity Profile; line element controls Run out: circular & total Location: concentricity; the return of symmetry; position

Textbooks

1. Drake, P. J., Dimensioning and Tolerance Handbook, McGraw-Hill, Inc., New York. 1999.
2. Meadows, J. D., Geometric Dimensioning and Tolerancing: Applications and Techniques for use in Design, Manufacturing and Inspection, Marcel Dekker, Inc., New York. 1995.
3. Gill, P. S., Geometric Dimensioning and Tolerancing, S. K. Kataria& Sons, New Delhi.
4. ASME 14.5 - 2009 standards
5. Alex Krulikowski, Fundamentals of geometric dimensionining and tolerancing.
6. James D Meadows, ―Measurement of Geometric Tolerances in Manufacturing.

Reference Books

1. Gupta, I. C., A Textbook of Engineering Metrology, DhanpatRai Publications, New Delhi.
2. Galyer, J. F. W. and C. R. Shotbolt, Metrology for Engineers, Cassell Publishers, London.
3. Henzold, G., Handbook of Geometrical Tolerancing: Design, Manufacturing and Inspection, John Wiley & Sons, Chichester.
4. Muralikrishnan, B. and J. Raja, Computational Surface and Roundness Metrology, Springer, USA.
5. Relevant Indian and International Standards.
6. Whitehouse, D. J., Surfaces and their Measurement, Hermes Penton Science, London.

Course Title	ENTREPRENEURSHIP					B. Tech. ME VII Sem		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
20OE311	**OEC III**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	0	--	3	30	70	100
Mid Exam Duration: 2Hrs					**End Exam Duration: 3Hrs**			

Course Objectives:

1. Understand the concepts of entrepreneurship, its need and scope Understand meaning of term entrepreneur, classification of entrepreneur and qualities of an entrepreneur.
2. Concept and procedure of idea generation
3. Elements of business plan and its procedure
4. Project management and its techniques
5. Behavioral issues and Time management

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Identify opportunities and deciding nature of industry
CO 2	Know the importance of Women entrepreneurship, Brainstorm ideas for new and innovative products or services
CO 3	Identify the importance of MSME and know the preparation of Business plan
CO 4	Use project management techniques like PERT and CPM
CO5	Analyze behavioral aspects and use time management matrix

UNIT-I

Entrepreneur and Entrepreneurship: Concept of Entrepreneur, Characteristics of entrepreneur, Functions of an Entrepreneur, Types of entrepreneur, Concept of Entrepreneurship, Types of Entrepreneurship, Enterprise, Types of Enterprise, Entrepreneurial Myths, Challenges and Opportunities in Entrepreneurship in India, Role of Entrepreneurship in Economic Development,

UNIT-II

Women Entrepreneurship and Choice of Technology: Concept of Women Entrepreneur ,Problems of Women Entrepreneur ,Growth of women entrepreneurship in India, Evaluation of ideas and their sources, Selection of Technology, Collaborative interaction for Technology development, Social Responsibility and Business Ethics.

UNIT-III

MSMEs& New Venture Creation: Concept of MSME, Role & Importance of MSMEs, Growth & development of MSMEs in India, Current schemes for MSMEs, Business opportunities in India, Elements of Business Plan and its salient features presenting a business plan.

UNIT-IV

Project Management: During construction phase, project organization, project planning and control using CPM, PERT techniques, Human aspects of project management, Assessment of tax burden.

UNIT-V

Entrepreneurial Behaviours and Motivation: Introduction, Entrepreneurial Input, And Entrepreneurial Motivation: Concept and Need, Theories of Motivation, Motives for Entrepreneur

Time Management: Approaches of time management, their strengths and weaknesses. Time management matrix and the urgency addiction

Text Books:

1. Elias G. Carayannis,Elpida T. Samara “Innovation and Entrepreneurship”, Springer
2.Vasant Desai, “Dynamics of Entrepreneurial Development and Management”, Himalaya Publishing House, .
3. S.S. Khanka, “Entrepreneurial Development”, S. Chand & Co. Pvt. Ltd., New Delhi
4. Prasanna Chandra, “Project-Planning, Analysis, Selection, Implementation and Review”, Tata Mcgraw-Hill Publishing Company Ltd.

References:

1. Robert D. Hisrich, Michael P. Peters, “Entrepreneurship”, 5/e, Tata Me Graw Hill Publishing Company Ltd., 2015.
2. Stephen R. Covey and A. Roger Merrill, “First Things First”, Simon and Schuster Publication.
3. Sudha G.S., “Organizational Behavior”, National Publishing House, 1996.

Course Title	Solar Energy Systems				B. Tech. ME VII Sem		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**	
20OE312	**OEC**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	0	0	3	40	60	100
Mid Exam Duration: 90 MIN					**End Exam Duration: 3Hrs**		

Course Objectives:

- Familiarize with basics of solar radiation, available solar energy and its measurement.
- Familiarize with solar collectors, construction and operation of solar collectors.
- Understand solar energy conversion systems, applications and power generation.
- Learn the principles PV technology and techniques of various solar cells/ materials for energy conversion
- Know the advance current technology of the solar energy systems for making the process economical, environmentally safe and sustainable.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Gain Knowledge On Basic Concepts Of Solar Radiation And Solar Collectors.
CO 2	Illustrate Design And Operation Of Solar Heating And Cooling Systems.
CO 3	Discuss The Principles Of Solar Thermo Photovoltaic cells
CO 4	Analyze The Performance Of A Solar Cell Array System.
CO5	Explain Passive Heating Concepts And Passive Cooling Concepts.

UNIT – I

Solar radiation and collectors

Solar angles – Sun path diagrams – Radiation - extra terrestrial characteristics - measurement and estimation on horizontal and tilted surfaces - flat plate collector thermal analysis - testing methods- evacuated tubular collectors - concentrator collectors – classification - design and performance parameters - tracking systems - compound parabolic concentrators - parabolic trough concentrators - concentrators with point focus - Heliostats – performance of the collectors.

UNIT-II

Solar thermal technologies

Principle of working, types, design and operation of - Solar heating and cooling systems - Thermal Energy storage systems – Solar Desalination – Solar cooker : domestic, community – Solar pond – Solar drying.

UNIT – III

Solar PV fundamentals

Semiconductor – properties - energy levels - basic equations of semiconductor devices physics. Solar cells - p-n junction: homo and hetro junctions - metal-semiconductor interface - dark and illumination characteristics - figure of merits of solar cell - efficiency limits - variation of efficiency with band-gap and temperature - efficiency measurements - high efficiency cells – Solar thermo-photovoltaic cells

UNIT - IV

SPV system design and applications

Solar cell array system analysis and performance prediction- Shadow analysis: reliability - solar cell array design concepts - PV system design - design process and optimization - detailed array design - storage autonomy - voltage regulation - maximum tracking - centralized and decentralized SPV systems - stand alone - hybrid and grid connected system - System installation - operation and maintenances - field experience - PV market analysis and economics of SPV systems.

UNIT - V

Solar passive architecture

Thermal comfort - bioclimatic classification – passive heating concepts: direct heat gain - indirect heat gain - isolated gain and sunspaces - passive cooling concepts: evaporative cooling - Radiative cooling - application of wind, water and earth for cooling; shading - paints and cavity walls for cooling - roof radiation traps - earth air-tunnel. – Energy efficient landscape design - thermal comfort.

TEXT BOOKS:

1Goswami D.Y., Kreider, J. F. and Francis., "Principles of Solar Engineering', Taylor and Francis, 2000.
2.Chetan Singh Solanki, "Solar Photovoltatics – Fundamentals, Technologies and Applications", PHI Learning Private limited,
2011.

REFERENCES:

1. Sukhatme S.P.,. Nayak.J.P, 'Solar Energy – Principle of Thermal Storage and collection", Tata McGraw Hill, 2008.
2. Solar Energy International, "Photovoltaic – Design and Installation Manual" – New Society Publishers, 2006.
3. Roger Messenger and Jerry Vnetre, "Photovoltaic Systems Engineering", CRC Press, 2010.

Course Title	INTERNAL COMBUSTION ENGINE				B. Tech. ME VII Sem		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**	
20OE313	**OEC**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	0	0	3	40	60	100
Mid Exam Duration: 90 MIN					**End Exam Duration: 3Hrs**		

Course Objectives:

- This course provides techniques of applying management principles to professional positions held by Engineers and Engineering Technologists
- The management functions, especially suited to scientist & Professionals in technical and industrial environment are part of the curriculum
- Students are exposed to the theory and practices of modern management approaches, tools and techniques in complex industrial & Competitive economic environment

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	• Use knowledge and comprehension in management tools to apply in technical organizations.
CO 2	• Understand and build their analytical abilities in the use of Industrial Management
CO 3	• Use management techniques to direct the organizations/industries for goal achievement
CO 4	• Solve problems associated with the operations management and scheduling of resources in efficiently and effectively.
CO5	• The students may be asked use knowledge of management techniques and write a computer program to address and solve more complicated problems and to study the effect of various parameters on the management/organization

UNIT – I

Power Cycles:

Carnot cycle, Air standard cycles -Description and representation of Otto cycle, Diesel cycle & Dual cycles on P–V and T-S diagram -Thermal Efficiency – Comparison of Otto, Diesel and Dual cycles. Simple problems on Otto, Diesel and Dual cycles

UNIT-II

I.C. Engines:

Energy conversion – basic engine components –Classification of I.C. Engines, Working principle of two stroke and four stroke engines - comparison of two stoke and four stroke, SI and CI engines –Valve and port timing diagrams, application of I.C Engines.

UNIT – III

Engine Systems:

Working principle of, Magneto & Battery Ignition System - Simple Carburetor - Common rail fuel Injection System - Air & Thermostat cooling system - Petrol & Pressure Lubrication system.

UNIT - IV

Combustion in S.I. Engines:

Homogeneous Mixture - Stages of combustion - Importance of flame speed and factors influencing the flame speed –Abnormal Combustion - Phenomenon of Knocking, Summary of Enginevariables affecting the knocking, pre-ignition.

UNIT - V

Testing and Performance:

Engine Performance Parameters - Determination of brake power, friction power and indicated power – Performance test – Heat balance sheet and chart- Emissions from Diesel & Petrol Engines, Euro Norms - Simple problems on performance and heat balance sheet.

TEXT BOOKS:

1. I.C. Engines, V. GANESAN- TMH.
2. I.C. Engines / Heywood /McGraw Hill.

REFERENCES:

1. Thermal Engineering / R.K Rajput / Lakshmi Publications.
2. I.C Engines – Mathur& Sharma – DhanpathRai& Sons.
3. Engineering fundamentals of I.C Engines – Pulkrabek / Pearson /PHI
4. Thermal Engineering / Rudramoorthy – TMH

Course Title	ENERGY AUDITING				B. Tech. ME VII Sem		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**	
20OE314	**OEC**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	0	0	3	40	60	100
Mid Exam Duration: 90 MIN					**End Exam Duration: 3Hrs**		

Course Objectives:

- Introduce the concepts of energy scenario and need for energy policy for industries in India.
- Familiarize with the Energy Audit concepts and its approaches.
- Teach the principles and objectives of the Energy management.
- Discuss the Thermal and Electrical Energy management.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	● explain the fundamental aspects of energy scenario in India.
CO 2	● List the various national and state level energy policy .
CO 3	• explain the concepts of energy conservation in boilers.
CO 4	• identify the thermal energy components.
CO5	● explain the concepts of supply side methods to minimize supply.

UNIT – I

General Aspects

Review of energy scenario in India, General Philosophy and need of Energy Audit and Management, Basic elements and measurements - Mass and energy balances – Scope of energy auditing industries - Evaluation of energy conserving opportUNITies, Energy performance contracts, Fuel and Energy substitution, Need for Energy Policy for Industries, National & State level energy Policies.

UNIT-II

Energy Audit Concepts

Need of Energy audit - Types of energy audit – Energy management (audit) approach - understanding energy costs - Bench marking – Energy performance - Matching energy use to requirement - Maximizing system efficiencies -Optimizing the input energy requirements - Duties and responsibilities of energy auditors- Energy audit instruments - Procedures and Techniques.

UNIT – III

Principles and Objectives of Energy Management

Design of Energy Management Programmes - Development of energy management systems – Importance - Indian need of Energy Management - Duties of Energy Manager - Preparation and presentation of energy audit reports - Monitoring and targeting, some case study and potential energy savings.

UNIT - IV

Thermal Energy Management

Energy conservation in boilers - steam turbines and industrial heating systems - Application of FBC - Cogeneration and waste heat recovery -Thermal insulation - Heat exchangers and heat pumps –HVC industries-Building Energy Management.

UNIT - V

Electrical Energy Management

Supply side Methods to minimize supply-demand gap- Renovation and modernization of power plants - Reactive power management – HVDC- FACTS - Demand side - Conservation in motors - Pumps and fan systems – Energy efficient motors

TEXT BOOKS:

1Murphy, W. R., Energy Management, Elsevier, 2007.
2.Smith, C. B., Energy Management Principles, Pergamum, 2007
3.Handbook of Energy Audit, Sonal Desai, Mcgraw Hill Education Private Ltd

REFERENCES:

1.Turner, W. C., Doty, S. and Truner, W. C., Energy Management Hand book, 7th edition, Fairmont Press, 2009.
2. De, B. K., Energy Management audit & Conservation, 2nd Edition, Vrinda Publication, 2010.
3. Energy Management Handbook – W.C. Turner (John Wiley and Sons, A Wiley a. Interscience publication)
4. Industrial Energy Management and Utilisation –L.C. Witte, P.S. Schmidt, D.R. Brown (Hemisphere Publication, Washington, 1988)
5. Industrial Energy Conservation Manuals, MIT Press, Mass, 1982
6. Energy Conservation guide book Patrick/Patrick/Fardo (Prentice hall1993)

Course Title	SUSTAINABLE ENGINEERING				B. Tech. ME VII Sem		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**	
20OE315	**OEC**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	0	0	3	40	60	100
Mid Exam Duration: 90 MIN					**End Exam Duration: 3Hrs**		

Course Objectives:

- To have an increased awareness among students on Issues in areas of sustainability.
- To understand the role of Engineering and technology within sustainable development
- To know the Methods ,tools and incentives for sustainable product service system development
- To Establish a clear understanding of the role and impact of various aspects of Engineering and emerging decisions on environmental, societal and economic problems

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	● Understand the relevance and the concept of sustainability and the global initiatives in this Direction.
CO 2	● Explain the different types of environmental pollution problems and their sustainable
CO 3	● Discuss the environmental regulations and standards .
CO 4	● Outline the concepts related to conventional and non-conventional energy
CO5	● Demonstrate the broad perspective of sustainable practices by utilizing engineering knowledge and principles

UNIT-I

Sustainability:

Introduction, concept, evolution of the concept; Social, environmental and economic sustainability concepts; Sustainable development, Nexus between Technology and Sustainable development; Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs), Clean Development Mechanism (CDM).

UNIT – II

Environmental Pollution:

Air Pollution and its effects, Water pollution and its sources, Zero waste concept and 3 R concepts in solid waste management; Greenhouse effect, Global warming, Climate change, Ozone layer depletion, Carbon credits, carbon trading and carbon foot print, legal provisions for environmental protection.

UNIT – III

Environmental management standards: ISO 14001:2015 frame work and benefits, Scope and goal of Life Cycle Analysis (LCA), Circular economy, Bio-mimicking, Environment Impact Assessment (EIA), Industrial ecology and industrial symbiosis.

UNIT – IV

Resources and its utilization: Basic concepts of Conventional and non-conventional energy, General idea about solar energy, Fuel cells, Wind energy, Small hydro plants, bio-fuels, Energy derived from oceans and Geothermal energy.

UNIT-V

Sustainability practices: Basic concept of sustainable habitat, Methods for increasing energy efficiency in buildings, Green Engineering, Sustainable Urbanization, Sustainable cities, Sustainable transport

Textbooks:

1.Sustainable Engineering: Drivers, Metrics, Tools, And Applications
Krishna R. Reddy, Claudio Cameselle, Jeffrey A. Adams.
2. Introduction to Sustainability for Engineers By**Tulseeram, Ramjeawon**
3. sustainable Engineering: Principles and Practice Hardcover – 13 June 2019 by Bhavik R. Bakshi

Reference Books:

1. Allen, D. T. and Shonnard, D. R., Sustainabilitngineering: Concepts, Design and Case Studies,PrenticeHall.

2. Bradley. A.S; Adebayo,A.O., Maria, P. Engineering applications in sustainable design and development,Cengageleaming

3. Environment Impact Assessment Guidelines, Notification of Government of India, 2006

4.Mackenthun, K. M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998

5 ECBC Code 2007, Bureau of Energy Efficiency, New Delhi Bureau of Energy Efficiency Publications-Rating System, TERI Publications - GRIHA Rating System

Course Title	INDUSTRIAL ENGINEERING & MANAGEMENT				B. Tech. ME VII Sem		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**	
20OE316	**OEC**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	0	0	3	40	60	100
Mid Exam Duration: 90 MIN					**End Exam Duration: 3Hrs**		

Course Objectives:

- This course provides techniques of applying management principles to professional positions held by Engineers and Engineering Technologists
- The management functions, especially suited to scientist & Professionals in technical and industrial environment are part of the curriculum
- Students are exposed to the theory and practices of modern management approaches, tools and techniques in complex industrial & Competitive economic environment

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Understand the concepts of Management, organization principles and also motivational qualities and leadership
CO 2	Apply the knowledge where to and how to locate a plant, difficulties of plant layout.
CO 3	Evaluate various types of work studies processing charts and job evaluation techniques.
CO 4	Apply types of control charts and improvement of quality with analysis techniques.
CO5	Use knowledge of management techniques in improving the Enterprise planning and project management.

MAPPING OF COs & POs:

CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			2					2	2	3	2	
CO2			2			2			3	3	3	
CO3			3	2		2			3	3	3	
CO4	2	2	3	2		2			3	3		

UNIT-I

INTRODUCTION:

Concepts of Management and Organization – Functions of Management – Evolution of Management Thought : Taylor‟s Scientific Management, Fayol‟s Principles of Management, Douglas McGregor‟s Theory X and Theory Y, Mayo‟s Hawthorne Experiments, Hertzberg‟s Two Factor Theory of Motivation, Maslow‟s Hierarchy of Human Needs, Systems Approach to Management.

UNIT-II

PLANT LOCATION & LAYOUT:

Plant location, definition, factors affecting the plant location, comparison of rural and urban sites- methods for selection of plant.Types of production systems, Plant Layout – definition, objectives and types of plant layout.

UNIT-III

WORK STUDY:

Introduction, objectives of work study, steps in work study, purpose of method study, procedure of method study, recording techniques. Work measurement-purpose of work measurement, time studyprocedure-performance rating, standard time calculations (simple problems).

UNIT-IV

MATERIALS MANAGEMENT:

Objectives, Inventory – functions, types, associated costs, inventory control techniques-ABC and VED analysis. Stores Management and Stores Records. Purchase management duties of purchase of manager, associated forms, purchase procedure, methods of purchasing. Introduction to production planning and control (PPC) Objectives of PPC, Functions of PPC

UNIT-V

QUALITY CONTROL:

Meaning, process control, SQC control charts, single, double and sequential sampling, Introduction to TQM. Job Evaluation and merit rating: introduction-Job evaluation-objectives, benefits and limitations of job evaluation-methods of job evaluation

TEXT BOOKS:

1. DR. Ravi Shankar: Industrial Engineering and management/Galgotia publications pvt. Ltd.
2. Khanna O.P.: Industrial Engineering

REFERENCE BOOKS:

1. Industrial engineering and operations management by S.K. Sharma and Savita Sharma.
2. T.R. Banga : Industrial Engineering and Management
3. M. Mahajan: Industrial engineering and production management, DhanpatRai& Co.

<table>
<tr><td>Course Title</td><td colspan="5">INTERNSHIP</td><td colspan="3">B. Tech. ME VIISem</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2003716</td><td rowspan="2">PROJECT</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td></td><td></td><td></td><td>2</td><td>100</td><td></td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration:</td><td colspan="4">End Exam Duration:</td></tr>
<tr><td colspan="9">o Course Objectives: The objective of the project is to enable the student to take up investigative study in industry in the field of Mechanical Engineering and Ability to articulate what was learned and how it will be apply to your professional career goals</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">The student will append, to their internship contract, a statement of at least 250 words which explains how this internship contributes to their academic and career goals</td></tr>
<tr><td>CO 2</td><td colspan="8">Identify and transfer existing ideas into new contexts and applications</td></tr>
<tr><td>CO 3</td><td colspan="8">Apply and transfer academic knowledge into the real-world</td></tr>
<tr><td>CO 4</td><td colspan="8">Design a component or a product applying all the relevant standards and with realistic constraints</td></tr>
</table>

The following are the rules and regulation for **INTERNSHIP:**

6. The student has to spend 40 to 50 Hrs in the semester on any Internship and submit a report for evaluation.
7. The project is evaluated for 100 marks in the semester by a committee consisting of head of the department, project mentor and one senior faculty member of the department.
8. A student shall acquire 2 credits assigned, when he/she secures 50% or more marks from the total of 100 marks.
9. In case, if a student fails, he/she shall resubmit the report.
10. There is no external evaluation for the Internship.