UNIVERSITY COLLEGE OF ENGINEERING VIZIANAGARAM
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
B.TECH (MECHANICAL ENGINEERING) - R19
EFFECTIVE FROM 2019-20 BATCH

B.Tech COURSE STRUCTURE
For

MECHANICAL ENGINEERING
UNIVERSITY COLLEGE OF ENGINEERING VIZIANAGARAM
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
VIZIANAGARAM-535003, ANDHRA PRADESH, INDIA.

(Applicable for batches Admitted from 2019-2020)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
KAKINADA - 533 003, Andhra Pradesh, India

UNIVERSITY COLLEGE OF ENGINEERING VIZIANAGARAM
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
B.TECH (MECHANICAL ENGINEERING) - R19
EFFECTIVE FROM 2019-20 BATCH

B. Tech (R19) UCEV *w.e.f* 2019-20

DEPARTMENT OF MECHANICAL ENGINEERING

UNIVERSITY COLLEGE OF ENGINEERING VIZIANAGARAM
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
VIZIANAGARAM-535003, ANDHRA PRADESH, INDIA.

B.Tech COURSE STRUCTURE (2019 Admitted batch)

I Year- I SEMESTER

S.NO	Code	Subject	L	T	P	C
1	HS	Communicative English	3			3
2	BS	Calculus	3			3
3	BS	Engineering Chemistry	3			3
4	ES	Problem solving and Programming using C	3			3
5	ES	Engineering Graphics and Drafting	1		3	2.5
6	HS	English Communication Skills lab-I			3	1.5
7	BS	Engineering Chemistry Lab			3	1.5
8	ES	Problem solving and Programming using C-Lab			3	1.5
9	ES	Mechanical Workshop Practice			3	1.5
		Mandatory Courses				
10	MC	Constitution of India	3			0
11	MC	Physical Fitness Activities/Yoga	2			0
		Total				20.5

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B.Tech COURSE STRUCTURE (2019 Admitted batch)

I Year- II SEMESTER

S.NO	Code	Subject	L	T	P	C
1	BS	Linear Algebra and Numerical Methods	3			3
2	BS	Engineering Physics	3			3
3	ES	Basic Electrical & Electronics Engineering	3			3
4	ES	Computer Aided Engineering Drawing	1		3	2.5
5	ES	Engineering Mechanics	3		0	3
6	HS	English Communication Skills lab-II			3	1.5
7	BS	Engineering Physics Lab			3	1.5
8	ES	Basic Electrical& Electronics Engineering Lab			3	1.5
9	PR	Engineering Exploration Project-Design Thinking (15 Hrs Per Semester)				0.5
		Mandatory Courses				
10	MC	Professional Ethics and Human Values	3			0
		Total				19.5

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B.Tech COURSE STRUCTURE (2019 Admitted batch)

II Year- I SEMESTER

S.NO	Code	Subject	L	T	P	C
1	HS	Managerial Economics and Financial Accountancy	3			3
2	BS	Vector Calculus, Transforms and PDE	3			3
3	PCC-ME	Mechanics of Solids	3			3
4	PCC-ME	Metallurgy & Material Science	3			3
5	PCC-ME	Production Technology	3			3
6	PCC-ME	Thermodynamics	3			3
7	PCC-ME	Mechanics of Solids & Metallurgy Lab				1.5
8	PCC-ME	Production Technology Lab				1.5
		Mandatory Courses				
9	MC	Environmental Science	3			0
		Total				21

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II Year- II SEMESTER

S.NO	Code	Subject	L	T	P	C
1	HS	Industrial Management	3			3
2	BS	Complex Variables and Statistical Methods	3			3
3	PCC-ME	Kinematics of Machinery	3			3
4	PCC-ME	Applied Thermodynamics-I	3			3
5	PCC-ME	Fluid Mechanics & Hydraulic Machines	3			3
6	PCC-ME	Design of Machine Members-I	3			3
7	PCC-ME	Fluid Mechanics & Hydraulic Machines Lab			3	1.5
8	PCC-ME	Machine Drawing			3	1.5
		Mandatory Courses				
9	MC	Intellectual Property Rights & Patents	3			0
		Total				21

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B.Tech COURSE STRUCTURE (2019 Admitted batch)

III Year- I SEMESTER

S.NO	Code	Subject	L	T	P	C
1	PCC-ME	Dynamics of Machinery	3			3
2	PCC-ME	Design of Machine Members-II	3			3
3	PCC-ME	Metal Cutting & Machine Tools	3			3
4	ES	Operations Research	3			3
5	PCC-ME	Applied Thermodynamics-II	3			3
6	PCC-Lab1	Applied Thermodynamics Lab			3	1.5
7	PCC-Lab 2	Theory of Machines Lab			3	1.5
8	PCC-Lab3	Machine Tools Lab			3	1.5
		Total				19.5

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III Year- II SEMESTER

S.NO	Code	Subject	L	T	P	C
1	PCC-ME	Instrumentation & Control Systems	3			3
2	PCC-ME	Heat Transfer	3			3
3	PCC-ME	Finite Element Methods	3			3
4	PCC-ME	CAD/CAM	3			3
5	PEC- 1	1. Non Destructive Evaluation 2. Joining Processes 3. Automobile Engineering 4. Mechanical Vibrations 5. MOOCS	3			3
6	PCC-ME	Instrumentation & Control Systems Lab			3	1.5
7	PCC-ME	Heat Transfer Lab			3	1.5
8	PCC-ME	Simulation Lab-I			3	1.5
		Total				19.5

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B.Tech COURSE STRUCTURE (2019 Admitted batch)

S.NO	Course Code	Course Title	L	T	P	Credits
1	PROJ-ME	Summer Internship/Design/Fabrication project/Industry Oriented Mini Project	0	0	60 Hrs	2

IV Year- I SEMESTER

S.NO	Code	Subject	L	T	P	C
1	PCC-ME	Engineering Metrology	3			3
2	PEC-2	1. Additive Manufacturing 2. Refrigeration & Air Conditioning 3. Advanced Mechanics of Solids 4. Condition Monitoring	3			3
3	PEC-3	1. Advanced Manufacturing Processes 2. Automation in Manufacturing 3. Computational Fluid Dynamics 4. Noise & Vibration Control	3			3
4	OEC-1	OPEN ELECTIVE –I	3			3
5	PCC-ME	Engineering Metrology Lab			3	1.5
6	PCC-ME	Simulation Lab-II			3	1.5
7	PROJ	PROJECT-I			8	4
		Total				21

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B.Tech COURSE STRUCTURE (2019 Admitted batch)

IV Year- II SEMESTER

S.NO	Code	Subject	L	T	P	C
1	PEC-4	1. Production Planning & Control 2. Gas Dynamics and Jet Propulsion 3. Industrial Hydraulics and Pneumatics 4. Statistical Quality Control	3			3
2	PEC-5	1. Composite Materials 2. Nano Materials 3. Thermal Equipment & Design 4. Power Plant Engineering	3			3
3	OEC-2	OPEN ELECTIVE -II	3			3
4	OEC-3	OPEN ELECTIVE –III	3			3
5	PROJ-II	Project-II			12	6
		Total				18

OPEN ELECTIVE -I 1. Operations Management 2. Optimization techniques 3. Industrial Robotics 4. Total Quality Management	**OPEN ELECTIVE -II** 1. Supply Chain Management 2. Energy Conversation Management 3. Renewable Energy Sources 4. Entrepreneurship
OPEN ELECTIVE -III 1. Nano Technology 2. Design of Experiments 3. Product Design & Development 4. Advanced Materials	

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L	T	P	C
3	0	0	3

B.Tech I Year I Semester

Communicative English

(Common to all Branches)

Introduction

The course is designed to train students in receptive (listening and reading) as well as productive and interactive (speaking and writing) skills by incorporating a comprehensive, coherent and integrated approach that improves the learners' ability to effectively use English language in academic/ workplace contexts. The shift is from *learning about the language* to *using the language*. On successful completion of the compulsory English language course/s in B.Tech., learners would be confident of appearing for international language qualification/proficiency tests such as IELTS, TOEFL, or BEC, besides being able to express themselves clearly in speech and competently handle the writing tasks and verbal ability component of campus placement tests. Activity based teaching-learning methods would be adopted to ensure that learners would engage in actual use of language both in the classroom and laboratory sessions.

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 role plays, 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

Unit I:

Lesson-1: A Drawer full of happiness from "**Infotech English**", Maruthi Publications

Lesson-2: Deliverance by Premchand from "**The Individual Society",** Pearson Publications. (Non-detailed)

Listening: Listening to short audio texts and identifying the topic. Listening to short audio texts and identifying the context and specific pieces of information to answer a series of questions both in speaking and writing.

Speaking: Asking and answering general questions on familiar topics such as home, family, work, studies and interests. Self introductions and introducing others.

Reading: Skimming text to get the main idea. Scanning to look for specific pieces of information.

Reading for Writing: Paragraph writing (specific topics) using suitable cohesive devices; linkers, sign posts and transition signals; mechanics of writing - punctuation, capital letters.

Vocabulary: Technical vocabulary from across technical branches (20) GRE Vocabulary (20) (Antonyms and Synonyms, Word applications) Verbal reasoning and sequencing of words.

Grammar: Content words and function words; word forms: verbs, nouns, adjectives and adverbs; nouns: countables and uncountables; singular and plural basic sentence structures; simple question form - wh-questions; word order in sentences.

Pronunciation: Vowels, Consonants, Plural markers and their realizations

Unit II:

Lesson-1: Nehru's letter to his daughter Indira on her birthday from "**Infotech English**", Maruthi Publications

Lesson-2: Bosom Friend by Hira Bansode from "**The Individual Society",** Pearson Publications. (Non-detailed)

Listening: Answering a series of questions about main idea and supporting ideas after listening to audio texts, both in speaking and writing.

Speaking: Discussion in pairs/ small groups on specific topics followed by short structured talks. Functional English: Greetings and leave takings.

Reading: Identifying sequence of ideas; recognizing verbal techniques that help to link the ideas in a paragraph together.

Reading for Writing: Summarizing - identifying main idea/s and rephrasing what is read; avoiding redundancies and repetitions.

Vocabulary: Technical vocabulary from across technical branches (20 words). GRE Vocabulary Analogies (20 words) (Antonyms and Synonyms, Word applications)

Grammar: Use of articles and zero article; prepositions.

Pronunciation: Past tense markers, word stress-di-syllabic words

Unit III:

Lesson-1: Stephen Hawking-Positivity 'Benchmark' from "**Infotech English**", Maruthi Publications

Lesson-2: Shakespeare's Sister by Virginia Woolf from "**The Individual Society",** Pearson Publications. (Non-detailed**)**

Listening: Listening for global comprehension and summarizing what is listened to, both in speaking and writing.

Speaking: Discussing specific topics in pairs or small groups and reporting what is discussed. Functional English: Complaining and Apologizing.

Reading: Reading a text in detail by making basic inferences - recognizing and interpreting specific context clues; strategies to use text clues for comprehension. Critical reading.

Reading for Writing: Summarizing - identifying main idea/s and rephrasing what is read; avoiding redundancies and repetitions. Letter writing-types, format and principles of letter writing. E-mail etiquette, Writing CV's.

Vocabulary: Technical vocabulary from across technical branches (20 words). GRE Vocabulary (20 words) (Antonyms and Synonyms, Word applications) Association, sequencing of words

Grammar: Verbs - tenses; subject-verb agreement; direct and indirect speech, reporting verbs for academic purposes.

Pronunciation: word stress-poly-syllabic words

Unit IV:

Lesson-1: Liking a Tree, Unbowed: Wangari Maathai-biography from "**Infotech English**", Maruthi Publications

Lesson-2: Telephone Conversation-Wole Soyinka from "**The Individual Society",** Pearson Publications**.** (Non-detailed)

Listening: Making predictions while listening to conversations/ transactional dialogues without video (only audio); listening to audio-visual texts.

Speaking: Role plays for practice of conversational English in academic contexts (formal and informal) - asking for and giving information/directions. Functional English: Permissions, Requesting, Inviting.

Reading: Studying the use of graphic elements in texts to convey information, reveal trends/patterns/relationships, communicative process or display complicated data.

Reading for Writing: Information transfer; describe, compare, contrast, identify significance/trends based on information provided in figures/charts/graphs/tables. Writing SOP, writing for media.

Vocabulary: Technical vocabulary from across technical branches (20 words) GRE Vocabulary (20 words) (Antonyms and Synonyms, Word applications) Cloze Encounters.

Grammar: Quantifying expressions - adjectives and adverbs; comparing and contrasting; degrees of comparison; use of antonyms

Pronunciation: Contrastive Stress

Unit V:

Lesson-1: Stay Hungry-Stay foolish from "**Infotech English**", Maruthi Publications

Lesson-2: Still I Rise by Maya Angelou from "**The Individual Society",** Pearson Publications. (Non-detailed)

Listening: Identifying key terms, understanding concepts and interpreting the concepts both in speaking and writing.

Speaking: Formal oral presentations on topics from academic contexts - without the use of PPT slides. Functional English: Suggesting/Opinion giving.

Reading: Reading for comprehension. RAP Strategy Intensive reading and Extensive reading techniques.

Reading for Writing: Writing academic proposals- writing research articles: format and style.

Vocabulary: Technical vocabulary from across technical branches (20 words) GRE Vocabulary (20 words) (Antonyms and Synonyms, Word applications) Coherence, matching emotions.

Grammar: Editing short texts – identifying and correcting common errors in grammar and usage (articles, prepositions, tenses, subject verb agreement)

Pronunciation: Stress in compound words

Course Outcomes:

At the end of the module, the learners will be able to

- understand social or transactional dialogues spoken by native speakers of English and identify the context, topic, and pieces of specific information
- ask and answer general questions on familiar topics and introduce oneself/others
- employ suitable strategies for skimming and scanning to get the general idea of a text and locate specific information

- recognize paragraph structure and be able to match beginnings/endings/headings with paragraphs
- form sentences using proper grammatical structures and correct word forms

Prescribed text books:

1. "Infotech English", Maruthi Publications. (Detailed)

2. "The Individual Society", Pearson Publications. (Non-detailed)

Prescribed text book for Laboratory for Semesters-I & II:

1. "Infotech English", Maruthi Publications. (with Compact Disc)

Reference Books

- Bailey, Stephen. *Academic writing: A handbook for international students*. Routledge, 2014.
- Chase, Becky Tarver. *Pathways: Listening, Speaking and Critical Thinking.* Heinley ELT; 2nd Edition, 2018.
- Skillful Level 2 Reading & Writing Student's Book Pack (B1) Macmillan Educational.
- Hewings, Martin. *Cambridge Academic English (B2)*. CUP, 2012.

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B.Tech I Year I Semester

L	T	P	C
3	0	0	3

Calculus
(Common to ALL branches)

Course Objectives:

- This course will illuminate the students in the concepts of calculus.
- To enlighten the learners in the concept of differential equations and multivariable calculus.
- 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.

UNIT I: Sequences, Series and Mean value theorems: (10 hrs)

Sequences and Series: Convergences and divergence – Ratio test – Comparison tests – Integral test – Cauchy's root test – Alternate series – Leibnitz's rule.

Mean Value Theorems (without proofs): Rolle's Theorem – Lagrange's mean value theorem – Cauchy's mean value theorem – Taylor's and Maclaurin's theorems with remainders.

UNIT II: Differential equations: (15 hrs)

Linear differential equations – Bernoulli's equations – Exact equations and equations reducible to exact form – Non-homogeneous equations of higher order with constant coefficients with non-homogeneous term of the type e^{ax}, sin ax, cos ax, polynomials in x^n, e^{ax} V(x) and x^nV(x) – Method of Variation of parameters

Applications: Orthogonal trajectories – Electrical circuits (RL, RC, RLC) – Simple Harmonic motion.

UNIT III: Partial differentiation: (10 hrs)

Introduction – Homogeneous function – Euler's theorem – Total derivative – Chain rule – Jacobian – Functional dependence – Taylor's and Mc Laurent's series expansion of functions of two variables.

Applications: Maxima and Minima of functions of two variables without constraints and Lagrange's method (with constraints).

UNIT IV: Multiple integrals: (8 hrs)

Double and Triple integrals – Change of order of integration – Change of variables.

Applications: Finding Areas and Volumes.

UNIT V: Special functions: (5 hrs)

Introduction to Improper Integrals-Beta and Gamma functions- Properties - Relation between Beta and Gamma functions- Evaluation of improper integrals.

Course Outcomes:

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

- utilize mean value theorems to real life problems
- solve the differential equations related to various engineering fields
- familiarize with functions of several variables which is useful in optimization
- Apply double integration techniques in evaluating areas bounded by region
- students will also learn important tools of calculus in higher dimensions. Students will become

  familiar with 2- dimensional and 3-dimensional coordinate systems
- Conclude the use of special function in multiple integrals

Text Books:

1. **B. S. Grewal,** Higher Engineering Mathematics, 43rd Edition, Khanna Publishers.
2. **Erwin Kreyszig,** Advanced Engineering Mathematics, 10th Edition, Wiley-India.

Reference Books:

1. **B. V. Ramana,** Higher Engineering Mathematics, 2007 Edition, Tata Mc. Graw Hill Education.
2. **Joel Hass, Christopher Heil and Maurice D. Weir,** Thomas calculus, 14th Edition, Pearson.
3. **Lawrence Turyn,** Advanced Engineering Mathematics, CRC Press, 2013.
4. **Srimantha Pal, S C Bhunia,** Engineering Mathematics, Oxford University Press.

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B.Tech I Year I Semester

L	T	P	C
3	0	0	3

ENGINEERING CHEMISTRY

(For Non-circuital branches CE, ME & MET)

Knowledge of basic concepts of Chemistry for Engineering students will help them as professional engineers later in design and material selection, as well as utilizing the available resources.

Course Objectives:

- ***Importance*** of usage of plastics in household appliances and composites (FRP) in aerospace and automotive industries.
- ***Outline*** the basics for the construction of electrochemical cells, batteries and fuel cells. Understand the mechanism of corrosion and how it can be prevented.

  Express the increase in demand as wide variety of advanced materials are introduced; which have excellent engineering properties.

  Classify and discuss the materials used in major industries like steel industry, metallurgical industries and construction industries and electrical equipment manufacturing industries. Lubrication is also ***summarized***.
- ***Relate*** the need of fuels as a source of energy to any industry, particularly industries like thermal power stations, steel industry, fertilizer industry etc., and hence introduced.
- ***Explain*** the importance and usage of water as basic material in almost all the industries; ***interpret*** drawbacks of steam boilers and also how portable water is supplied for drinking purposes.

UNIT I: POLYMER TECHNOLOGY

Polymerisation:- Introduction-methods of polymerization (emulsion and suspension)-physical and mechanical properties.

Plastics: Compounding-fabrication (compression, injection, blown film, extrusion) - preparation, properties and applications of PVC, polycarbonates and Bakelite-mention some examples of plastic materials used in electronic gadgets, recycling of e-plastic waste.

Elastomers:- Natural rubber-drawbacks-vulcanization-preparation, properties and applications of synthetic rubbers (Buna S, thiokol and polyurethanes).

Composite materials: Fiber reinforced plastics-conducting polymers-biodegradable polymers-biopolymers-biomedical polymers.

UNIT II: ELECTROCHEMICAL CELLS AND CORROSION

Single electrode potential-Electrochemical series and uses of series-standard hydrogen electrode, calomel electrode-concentration cell-construction of glass electrode-Batteries: Dry cell, Ni-Cd cells, Ni-Metal hydride cells, Li ion battery, zinc air cells–Fuel cells: H_2-O_2, CH_3OH-O_2, phosphoric acid, molten carbonate.

Corrosion:-Definition-theories of corrosion (chemical and electrochemical)-galvanic corrosion, differential aeration corrosion, stress corrosion, waterline corrosion-passivity of metals-galvanic series-factors influencing rate of corrosion-corrosion control (proper designing, cathodic protection)-Protective coatings: Surface preparation, cathodic and anodic coatings, electroplating, electroless plating (nickel). Paints (constituents, functions, special paints).

UNIT III: CHEMISTRY OF MATERIALS

Nano materials:- Introduction-sol-gel method-characterization by BET, SEM and TEM methods-applications of graphene-carbon nanotubes and fullerenes:Types, preparation and applications

Thermal analysis techniques: Instrumentation and applications of thermogravimetric analysis (TGA), differential thermal analysis (DTA), differential scanning calorimetry (DSC).

Refractories: - Definition, classification, properties (refractoriness, refractoriness under load, porosity and thermal spalling), failure of refractories.

Lubricants: - Definition, mechanism of lubricants and properties (definition and importance).

Cement: - Constituents, manufacturing, parameters to characterize the clinker formation: lime saturation factor (LSF), silica ratio (SR) and alumina ratio (AR), chemistry of setting and hardening, deterioration of cement.

UNIT IV: FUELS

Introduction-calorific value-HCV and LCV-problems using Dulong's formula-proximate and ultimate analysis of coal sample-significance of these analyses-problems-Petroleum (refining-cracking)-Synthetic petrol (Fischer Tropsch and Bergius)-petrol knocking-diesel knocking-octane and cetane ratings-anti-knock agents-Introduction to alternative fuels (Bio-diesel, ethanol, methanol, Natural gas, LPG, CNG)-Flue gas analysis by Orsat apparatus-Rocket fuels.

UNIT V: WATER TECHNOLOGY

Hardness of water-determination of hardness by complexometric method-boiler troubles (priming and foaming, scale formation, boiler corrosion, caustic embrittlement)-internal treatments-softening of hard water (zeolite processs and related sums, ion exchange process)-treatment of industrial waste water

Portable water and its specifications-steps involved in purification of water-chlorination, break point chlorination-reverse osmosis and electro dialysis.

Learning Outcomes: ***At the end of the course, the students will be able to***

- ***Outline*** preparation, properties and applications of some plastic materials and synthetic rubber explain the mechanism of conduction in conducting polymers.
- ***Explain*** the theory of construction of battery, fuel cells and categorize the reasons for corrosion and study some methods of corrosion control.
- ***Outline*** the awareness of materials like nanomaterials, fullerenes, refractories and lubricants.
- ***Differentiate*** petroleum, petrol, synthetic petrol, study alternate fuels and flue gases.
- ***Explain*** the impurities present in raw water, problems associated with them and how to avoid them are understood.

Text Books:

1. Engineering Chemistry by Jain and Jain; Dhanpat Rai Publicating Co. Latest edition
2. Engineering Chemistry by Shikha Agarwal; Cambridge University Press, 2019 edition.

Reference Books:

1. A text book of engineering Chemistry by S. S. Dara; S. Chand & Co Ltd., Latest Edition
2. Engineering Chemistry by Shashi Chawla; Dhanpat Rai Publicating Co. Latest edition

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I B. Tech - I Semester.

L	T	P	C
3	0	0	3

Problem Solving and Programming Using C

Course Objectives:

- To impart adequate knowledge on the need of programming languages and problem solving techniques and develop programming skills.
- To enable effective usage of Control Structures and Implement different operations on arrays.
- To Demonstrate the use of Strings and Functions.
- To impart the knowledge of pointers and understand the principles of dynamic memory allocation.
- To understand structures and unions and illustrate the file concepts and its operations.
- To impart the Knowledge Searching and Sorting Techniques.

UNIT-I

Introduction to Computer Problem Solving: Programs and Algorithms, Computer Problem Solving Requirements, Phases of Problem Solving, Problem Solving Strategies, Top-Down Approach, Algorithm Designing, Program Verification, Improving Efficiency, Algorithm Analysis and Notations.

UNIT-II

Introduction to C Programming: Introduction, Structure of a C Program, Comments, Keywords, Identifiers, Data Types, Variables, Constants, Input/output Statements, Operators, Type Conversion.

Control Flow, Relational Expressions: Conditional Branching Statements: if, if-else, if-else–if, switch. Basic Loop Structures: while, do-while loops, for loop, nested loops, The Break and Continue Statements, goto statement.

UNIT-III

Arrays: Introduction, Operations on Arrays, Arrays as Function Arguments, Two dimensional Arrays, Multi dimensional arrays.

Pointers: Concept of a Pointer, Declaring and Initializing Pointer Variables, Pointer Expressions and Address Arithmetic, Null Pointers, Generic Pointers, Pointers as Function Arguments, Pointers and Arrays, Pointer to Pointer, Dynamic Memory Allocation, Dangling Pointer, Command Line Arguments.

UNIT-IV

Functions: Introduction, Function Declaration, Function Definition, Function Call, Categories of Functions, Passing Parameters to Functions, Scope of Variables, Variable Storage Classes, Recursion.

Strings: String Fundamentals, String Processing with and without Library Functions, Pointers and Strings.

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UNIT-V

Structures, Unions, Bit Fields: Introduction, Nested Structures, Arrays of Structures, Structures and Functions, Self-Referential Structures, Unions, Enumerated Data Type –enum variables, Using Typedef keyword, Bit Fields.

Data Files: Introduction to Files, Using Files in C, Reading from Text Files, Writing to Text Files, Random File Access.

Course Outcomes:

At the end of the Course, Student will be able to:

- Illustrate the Fundamental concepts of Computers and basics of computer programming.
- Use Control Structures and Arrays in solving complex problems.
- Develop modular program aspects and Strings fundamentals.
- Demonstrate the ideas of pointers usage.
- Solve real world problems using the concept of Structures, Unions and File operations.

Text Books:

1. How to solve it by Computer, R. G. Dromey, and Pearson Education.
2. Computer Programming, Reema Thareja, Oxford University Press.

Reference Books:

1. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill.
2. Programming In C A-Practial Approach, Ajay Mittal, Pearson.
3. C Programming – A Problem Solving Approach, Forouzan, Gilberg, Cengage.
4. The C Programming Language, Dennis Richie And Brian Kernighan, Pearson Education.
5. Programming In C, Ashok Kamthane, Second Edition, Pearson Publication.
6. Let us C , Yaswanth Kanetkar, 16th Edition,BPB Publication.

Web Links:

1. http://www.c4learn.com/
2. http://www.geeksforgeeks.org/c/
3. http://nptel.ac.in/courses/122104019/
4. http://www.learn-c.org/
5. https://www.tutorialspoint.com/cprogramming/

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L	T	P	C
1	0	3	2.5

I BTech - I Semester

ENGINEERING GRAPHICS AND DRAFTING

Course Objective: Engineering drawing being the principal method of communication for engineers, the objective is to introduce the students, the techniques of constructing the various types of polygons, curves and scales. The objective is also to visualize and represent the 3D objects in 2D planes with proper dimensioning, scaling etc.

Unit I

Objective: To introduce the students to use drawing instruments and to draw polygons, Engg. Curves.

Polygons: Constructing regular polygons by general methods, inscribing and describing polygons on circles.

Curves: Parabola, Ellipse and Hyperbola by general and special methods, cycloids, involutes, tangents & normals for the curves.

Scales: Plain scales, diagonal scales and vernier scales

Unit II

Objective: To introduce the students to use orthographic projections, projections of points & simple lines. To make the students draw the projections of the lines inclined to both the planes.

Orthographic Projections: Reference plane, importance of reference lines, projections of points in various quadrants, projections of lines, line parallel to both the planes, line parallel to one plane and inclined to other plane.

Projections of straight lines inclined to both the planes, determination of true lengths, angle of inclination and traces.

Unit III

Objective: The objective is to make the students draw the projections of the plane objects/ inclined to both the reference planes.

Projections of planes: regular planes perpendicular/parallel to one reference plane and inclined to the other reference plane; inclined to both the reference planes.

Unit IV

Objective: The objective is to make the students draw the projections of the various types of solids in different positions inclined to one of the planes.

Projections of Solids – Prisms, Pyramids, Cones and Cylinders with the axis inclined to both the planes.

Unit V

Objective: The objective is to represent the object in 3D view through isometric views. The student will be able to represent and convert the isometric view to orthographic view and vice versa.

Conversion of isometric views to orthographic views; Conversion of orthographic views to isometric views.

Computer Aided Drafting, Creating 2D&3D drawings of objects using relevant software.

Note: In the End Examination there will be no question from CAD.

TEXT BOOKS:

1. Engineering Drawing by N.D. Bhatt, Chariot Publications
2. Engineering Drawing by Agarwal & Agarwal, Tata McGraw Hill Publishers

REFERENCE BOOKS:

1. Engineering Drawing by K.L.Narayana & P. Kannaiah, Scitech Publishers
2. Engineering Graphics for Degree by K.C. John, PHI Publishers
3. Engineering Graphics by PI Varghese, McGrawHill Publishers
4. Engineering Drawing + AutoCad – K Venugopal, V. Prabhu Raja, New Age

Course Outcome:

CO1. To make the students to draw the attributes and its importance in the fields of design and manufacturing

CO2. To make the student familiar with the techniques used for drawing various geometric elements used in engineering practice.

CO3. Making them to understand orthographic projections of points, lines, planes and solids in various positions with respect to different reference planes.

CO4. Ability to use the concepts of isometric projections to analyze 3D objects by viewing their 2D projections and vice versa.

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L	T	P	C
0	0	3	1.5

I BTech - I Semester

English Communicative Skills Lab-I
(Common to all Branches)

UNIT I:

Pronunciation-Vowels, Consonants

Oral Activity: JAM

UNIT II:

Pronunciation: Consonants

Oral Activity: Past tense markers

UNIT III:

Pronunciation: Word Stress

Oral Activity: Hypothetical Situations

UNIT IV:

Pronunciation: Disyllabic words, polysyllabic words

Oral Activity: Self /Peer profile

UNIT V: Common Errors in Pronunciation
Neutralizing Accent

Prescribed text book: Phonetic Transcription

1. "**Infotech English**", Maruthi Publications.

References Books :

1. Exercises in Spoken English Part 1,2,3,4, OUP and CIEFL.
2. English Pronunciation in use- Mark Hancock, Cambridge University Press.
3. English Phonetics and Phonology-Peter Roach, Cambridge University Press.
4. English Pronunciation in use- Mark Hewings, Cambridge University Press.
5. English Pronunciation Dictionary- Daniel Jones, Cambridge University Press.
6. English Phonetics for Indian Students- P. Bala Subramanian, Mac Millan Publications.

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B.Tech I Year I Semester

L	T	P	C
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ENGINEERING CHEMISTRY LAB

(For Non-circuital branches CE, ME & MET)

Introduction to Chemistry laboratory – Molarity, normality, primary, secondary standard solutions, volumetric titrations, quantitative analysis

1. Determination of HCl using standard Na_2CO_3 solution.
2. Determination of alkalinity of a sample containing Na_2CO_3 and NaOH.
3. Determination of Mn (II) using standard oxalic acid solution.
4. Determination of ferrous iron using standard $K_2Cr_2O_7$ solution.
5. Determination of copper (II) using standard hypo solution.
6. Determination of temporary and permanent hardness of water using standard EDTA solution.
7. Determination of iron (III) by a colorimetric method.
8. Determination of the concentration of acetic acid using sodium hydroxide (pH-metry method).
9. Determination of the concentration of strong acid vs strong base (by conductometric method).
10. Determination of strong acid vs strong base (by potentiometric method).
11. Determination of Mg^{+2} present in an antacid.
12. Determination of $CaCO_3$ present in an egg shell.
13. Estimation of Vitamin C.
14. Determination of % moisture and % volatile matter in coal sample by proximate analysis.
15. Preparation of biodiesel.
16. Preparation of nylon-6, 6 and Bakelite (demonstration only).

Of the above experiments at-least 10 assessment experiments should be completed in a semester.

Outcomes: The students entering into the professional course have practically very little exposure to lab classes. The experiments introduce volumetric analysis; redox titrations with different indicators; EDTA titrations; then they are exposed to a few instrumental methods of chemical analysis. Thus at the end of the lab course, the student is exposed to different methods of chemical analysis and use of some commonly employed instruments. They thus acquire some experimental skills.

Reference Books

1. A Textbook of Quantitative Analysis, Arthur J. Vogel.

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I B. Tech - I Semester.

L	T	P	C
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Problem Solving and Programming Using C Lab

Course Objectives:

- To impart knowledge on basic Linux commands, various Editors, Raptor.
- To make the students understand the concepts of C programming.
- To nurture the students on Control Structures and develop different operations on arrays.
- To make use of String fundamentals and modular programming constructs.
- To implement programs using dynamic memory allocation.
- To explain the concepts of Structure, Unions and files for solving various problems.

List of Experiments:

1. Introduction to Algorithms and Flowcharts

1.1) Implement Algorithm Development for Exchange the values of Two numbers.
1.2) Given a set of n student's examination marks (in the range 0-100) make a count of the number of students that passed the examination. A Pass is awarded for all of 50 and above.
1.3) Given a set of n numbers design an algorithm that adds these numbers and returns the resultant sum. Assume N is greater than or equal to zero.

2. Introduction to C Programming

2.1) Basic Linux Commands.
2.2) Exposure to Turbo C, Vi, Emacs, Code Blocks IDE, Dev C++.
2.3) Writing simple programs using printf(), scanf() .

3. Raptor

3.1) Installation and Introduction to Raptor.
3.2) Draw a flow chart to find the Sum of 2 numbers.
3.3) Draw a flow chart to find Simple interest.

4. Basic Math

4.1) Write a C Program to convert Celsius to Fahrenheit and vice versa.
4.2) Write a C Program to find largest of three numbers using ternary operator.
4.3) Write a C Program to Calculate area of a Triangle using Heron's formula.

5. Control Flow- I

5.1) Write a C Program to Find Whether the Given Year is a Leap Year or not.
5.2) Write a C program to find the roots of a Quadratic Equation.
5.3) Write a C Program to make a simple Calculator to Add, Subtract, Multiply or Divide Using Switch…case.

6. Control Flow- II

6.1) Write a C Program to Find Whether the Given Number is Prime number or not.
6.2) Write a C Program to Find Whether the Given Number is Armstrong Number or not.
6.3) Write a C program to print Floyd Triangle.

7. Control Flow- III

7.1) Write a C program to find the sum of individual digits of a positive integer.
7.2) Write a C program to check whether given number is palindrome or not.
7.3) Write a C program to read two numbers, x and n, and then compute the sum of the geometric progression $1+x+x^2+x^3+\ldots\ldots\ldots\ldots+x^n$.

8. Arrays

8.1) Write a C program to search an element in the given array (Linear Search).
8.2) Write a C program to perform matrix addition.
8.3) Write a C program to perform matrix multiplication.

9. Pointers

9.1) Write a C Program to Perform Addition, Subtraction, Multiplication and Division of two numbers using Command line arguments.
9.2) Write a C program to find sum of n elements entered by user. To perform this program, allocate memory dynamically using malloc () function.
9.3) Write a C program to find sum of n elements entered by user. To perform this program, allocate memory dynamically using calloc () function.

10. Functions, Array & Pointers

10.1) Write a C Program to demonstrate parameter passing in Functions.
10.2) Write a C Program to find Fibonacci, Factorial of a number with Recursion and without recursion.
10.3) Write a C Program to find the sum of given numbers with arrays and pointers.

11. Strings

11.1) Implementation of string manipulation operations with library function:
a) copy
b) concatenate
c) length
d) compare
11.2) Implementation of string manipulation operations without library function:
a) copy
b) concatenate
c) length
d) compare
11.3) Verify whether the given string is a palindrome or not.

12. Structures

12.1) Write a C Program to Store Information of a book Using Structure.

12.2) Write a C Program to Add Two Complex Numbers by Passing Structure to a Function.

13. Files

13.1) Write a C program to open a file and to print the contents of the file on screen.

13.2) Write a C program to copy content of one file to another file.

13.3) Write a C program to merge two files and store content in another file.

14. Application

Creating structures to capture the student's details save them in file in proper record format, search and prints the student details requested by the user.

Note: Draw the flowcharts using Raptor from Experiment 3 to Experiment 6.

Course Outcomes:

- Implement basic programs in C and design flowcharts in Raptor.
- Use Conditional and Iterative statements to solve real time scenarios in C.
- Implement the concept of Arrays and Modularity and Strings.
- Apply the Dynamic Memory Allocation functions using pointers.
- Develop programs using structures, and Files.

Reference Books:

1. Let Us C Yashwanth Kanetkar, 16th edition, BPB Publications.
2. Programming in C A-Practial Approach Ajay Mittal. Pearson Education.
3. The C programming Language, Dennis Richie and Brian Kernighan, Pearson Education.
4. Problem solving using C , K Venugopal,3rd Edition,TMG Publication.

Web Links:

1. https://www.hackerrank.com/
2. https://www.codechef.com/
3. https://www.topcoder.com/
4. https://code-cracker.github.io/
5. https://raptor.martincarlisle.com/
6. https://nptel.ac.in/courses/106105085/2

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I B. Tech - I Semester.

L	T	P	C
0	0	3	1.5

MECHANICAL WORKSHOP PRACTICE

Course Objective: To impart hands-on practice on basic engineering trades and skills.

Note: At least two exercises to be done from each trade.
Trade:

1.Carpentry	1. T-Lap Joint 2. Cross Lap Joint 3. Dovetail Joint 4. Mortise and Tenon Joint
2.Fitting	1. Vee Fit 2. Square Fit 3. Half Round Fit 4. Dovetail Fit
3.Black Smithy	1. Round rod to Square 2. S-Hook 3. Round Rod to Flat Ring 4. Round Rod to Square headed bolt
4.House Wiring	1. Parallel / Series Connection of three bulbs 2. Stair Case wiring 3. Florescent Lamp Fitting 4. Measurement of Earth Resistance
5.Tin Smithy	1. Taper Tray 2. Square Box without lid 3. Open Scoop 4. Funnel
6. IT Workshop	1.Assembly & Disassembly of Computer

Course Outcomes:
CO1. Able to understand the basic engineering trades
CO2. Able to analyze working of various tools
CO3.Able to understand the basic hardware of computer

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B.Tech I Year I Semester

L	T	P	C
3	0	0	0

Constitution of India
(Common to All Branches)

Course Objectives:

- To Enable the student to understand the importance of constitution
- To understand the structure of executive, legislature and judiciary
- To understand philosophy of fundamental rights and duties
- To understand the autonomous nature of constitutional bodies like Supreme Court and high court controller and auditor general of India and election commission of India.
- To understand the central and state relation financial and administrative.

UNIT-I

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

UNIT-II

Union Government and its Administration Structure of the Indian Union: Federalism, Centre- 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: Organisation, Structure and Functions

UNIT-IV

Local Administration - District's Administration Head - Role and Importance, Municipalities –

Mayor and role of Elected Representative - CEO of Municipal Corporation PachayatiRaj: Functions PRI: ZilaPanchayat, Elected officials and their roles, CEO ZilaPanchayat: Block level Organizational Hierarchy - (Different departments), Village level - Role of Elected and Appointed officials - Importance of grass root democracy

UNIT-V

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

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Course Outcomes:

At the end of the semester/course, the student will be able to have a clear knowledge on the following:

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

1. Know the sources, features and principles of Indian Constitution.
2. Learn about Union Government, State government and its administration.
3. Get acquainted with Local administration and Pachayati Raj.
4. Be aware of basic concepts and developments of Human Rights.
5. Gain knowledge on roles and functioning of Election Commission

References Books:

1. Durga Das Basu, Introduction to the Constitution of India, Prentice – Hall of India Pvt. Ltd.. New Delhi
2. SubashKashyap, Indian Constitution, National Book Trust
3. J.A. Siwach, Dynamics of Indian Government & Politics
4. D.C. Gupta, Indian Government and Politics
5. H.M.Sreevai, Constitutional Law of India, 4th edition in 3 volumes (Universal Law Publication)
6. J.C. Johari, Indian Government andPolitics Hans
7. J. Raj IndianGovernment and Politics
8. M.V. Pylee, Indian Constitution Durga Das Basu, Human Rights in Constitutional Law, Prentice – Hall of India Pvt. Ltd.. New Delhi
9. 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:

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

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B.Tech I Year II Semester

L	T	P	C
3	0	0	3

Linear algebra and Numerical Methods
(Common to ALL branches)

Course Objectives:

- To instruct the concept of Matrices in solving linear algebraic equations
- To elucidate the different numerical methods to solve nonlinear algebraic equations
- To disseminate the use of different numerical techniques for carrying out numerical integration.
- 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.

Unit I: Solving systems of linear equations, Eigen values and Eigen vectors: (10 hrs)

Rank of a matrix by echelon form and normal form- Gauss Jordan method to find inverse – Solving system of homogeneous and non-homogeneous equations linear equations — Eigen values and Eigen vectors and their properties.
Applications: Free vibration of a two-mass system.

Unit-II: Cayley-Hamilton theorem and Quadratic forms: (10 hrs)

Cayley-Hamilton theorem (without proof) – Finding inverse and power of a matrix by Cayley-Hamilton theorem – Reduction to Diagonal form – Quadratic forms and nature of the quadratic forms – Reduction of quadratic form to canonical forms by orthogonal transformation.

UNIT III: Iterative methods: (8 hrs)

Introduction – Algebraic transcendental equations: Bisection method – Secant method – Method of false position – Iteration method – Newton-Raphson method (One variable and simultaneous Equations)

Solving system of linear equations: Gauss elimination- Diagonal dominance- Jacobi and Gauss-Seidel methods– Necessary and sufficient condition for convergence(only statement)-Power Method for finding Largest Eigenvalue –Eigenvector.

UNIT IV: Interpolation: (10 hrs)

Introduction – Errors in polynomial interpolation – Finite differences – Forward differences – Backward differences – Central differences – Relations between operators – Newton’s forward

and backward formulae for interpolation – Interpolation with unequal intervals – Lagrange's interpolation formula – Newton's divide difference formula.

UNIT V: Numerical integration and solution of ordinary differential equations: (10 hrs)

Trapezoidal rule – Simpson's $1/3^{rd}$ and $3/8^{th}$ rule – Solution of ordinary differential equations by Taylor's series – Picard's method of successive approximations – Euler's method – Runge-Kutta method (second and fourth order) – Milne's Predictor and Corrector Method.

Course Outcomes:

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

- develop the use of matrix algebra techniques that is needed by engineers for practical applications
- solve system of linear algebraic equations using Gauss elimination, Gauss Jordan, Gauss Seidel
- evaluate approximating the roots of polynomial and transcendental equations by different algorithms
- apply Newton's forward & backward interpolation and Lagrange's formulae for equal and unequal intervals
- apply different algorithms for approximating the solutions of ordinary differential equations to its analytical computations

Text Books:

1. **M. K. Jain, S. R. K. Iyengar and R. K. Jain,** Numerical Methods for Scientific and Engineering Computation, New Age International Publications.
2. **B. S. Grewal,** Higher Engineering Mathematics, 43^{rd} Edition, Khanna Publishers.

Reference Books:

1. **B. V. Ramana,** Higher Engineering Mathematics, 2007 Edition, Tata Mc. Graw Hill Education.
2. **David Poole,** Linear Algebra- A modern introduction, 4^{th} Edition, Cengage.
3. **Steven C. Chapra,** Applied Numerical Methods with MATLAB for Engineering and Science, Tata Mc. Graw Hill Education.
4. **Lawrence Turyn,** Advanced Engineering Mathematics, CRC Press.

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B.Tech I Year II Semester

ENGINEERING PHYSICS

For Non-Circuital Branches (CE, ME & MET)

L	T	P	C
3	0	0	3

The designed curriculum introduces the fundamentals of elasticity, sensors, and mechanics of solids to CE, ME and MET students so as to acquaint them with the behavior of materials and develop a basic understanding of the advanced courses in their respective branches.

Course Objectives:

- **To demonstrate** the use of Newton's laws of motion for understanding the mechanics of a particle.
- **Tap** the simple harmonic motion and its adaptability for improved acoustic quality of concert halls-impart concepts of flaw detection techniques using ultrasonics.
- **Study** the structure – property relationship exhibited by solid materials within the elastic limit. **Impart** knowledge basic concepts of lasers and fibre optics along with its engineering applications
- **Familiarize** types of sensors for various engineering applications.
- **To impart** knowledge concerning the electrical behaviour of dielectric materials.
- To **demonstrate** the properties of magnets.

UNIT-I: Mechanics (**10hrs)**

Basic Laws of Vectors and Scalars - Rotational Frames - Conservative and Non – Conservative Forces - F = - grad V - Newton's Laws in Inertial and Linear Accelerating Non – Inertial Frames of Reference - Rotating Frame of Reference with Constant Angular Velocity - Harmonic Oscillator - Damped Harmonic Motion - Forced Oscillations and Resonance - Quality Factor - Mechanical and Electrical Oscillators.

UNIT-II: Acoustics and Ultrasonics (**9hrs)**

Acoustics: Reverberation - Reverberation Time - Sabine's Formula (Derivation using Growth and Decay Method) - Absorption Coefficient and its Determination - Factors Affecting Acoustics of Buildings and their Remedies.

Ultrasonics: Production of Ultrasonics by Magnetostriction and Piezoelectric Methods - Acoustic Grating - Non–Destructive Testing - Pulse Echo System through Transmission and Reflection Modes - Applications.

UNIT-III: Elasticity and Sensors (**10hrs)**

Elasticity: Stress - Strain - Hooke's Law - Stress – Strain Curve - Generalized Hooke's Law with and without Thermal Strains for Isotropic Materials - Different Types of Moduli and their Relations - Bending of Beams - Bending Moment of a Beam - Depression of Cantilever.

Sensors (Qualitative Description Only): Different Types of Sensors and Applications - Strain and Pressure Sensors - Piezoelectric, Magnetostrictive Sensors - Temperature Sensor - Bimetallic Strip - Fibre Optic Methods of Pressure Sensing - Pyroelectric Detectors.

UNIT-IV: Lasers and Fiber Optics (**9hrs)**

Lasers: Characteristics - Spontaneous and Stimulated Emission of Radiation - Einstein's Coefficients - Population Inversion - Pumping Mechanisms - Ruby Laser - Helium Neon Laser -Applications.

Fibre Optics: Total Internal Reflection - Acceptance Angle - Numerical Aperture - Classification of Fibers Based on Refractive Index Profile and Modes - Block Diagram of Fiber Optic Communication.

UNIT-V: Magnetic and Dielectric Materials (**10 hrs)**

Magnetic Materials: Introduction - Magnetic Dipole Moment - Magnetization - Magnetic Susceptibility and Permeability - Origin of Permanent Magnetic Moment - Classification of Magnetic Materials - Domain Concept of Ferromagnetism - Hysteresis - Soft and Hard Magnetic Materials.

Dielectric Materials: Introduction - Dielectric Polarization - Dielectric Polarizability - Susceptibility and Dielectric Constant - Electronic and Ionic Polarizations (Quantitative) - Orientation Polarization (Qualitative) - Lorentz Field - Claussius – Mossotti Equation - Frequency Dependence of polarization.

Course Outcomes:

The students will be able to

- **describe** the fundamental principles of acoustics with emphasis on physical mechanisms, law and relationships
- **assess** harmonic motion in undamped, damped and forced oscillations
- **apply** the concepts of strain, internal force, stress and equilibrium to deformation of solids
- **understand** the interaction of radiation with matter
- **explain** the principles of physics in dielectrics, magnetic materials and semiconductors useful to engineering applications
- **illustrate** the fibre optic methods of pressure sensing and **infer** the functioning of temperature sensors like bimetallic strip and pyroelectric detectors
- **outline** the basic principle and operation of different types of *sensors*

Text books:

1. M.N. Avadhanulu, P.G.Kshirsagar "A Text book of Engineering Physics", 11th ed., S. Chand Publications, 2019
2. S.O. Pillai, Solid State Physics 8th ed., New Age International, 2018

Reference Books:

1. D. Kleppner and Robert Kolenkow "An introduction to Mechanics– II" Cambridge University Press, 2015
2. A Textbook of Engineering Physics, Volume-I (For 1st Year of Anna University) By M.N. Avadhanulu & T.V.S. Arun Murthy S Chand
3. Ian R Sinclair, Sensor and Transducers 3rd eds, 2001, Elsevier (Newnes)

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
B.TECH (MECHANICAL ENGINEERING) - R19
EFFECTIVE FROM 2019-20 BATCH

		L	T	P	C
I Year II semester	**Basic Electrical And Electronics Engineering (Common for Civil,MEC,MET Engg.)**	**3**	**0**	**0**	**3**

Preamble:
This course covers the topics related to analysis of various electrical circuits, operation of various electrical machines and electronic components to perform well in their respective fields.

Course objectives:

- To learn the basic principles of electrical circuital law's and analysis of networks.
- To understand principle of operation and construction details of DC machines & Transformers.
- To understand principle of operation and construction details of alternator and 3-Phase induction motor.
- To study operation of PN junction diode, half wave, full wave rectifiers and OP-AMPs.
- To learn operation of PNP and NPN transistors and various amplifiers.

Unit - I
Electrical Circuits
Basic definitions – types of network elements – Ohm's Law – Kirchhoff's Laws – inductive networks – capacitive networks – series – parallel circuits – star-delta and delta-star transformations-Numerical Problems.

Unit - II
DC Machines
Principle of operation of DC generator – EMF equation – types of DC machines – torque equation – applications – three point starter – speed control methods of DC motor – Swinburne's Test-Numerical Problems.

Unit - III
AC Machines:
Transformers
Principle of operation and construction of single phase transformers – EMF equation – Losses – OC & SC tests – efficiency and regulation-Numerical Problems.

AC Rotating Machines
Principle of operation and construction of alternators – types of alternators –Regulation of alternator by synchronous impedance method- principle of operation of synchronous motor – principle of operation of 3-Phase induction motor – slip-torque characteristics – efficiency – applications-Numerical Problems.

Unit IV
Rectifiers and Linear ICs and Transistors
PN junction diodes – diode applications (half wave and bridge rectifiers).Characteristics of operation amplifiers (OP-AMP) – application of OP-AMPs (inverting, non-inverting, integrator and differentiator) - Numerical Problems.

Unit V
Transistors
PNP and NPN junction transistor, transistor as an amplifier – transistor amplifier – frequency response of CE amplifier – concepts of feedback amplifier-Numerical Problems.

Course Outcomes:

The student should be able to:

- Analyse various electrical networks.
- Understand operation of DC generators,3-point starter and DC machine testing by Swinburne's Test.
- Analyse performance of single-phase transformer.
- Explain operation of 3-phase alternator and 3-phase induction motors.
- Analyse operation of half wave, full wave bridge rectifiers and OP-AMPs and Explain single stage CE amplifier and concept of feedback amplifier.

Text Books:

1. Electrical Technology by Surinder Pal Bali, Pearson Publications.
2. Electronic Devices and Circuits by R.L. Boylestad and Louis Nashelsky, 9th edition, PEI/PHI 2006.

Reference Books:

1. Electrical Circuit Theory and Technology by John Bird, Routledge Taylor &Francis Group
2. Basic Electrical Engineering by M.S.Naidu and S.Kamakshiah, TMH Publications
3. Fundamentals of Electrical Engineering by Rajendra Prasad, PHI Publications,2nd edition
4. Basic Electrical Engineering by Nagsarkar, Sukhija, Oxford Publications,2nd edition
5. Industrial Electronics by G.K. Mittal, PHI.

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L	T	P	C
1	0	3	2.5

I Year B.Tech. – II Sem.

COMPUTER AIDED ENGINEERING DRAWING

Course Objective: To enhance the student's knowledge and skills in engineering drawing and to introduce drafting packages and commands for computer aided drawing and modeling.

UNIT-I:

Objective: The knowledge of projections of solids is essential in 3D modeling and animation. The student will be able to draw projections of solids. The objective is to enhance the skills they already acquired in their earlier course in drawing of projection.

PROJECTIONS OF SOLIDS: Projections of Regular Solids inclined to both planes – Auxiliary Views.

UNIT-II:

The knowledge of sections of solids and development of surfaces is required in designing and manufacturing of the objects. Whenever two or more solids combine, a definite curve is seen at their intersection.

SECTIONS OF SOLIDS: Sections and Sectional views of Right Regular Solids – Prism, Cylinder, Pyramid, Cone – Auxiliary views.

DEVELOPMENT AND INTERPENETRATION OF SOLIDS: Development of Surfaces of Right Regular Solids – Prism, Cylinder, Pyramid, Cone and their parts.

UNIT-III:

The intersection of solids also plays an important role in designing and manufacturing. The objective is to impart this knowledge through this topic. A perspective view provides a realistic 3D View of an object. The objective is to make the students learn the methods of Iso and Perspective views.

INTERPENETRATION OF RIGHT REGULAR SOLIDS: Intersection of Cylinder Vs Cylinder, Cylinder Vs Prism, Cylinder Vs Cone, Prism Vs Cone.

PERSPECTIVE PROJECTIONS: Perspective View: Points, Lines, Plane Figures and Simple Solids, Vanishing Point Methods (General Method only).

In part B computer aided drafting is introduced.

UNIT IV:

The objective is to introduce various commands in AutoCAD to draw the geometric entities and to create 2D and 3D wire frame models.

INTRODUCTION TO COMPUTER AIDED DRAFTING: Generation of points, lines, curves, polygons, dimensioning. Types of modeling : object selection commands – edit, zoom, cross hatching, pattern filling, utility commands, 2D wire frame modeling, 3D wire frame modeling,.

UNIT V:

By going through this topic the student will be able to understand the paper-space environment thoroughly.

VIEW POINTS AND VIEW PORTS: view point coordinates and view(s) displayed, examples to exercise different options like save, restore, delete , joint , single option.

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UNIT VI:

The objective is to make the students create geometrical model of simple solids and machine parts and display the same as an Isometric, Orthographic or Perspective projection.

COMPUTER AIDED SOLID MODELING: Isometric projections, orthographic projections of isometric projections, Modeling of simple solids, Modeling of Machines & Machine Parts.

TEXT BOOKS :

1. Engineering drawing by N.D Bhatt , Charotar publications.
2. Engineering Graphics, K.C. john, PHI Publications

REFERENCES:

1. Mastering Auto CAD 2013 and Auto CAD LT 2013 – George Omura, Sybex
2. Auto CAD 2013 fundamentals- Elisemoss, SDC Publ.
3. Engineering Drawing and Graphics using Auto Cad – T Jeyapoovan, vikas
4. Engineering Drawing + AutoCAD – K Venugopal, V. Prabhu Raja, New Age
5. Engineering Drawing – RK Dhawan, S Chand
6. Engineering Drawing – MB Shaw, BC Rana, Pearson
7. Engineering Drawing – KL Narayana, P Kannaiah, Scitech
8. Engineering Drawing – Agarwal and Agarwal, Mc Graw Hill
9. Engineering Graphics – PI Varghese, Mc Graw Hill
10. Text book of Engineering Drawing with auto-CAD , K.venkata reddy/B.S . publications.
11. Engineering Drawing with Auto CAD/ James D Bethune/Pearson Publications
12. Engineering Graphics with Auto CAD/Kulkarni D.M, Rastogi A.P, Sarkar A.K/PHI Publications

End Semester examination shall be conducted for **Four** hours with the following pattern:

a) Two hours-Conventional drawing
b) Two hours – Computer Aided Drawing

Course outcomes:

From this course the student is expected to learn
CO1: The concepts of sections and developments of solids
CO2: The formation of layers during intersection of different types of regular solids.
CO3: Basics in AUTO CAD
CO4: To draw the 2D and 3D objects using AUTO CAD

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L	T	P	C
3	0	0	3

I Year B.Tech. – II Sem.

ENIGINEERING MECHANICS

Objectives: The students completing this course are expected to understand the concepts of forces and its resolution in different planes, resultant of force system, Forces acting on a body, their free body diagrams using graphical methods. They are required to understand the concepts of centre of gravity and moments of inertia and their application, Analysis of frames and trusses, different types of motion, friction and application of work - energy method.

UNIT – I

Introduction to Engg. Mechanics – Basic Concepts.

Systems of Forces: Coplanar Concurrent Forces – Components in Space – Resultant – Moment of Force and its Application – Couples and Resultant of Force Systems.

Friction: Introduction**,** limiting friction and impending motion, coulomb's laws of dry friction, coefficient of friction, cone of friction

UNIT II

Equilibrium of Systems of Forces: Free Body Diagrams, , Lami's Theorm, Equations of Equilibrium of Coplanar Systems, Graphical method for the equilibrium, Triangle law of forces, converse of the law of polygon of forces condition of equilibrium, Equations of Equilibrium for Spatial System of forces, Numerical examples on spatial system of forces using vector approach, Analysis of plane trusses.

UNIT – III

Centroid: Centroids of simple figures (from basic principles) – Centroids of Composite Figures

Centre of Gravity: Centre of gravity of simple body (from basic principles), centre of gravity of composite bodies, Pappus theorems.

Area moments of Inertia: Definition – Polar Moment of Inertia, Transfer Theorem, Moments of Inertia of Composite Figures, Products of Inertia, Transfer Formula for Product of Inertia. **Mass Moment of Inertia:** Moment of Inertia of Masses, Transfer Formula for Mass Moments of Inertia, mass moment of inertia of composite bodies.

UNIT – IV

Rectilinear and Curvilinear motion of a particle: Kinematics and Kinetics- D'Alembert's Principle, Work Energy method and applications to particle motion- Impulse momentum method.

UNIT – V

Rigid body Motion: Kinematics and kinetics of translation, Rotation about fixed axis and plane motion, Work Energy method and Impulse momentum method.

TEXT BOOK:

1. Engg. Mechanics - S.Timoshenko & D.H.Young., 4th Edn - , Mc Graw Hill publications.

REFERENCES:

1. Engineering Mechanics statics and dynamics – R.C.Hibbeler, 11th Edn – Pearson Publ.
2. Engineering Mechanics , statics – J.L.Meriam, 6th Edn – Wiley India Pvt Ltd.
3. Engineering Mechanics , dynamics – J.L.Meriam, 6th Edn – Wiley India Pvt Ltd.
4. Engineering Mechanics , statics and dynamics – I.H.Shames, – Pearson Publ.
5. Mechanics For Engineers , statics - F.P.Beer & E.R.Johnston – 5th Edn Mc Graw Hill Publ.
6. Mechanics For Engineers, dynamics - F.P.Beer & E.R.Johnston –5th Edn Mc Graw Hill Publ.
7. Theory & Problems of engineering mechanics, statics & dynamics – E.W.Nelson, C.L.Best & W.G. McLean, 5th Edn – Schaum's outline series - Mc Graw Hill Publ.
8. Engineering Mechanics , Fedinand . L. Singer , Harper – Collins.
9. Engineering Mechanics statics and dynamics , A Nelson , Mc Graw Hill publications
10. Engineering Mechanics, Tayal. Umesh Publ.

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Course outcomes:

CO1. To Learn the principles (Axioms) of statics, able to find resultant & resolution of system of forces and resultant force.

CO2. Explore the concepts of constraints, free body diagram and action-reaction.

CO3. Estimate the geometric parameters like centroid, center of gravity and moment of inertia and identify their application.

CO4. Learn the analysis of frames and trusses and know the importance of friction.

CO5. Able to determine solution to dynamic problems through D'Alembert equilibrium equations, Impulse-Momentum and work– energy method

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English Communicative Skills Lab-II
(Common to all Branches)

UNIT I:

Pronunciation: Contrastive stress (Homograph)

Oral Activity: Telephone Etiquette

UNIT II:

Pronunciation: Word stress – Weak and Strong forms

Oral Activity :Role plays

UNIT III:

Pronunciation: Phonetics Transcription Oral Activity :Data Interpretation, Oral presentation skills

Oral Activity: Oral presentation Skills

UNIT IV:

Pronunciation: Connected speech (Pausing ,Tempo, Tone, Fluency ,etc..)

Oral Activity: Public Speaking ,Poster Presentation

UNIT V:

Pronunciation: Stress in compound words ,Rhythm and Intonation

Oral Activity: Group discussions: Do's and Don'ts –Types ,Modalities

Interview Skills: Preparatory Techniques, Frequently asked questions, Mock Interviews.

References:

1. Exercises in Spoken English Part 1,2,3,4, OUP and CIEFL.
2. English Pronunciation in use- Mark Hancock, Cambridge University Press.
3. English Phonetics and Phonology-Peter Roach, Cambridge University Press.
4. English Pronunciation in use- Mark Hewings, Cambridge University Press.
5. English Pronunciation Dictionary- Daniel Jones, Cambridge University Press.
6. English Phonetics for Indian Students- P. Bala Subramanian, Mac Millan Publications.
7. Technical Communication- Meenakshi Raman, Sangeeta Sharma, Oxford University Press.
8. Technical Communication- Gajendrea Singh Chauhan, Smita Kashiramka, Cengage Publications.

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B.Tech I Year II Semester

ENGINEERING PHYSICS LAB

(Any 10 of the following listed 15 experiments)

L	T	P	C
0	0	3	1.5

LIST OF EXPERIMENTS:

1. V-I Characteristics of a PN junction diode
2. Rigidity modulus of a material - Torsional Pendulum
3. LCR- series resonance circuit
4. Young's modulus of the given material bar by uniform bending – Pin and Microscope method
5. Sonometer
6. Wavelength of Laser by diffraction grating
7. V-I Characteristics of a Zener junction diode
8. Magnetic field along the axis of a current carrying coil – Stewart and Gee's apparatus
9. Dielectric Constant of different materials
10. RC circuit – time constant
11. Acceleration due to Gravity and Radius of Gyration - Compound Pendulum.
12. B-H curve
13. Magnetic susceptibility by Gouy's method
14. Velocity of ultrasonics - Acoustic Grating
15. Pressure variation with strain- strain Gauge sensor

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I Year II Semester	**BASIC ELECTRICAL & ELECTRONICS ENGINEERING LAB (Common for Civil,MEC,MET Engg.)**	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**

Course objectives:

- To predetermine the efficiency of dc shunt machine using Swinburne's test.
- To predetermine the efficiency and regulation of 1-phase transformer with O.C and S.C tests.
- To obtain performance characteristics of DC shunt motor &3-phase induction motor.
- To find out regulation of an alternator with synchronous impedance method.
- To control speed of dc shunt motor using Armature voltage and Field flux control methods.
- To find out the characteristics of PN junction diode & transistor
- To determine the ripple factor of half wave & full wave rectifiers.

Section A: Electrical Engineering:

The following experiments are required to be conducted as compulsory experiments:

1. Swinburne's test on D.C. Shunt machine (predetermination of efficiency of a given D.C. shunt machine working as motor and generator).
2. OC and SC tests on single phase transformer (predetermination of efficiency and regulation at given power factors).
3. Brake test on 3-phase Induction motor (determination of performance characteristics)
4. Regulation of alternator by Synchronous impedance method.
5. Speed control of D.C. Shunt motor by
   a) Armature Voltage control b) Field flux control method
6. Brake test on D.C. Shunt Motor.

Section B: Electronics Engineering:

The following experiments are required to be conducted as compulsory experiments:

1.PN junction diode characteristics a) Forward bias b) Reverse bias (Cut in voltage and resistance calculations)

2. Transistor CE characteristics (input and output)

3. Half wave rectifier with and without filters.

4. Full wave rectifier with and without filters.

5. CE amplifiers.

6. OP- amp applications (inverting, non inverting, integrator and differentiator)

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Course Outcomes:

The student should be able to:

- Compute the efficiency of DC shunt machine without actual loading of the machine.
- Estimate the efficiency and regulation at different load conditions and power factors for single phase transformer with OC and SC tests.
- Analyse the performance characteristics and to determine efficiency of DC shunt motor & 3-Phase induction motor.
- Pre-determine the regulation of an alternator by synchronous impedance method.
- Control the speed of dc shunt motor using Armature voltage and Field flux control methods.
- Draw the characteristics of PN junction diode & transistor
- Determine the ripple factor of half wave & full wave rectifiers.

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B.Tech I Year II Semester

L	T	P	C
3	0	0	0

Professional Ethics & Human Values

(Common to All Branches)

Course Objectives:

- To create an awareness on Engineering Ethics and Human Values.
- To instill Moral and Social Values and Loyalty
- To appreciate the rights of others.
- To create awareness on assessment of safety and risk

Unit I: Human Values:

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

Unit II: Engineering Ethics:

Senses of 'Engineering Ethics-Variety of moral issued –Types of inquiry –Moral dilemmas –Moral autonomy –Kohlberg's theory-Gilligan's theory-Consensus and controversy –Models of professional roles-Theories about right action-Self-interest -Customs and religion –Uses of Ethical theories –Valuing time –Cooperation –Commitment.

Unit III: Engineering as Social Experimentation

Engineering As Social Experimentation –Framing the problem –Determining the facts –Codes of Ethics – Clarifying Concepts –Application issues –Common Ground -General Principles –Utilitarian thinking respect for persons

UNIT IV: Engineers Responsibility for Safety and Risk:

Safety and risk –Assessment of safety and risk –Risk benefit analysis and reducing risk-Safety and the Engineer-Designing for the safety-Intellectual Property rights (IPR).

UINIT V: Global Issues

Globalization –Cross-culture issues-Environmental Ethics –Computer Ethics-Computers as the instrument of Unethical behavior –Computers as the object of Unethical acts –Autonomous-Computers-Computer codes of Ethics –Weapons Development -Ethics and Research –Analyzing Ethical Problems in research.

Course outcomes:

Students will be able to:

- Identify and analyze an ethical issue in the subject matter under investigation or in a relevant field
- Identify the multiple ethical interests at stake in a real-world situation or practice
- Articulate what makes a particular course of action ethically defensible
- Assess their own ethical values and the social context of problems
- Identify ethical concerns in research and intellectual contexts, including academic integrity, use and citation of sources, the objective presentation of data, and the treatment of human subjects
- Demonstrate knowledge of ethical values in non-classroom activities, such as service learning, internships, and field work

- Integrate, synthesize, and apply knowledge of ethical dilemmas and resolutions in academic settings, including focused and interdisciplinary research.

Books:

1. "Engineering Ethics includes Human Values" by M.Govindarajan, S.Natarajan and, V.S.SenthilKumar-PHI Learning Pvt. Ltd-2009
2. "Engineering Ethics" by Harris, Pritchard and Rabins, CENGAGE Learning, India Edition, 2009.
3. "Ethics in Engineering" by Mike W. Martin and Roland Schinzinger –Tata McGraw-Hill–2003.
4. "Professional Ethics and Morals" by Prof.A.R.Aryasri, DharanikotaSuyodhana-Maruthi Publications.
5. "Professional Ethics and Human Values" by A.Alavudeen, R.Kalil Rahman and M. Jayakumaran-LaxmiPublications.
6. "Professional Ethics and Human Values" by Prof.D.R.Kiran-
7. "Indian Culture, Values and Professional Ethics" by PSR Murthy-BS Publication

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B.Tech II Year I Semester

L	T	P	C
3	0	0	3

MANAGERIAL ECONOMICS AND FINANCIAL ANALYSIS
(Common to all Branches)

Course Objectives:

- The Learning objectives of this paper is to understand the concept and nature of Managerial Economics and its relationship with other disciplines and also to understand the Concept of Demand and Demand forecasting, Production function, Input Output relationship, Cost-Output relationship and Cost-Volume-Profit Analysis.
- To understand the nature of markets, Methods of Pricing in the different market structures and to know the different forms of Business organization and the concept of Business Cycles.
- To learn different Accounting Systems, preparation of Financial Statement and uses of different tools for performance evaluation. Finally, it is also to understand the concept of Capital, Capital Budgeting and the techniques used to evaluate Capital Budgeting proposals.

Unit-I

Introduction to Managerial Economics and demand Analysis:

Definition of Managerial Economics –Scope of Managerial Economics and its relationship with other subjects –Concept of Demand, Types of Demand, Determinants of Demand- Demand schedule, Demand curve, Law of Demand and its limitations- Elasticity of Demand, Types of Elasticity of Demand and Measurement- Demand forecasting and Methods of forecasting, Concept of Supply and Law of Supply.

Unit – II:

Theories of Production and Cost Analyses:

Theories of Production function- Law of Variable proportions-Isoquants and Isocosts and choice of least cost factor combination-Concepts of Returns to scale and Economies of scale-Different cost concepts: opportunity costs, explicit and implicit costs-Fixed costs, Variable Costs and Total costs – Cost –Volume-Profit analysis-Determination of Breakeven point(problems)-Managerial significance and limitations of Breakeven point.

Unit – III:

Introduction to Markets, Theories of the Firm & Pricing Policies:

Market Structures: Perfect Competition, Monopoly, Monopolistic competition and Oligopoly – Features – Price and Output Determination – Managerial Theories of firm: Marris and Williamson's models – other Methods of Pricing: Business Cycles: Meaning and Features – Phases of a Business

Cycle. Features and Evaluation of Sole Trader, Partnership, Joint Stock Company – State/Public Enterprises and their forms.

Unit – IV:

Introduction to Accounting & Financing Analysis:

Introduction to Double Entry System, Journal, Ledger, Trail Balance and Preparation of Final Accounts with adjustments – Preparation of Financial Statements-Analysis and Interpretation of Financial Statements-Ratio Analysis – Preparation of Funds flow and cash flow analysis (Problems)

Unit – V:

Capital and Capital Budgeting: Capital Budgeting: Meaning of Capital-Capitalization-Meaning of Capital Budgeting-Time value of money- Methods of appraising Project profitability: Traditional Methods(pay back period, accounting rate of return) and modern methods(Discounted cash flow method, Net Present Value method, Internal Rate of Return Method and Profitability Index)

Course Outcomes:

- The Learner is equipped with the knowledge of estimating the Demand and demand elasticities for a product and the knowledge of understanding of the Input-Output-Cost relationships and estimation of the least cost combination of inputs.
- One is also ready to understand the nature of different markets and Price Output determination under various market conditions and also to have the knowledge of different Business Units.
- The Learner is able to prepare Financial Statements and the usage of various Accounting tools for Analysis and to evaluate various investment project proposals with the help of capital budgeting techniques for decision making.

TEXT BOOKS:

1. Prof.J.V.Prabhakara Rao & Prof.P.Venkata Rao Maruthi Publications
2. S.A.Siddiqui & A.S.Siddiqui New Age International Publishers

REFERENCES:

1. Varshney R.L, K.L Maheswari, Managerial Economics, S. Chand & Company Ltd,
2. JL Pappas and EF Brigham, Managerial Economics, Holt, R & W; New edition edition
3. N.P Srinivasn and M. SakthivelMurugan, Accounting for Management, S. Chand & Company Ltd,

4. Maheswari S.N, An Introduction to Accountancy, Vikas Publishing House Pvt Ltd
5. I.M Pandey, Financial Management , Vikas Publishing House Pvt Ltd
6. V. Maheswari, Managerial Economics, S. Chand & Company Ltd

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B.Tech II Year - I Semester

L	T	P	C
3	0	0	3

Vector Calculus, Transforms and PDE

(Common to ECE, EEE of I B.Tech - II Semester & Civil, ME, MET of II B.Tech - I Semester)

Course Objectives:

- To familiarize the techniques in partial differential equations
- To furnish the learners with basic concepts and techniques at plus two level to lead them into advanced level by handling various real world applications.

Unit –I: Vector calculus: (10 hrs)

Vector Differentiation: Gradient – Directional derivative – Divergence – Curl – Scalar Potential.

Vector Integration: Line integral – Work done – Area – Surface and volume integrals – Vector integral theorems: Greens, Stokes and Gauss Divergence theorems (without proof).

Unit –II: Laplace Transforms: (10 hrs)

Laplace transforms of standard functions – Shifting theorems – Transforms of derivatives and integrals – Unit step function – Dirac's delta function – Inverse Laplace transforms – Convolution theorem (with out proof).

Applications: Solving ordinary differential equations (initial value problems) and integro differential equations using Laplace transforms.

Unit –III: Fourier series and Fourier Transforms: (10 hrs)

Fourier Series: Introduction – Periodic functions – Fourier series of periodic function – Dirichlet's conditions – Even and odd functions – Change of interval – Half-range sine and cosine series.

Fourier Transforms: Fourier integral theorem (without proof) – Fourier sine and cosine integrals – Sine and cosine transforms – Properties – inverse transforms – Finite Fourier transforms.

Unit –IV: PDE of first order: **(8 hrs)**

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Solutions of first order linear (Lagrange) equation and nonlinear (standard types) equations.

UNIT V: Second order PDE and Applications: (10 hrs)

Second order PDE: Solutions of linear partial differential equations with constant coefficients – RHS term of the type $e^{ax+by}, \sin(ax+by), \cos(ax+by), x^m y^n$.

Applications of PDE: Method of separation of Variables – Solution of One dimensional Wave, Heat and two-dimensional Laplace equation.

Course Outcomes:

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

- interpret the physical meaning of different operators such as gradient, curl and divergence
- estimate the work done against a field, circulation and flux using vector calculus
- apply the Laplace transform for solving differential equations
- find or compute the Fourier series of periodic signals
- know and be able to apply integral expressions for the forwards and inverse Fourier transform to a range of non-periodic waveforms
- identify solution methods for partial differential equations that model physical processes

Text Books:

1. **B. S. Grewal,** Higher Engineering Mathematics, 43rd Edition, Khanna Publishers.
2. **Erwin Kreyszig,** Advanced Engineering Mathematics, 10th Edition, Wiley-India.

Reference Books:

1. **B. V. Ramana,** Higher Engineering Mathematics, 2007 Edition, Tata Mc. Graw Hill Education.
2. **Dean. G. Duffy,** Advanced Engineering Mathematics with MATLAB, 3rd Edition, CRC Press.
3. **Peter O' Neil,** Advanced Engineering Mathematics, Cengage.
4. **Srimantha Pal, S C Bhunia,** Engineering Mathematics, Oxford University Press.

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L	T	P	C
3	0	0	3

II Year B.Tech. – I Sem.

MECHANICS OF SOLIDS

Course Objective: The students completing this course are expected to understand the basic terms like stress, strain, poissons ratio…etc and different stresses induced in beams, thin cylinders, thick cylinders, and columns. Further, the student shall be able to understand the shear stresses in circular shafts.

UNIT – I

SIMPLE STRESSES & STRAINS : Elasticity and plasticity – Types of stresses & strains–Hooke's law – stress – strain diagram for mild steel – Working stress – Factor of safety – Lateral strain, Poisson's ratio & volumetric strain – Bars of varying section – composite bars – Temperature stresses- Complex Stresses - Stresses on an inclined plane under different uniaxial and biaxial stress conditions - Principal planes and principal stresses - Mohr's circle - Relation between elastic constants, Strain energy – Resilience – Gradual, sudden, impact and shock loadings.

UNIT – II

SHEAR FORCE AND BENDING MOMENT : Definition of beam – Types of beams – Concept of shear force and bending moment – S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, u.d.l, 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 bending stresses – section modulus of rectangular and circular sections (Solid and Hollow), I,T, Angle and Channel sections – Design of simple beam sections.

SHEAR STRESSES: Derivation of formula – Shear stress distribution across various beams sections like rectangular, circular, triangular, I, T angle sections.

UNIT – IV

DEFLECTION OF BEAMS : Bending into a circular arc – slope, deflection and radius of curvature – Differential equation for the elastic line of a beam – Double integration and Macaulay's methods – Determination of slope and deflection for cantilever and simply supported beams subjected to point loads, - U.D.L uniformly varying load. Mohr's theorems – Moment area method – application to simple cases including overhanging beams, Statically indeterminate Beams and solution methods.

TORSION: Introduction-Derivation- Torsion of Circular shafts- Pure Shear-Transmission of power by circular shafts, Shafts in series, Shafts in parallel.

UNIT – V

THIN AND THICK CYLINDERS: Thin seamless cylindrical shells – Derivation of formula for longitudinal and circumferential stresses – hoop, longitudinal and Volumetric strains – changes in dia, and volume of thin cylinders – Riveted boiler shells – Thin spherical shells. Wire wound thin cylinders. Lame's equation – cylinders subjected to inside & outside pressures –compound cylinders.

COLUMNS:

Buckling and Stability, Columns with Pinned ends, Columns with other support Conditions, Limitations of Euler's Formula, Rankine's Formula,

TEXT BOOK:

1. Strength of materials /GH Ryder/ Mc Millan publishers India Ltd
2. Mechanics of materials by Gere & Timeshenko

REFERENCES :

1. Strength of Materials -By Jindal, Umesh Publications.
2. Analysis of structures by Vazirani and Ratwani- Khanna Publishers
3. Mechanics of Structures Vol-III, by S.B.Junnarkar- Charotar Publishing House
4. Strength of Materials by S.Timshenko- D. VAN NOSTRAND Company- PHI Publishers
5. Strength of Materials by Andrew Pytel and Ferdinond L. Singer Longman- Harpercollins College Division
6. Solid Mechanics, by Popov-
7. Mechanics of Materials/Gere and Timoshenko, CBS Publishers

Course outcomes:

On the completion of the course the student will able to

CO1: Model & Analyze the behavior of basic structural members subjected to various loading and support conditions based on principles of equilibrium.

CO2: Understand the apply the concept of stress and strain to analyze and design structural members and machine parts under axial, shear and bending loads, moment and torsional moment.

CO3: Students will learn all the methods to analyze beams, columns, frames for normal, shear, and torsion stresses and to solve deflection problems in preparation for the design of such structural components. Students are able to analyse beams and draw correct and complete shear and bending moment diagrams for beams.

CO4: Students attain a deeper understanding of the loads, stresses, and strains acting on a structure and their relations in the elastic behavior

CO5: Design and analysis of Industrial components like pressure vessels.

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EFFECTIVE FROM 2019-20 BATCH

L	T	P	C
3	0	0	3

II Year B.Tech. – I Sem.

METALLURGY & MATERIAL SCIENCE

Course Objective: To understand the basic fundamentals of Material science and Physical metallurgy. The basic concepts to be taught will help for the improvement, proper selection and effective utilization of materials which is essential to satisfy the ever increasing demands of the society.

UNIT – I

Structure of Metals and Constitution of alloys: Bonds in Solids, Metallic bond, crystallization of metals, Packing Factor for cubic structures - SC, BCC, FCC-line density, plane density. Grain and grain boundaries, effect of grain boundaries on the properties of metal / alloys – determination of grain size. Imperfections – point, line, Surface and volume. Slip and Twinning.
Necessity of alloying, types of solid solutions, Hume Rotherys rules, intermediate alloy phases, and electron compounds
Equilibrium Diagrams : Experimental methods of construction of equilibrium diagrams, Isomorphous alloy systems, equilibrium cooling and heating of alloys, Lever rule, coring miscibility gaps, eutectic systems, congruent melting intermediate phases, peritectic reaction. Transformations in the solid state – allotropy, eutectoid, peritectoid reactions, phase rule, relationship between equilibrium diagrams and properties of alloys. Study of important binary phase diagrams of Cu-Ni and Fe-Fe_3C.

UNIT –II

Cast Irons and Steels: Structure and properties of White Cast iron, Malleable Cast iron, grey cast iron, Spheriodal graphite cast iron, Alloy cast irons. Classification of steels, structure and properties of plain carbon steels, Low alloy steels, Hadfield manganese steels, tool and die steels.

UNIT – III

Non-ferrous Metals and Alloys: Structure and properties of Copper and its alloys, Aluminium and its alloys, Titanium and its alloys, Magnesium and its alloys, Super alloys.
Heat treatment of Alloys: Effect of alloying elements on Fe-Fe_3C system, Annealing, normalizing, hardening, TTT diagrams, tempering, hardenability, surface - hardening methods, Age hardening treatment, Cryogenic treatment of alloys.

UNIT – IV

Powder Metallurgy: Basic processes- Methods of producing metal powders- milling atomization-Granulation-Reduction-Electrolytic Deposition. Compacting methods – Sintering - Methods of manufacturing sintered parts. Sintering Secondary operations-Sizing, coining, machining -Factors determining the use of powder metallurgy-Application of this process.

UNIT – V

Ceramic and composite materials: Crystalline ceramics, glasses, cermets, abrasive materials,
Classification of composites, various methods of component manufacture of composites, particle – reinforced materials, fiber reinforced materials, metal ceramic mixtures, metal – matrix composites and C – C composites. Nanomaterials – definition, properties and applications.

TEXT BOOKS:

1. Introduction to Physical Metallurgy - Sidney H. Avener - McGrawHill
2. Essential of Materials science and engineering - Donald R.Askeland - Cengage.

REFERENCES :

1. Material Science and Metallurgy – Dr. V.D.kodgire- Everest Publishing House
2. Materials Science and engineering - Callister & Baalasubrahmanyam- Wiley Publications
3. Material Science for Engineering students – Fischer – Elsevier Publishers
4. Material science and Engineering - V. Rahghavan-PHI Publishers
5. Introduction to Material Science and Engineering – Yip-Wah Chung CRC Press
6. Material Science and Metallurgy – A V K Suryanarayana – B S Publications
7. Material Science and Metallurgy – U. C. Jindal – Pearson Publications

Course Outcome: The student will be able to analyse the basic fundamentals of metals, alloys, stability of phases, various heat treatment and strengthening processes, properties and applications of ferrous metals, non ferrous metals and ceramics.

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L	T	P	C
3	0	0	3

II Year B.Tech. – I Sem.

PRODUCTION TECHNOLOGY

Course Objective:

To impart basic knowledge and understanding about the primary manufacturing processes such as casting, joining, bulk forming, sheet metal forming and powder metallurgy and their relevance in current manufacturing industry.

UNIT – I

CASTING : Steps involved in making a casting – Advantage of casting and its applications. Patterns and Pattern making – Types of patterns – Materials used for patterns, pattern allowances and their construction, Molding – ingredients of molding – molding methods. Molding materials, Properties of molding sand, Testing of molding sand. Types of molding – hand molding – Machine molding. Core – different types of cores – materials – properties of core sand – core manufacturing.

UNIT – II

Principles of Gating, Gating ratio and design of Gating systems. Risers – Types, function and design, casting design considerations. Methods of melting and types of furnaces - cupola, electric arc, resistance and induction furnace. Solidification of castings, Solidification of pure metals and alloys, short & long freezing range alloys. Fettling. Casting defects. Basic principles and applications of special casting processes - Centrifugal casting – True, semi and centrifuging. Die casting and Investment casting.

UNIT – III

Welding : 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, power characteristics, Manual metal arc welding, Submerged arc welding, TIG & MIG welding. Electro – slag welding.

Resistance welding, Friction welding, Friction stir welding, Forge welding, Explosive welding; Thermit welding, Plasma Arc welding, Laser welding, electron beam welding, Soldering & Brazing.

Heat affected zones in welding; pre & post heating, Weldability of metals, welding defects – causes and remedies – destructive and nondestructive testing of welds.

UNIT – IV

Plastic deformation in metals and alloys, recovery, recrystallization and grain growth. Hot working and Cold working, Strain hardening and Annealing. Bulk forming processes: Forging - Types of Forging, Smith forging, Drop Forging, Roll forging, Forging hammers, Rotary forging, forging defects; Rolling – fundamentals, types of rolling mills and products, Forces in rolling and power requirements. Extrusion and its characteristics. Types of extrusion, Impact extrusion, Hydrostatic extrusion; Wire drawing and Tube drawing.

UNIT – V

Sheet metal forming - Blanking and piercing, Forces and power requirement in these operations, Deep drawing, Stretch forming, Bending, Springback and its remedies, Coining, Spinning, Types of presses and press tools.

High energy rate forming processes: Principles of explosive forming, electromagnetic forming, Electro hydraulic forming, rubber pad forming, advangates and limitations.

TEXT BOOKS:

1. Manufacturing Processes for Engineering Materials - Kalpakjain S and Steven R Schmid- Pearson Publ , 5th Edn.
2. Manufacturing Technology -Vol I- P.N. Rao- TMH

REFERENCES :

1. Manufacturing Science – A.Ghosh & A.K.Malik – East West Press Pvt. Ltd
2. Process and materials of manufacture- Lindberg- PHI
3. Production Technology- R.K. Jain- Khanna
4. Production Technology-P C Sharma-S. Chand
5. Manufacturing Processes- H.S. Shaun- Pearson
6. Manufacturing Processes- J.P. Kaushish- PHI
7. Workshop Technology -WAJ Chapman/CBS Publishers&Distributors Pvt.Ltd.
8. Production Technology-HMT- Tata McGrawHill

Course Outcomes:

CO1: Able to design the patterns and core boxes for metal casting processes
CO2: Able to design the gating system for different metallic components
CO3: Know the different types of manufacturing processes
CO4: Be able to use forging, extrusion processes
CO5: Learn about the different types of welding processes used for special fabrication.

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L	T	P	C
3	0	0	3

II Year B.Tech. – I Sem.

THERMODYNAMICS

Course Objectives:

To impart the knowledge of the thermodynamic laws and principles so as to enable the student to prepare an energy audit of any mechanical system that exchange heat and work with the surroundings.

UNIT – I

Introduction: Basic Concepts : System, boundary, Surrounding, control volume, Universe, Types of Systems, Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic Equilibrium, State, Property, Process - Reversible, Quasi static & Irreversible Processes, cycle, Causes of Irreversibility. Energy in State and in Transition - Types, Work and Heat, Point and Path function.

Zeroth Law of Thermodynamics – Concept of Temperature – Principles of Thermometry –Reference Points – Const. Volume gas Thermometer – Scales of Temperature, Ideal Gas Scale.

UNIT – II

Joule's Experiments – First law of Thermodynamics – Corollaries – First law applied to a Process – applied to a flow system – Steady Flow Energy Equation. Energy balance for closed systems-Specific heats- Internal energy, Enthalpy and Specific heats of Ideal gases- Internal energy, Enthalpy and Specific heats of Solids and liquids

Conservation of mass- Flow work and Energy of a flowing fluid- Energy analysis of steady flow systems- Some steady flow engineering devices, PMM-I.

UNIT III

Limitations of the First Law – Thermal Reservoir, Heat Engine, Heat pump, Parameters of performance, Second Law of Thermodynamics, Kelvin-Planck and Clausius Statements and their Equivalence, Corollaries, PMM of Second kind, Carnot cycle and its specialties, Carnot's theorem, Thermodynamic scale of Temperature.

Clausius Inequality, Entropy, Principle of Entropy Increase – Energy Equation, Availability and Irreversibility – Thermodynamic Potentials, Gibbs and Helmholtz Functions, Maxwell Relations – Elementary Treatment of the Third Law of Thermodynamics.

UNIT IV

Pure Substances, P-V-T- surfaces, T-S and h-s diagrams, Mollier Charts, Phase Transformations – Triple point and critical point, properties during change of phase, Dryness Fraction – Clausius – Clapeyron Equation, Property tables. Various Thermodynamic processes and energy Transfer – Steam Calorimetry.

Ideal Gas equation of state- Compressibility factor- Van der waals equation of state- Beattie-Bridgeman equation of state- Benedict-Webb-Rubin equation of state- Viral equation of state- compressibility charts – variable specific heats – gas tables.

UNIT – V

Mixtures of perfect Gases – Dalton's Law of partial pressure, Avogadro's Laws of additive volumes-Equivalent Gas constant and Molecular Internal Energy, Enthalpy, sp. Heats and Entropy of Mixture of perfect Gases and Vapour.

Atmospheric air - Psychrometric Properties – Dry bulb Temperature, Wet Bulb Temperature, Dew point Temperature, Thermodynamic Wet Bulb Temperature, Specific Humidity, Relative Humidity, saturated Air, Vapour pressure, Degree of saturation – Adiabatic Saturation , Carrier's Equation – Psychrometric chart.

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TEXT BOOKS:

1. Engineering Thermodynamics, PK Nag 6th Edn , McGraw Hill.
2. Fundamentals of Thermodynamics – Sonntag, Borgnakke, Van Wylen, 6th Edn, Wiley

REFERENCES:

1. Engineering Thermodynamics – Jones & Dugan PHI
2. Thermodynamics, an Engineering Approach, Yunus A Cenegel, Michael A Boles, 8th Edn in SI Units, McGraw Hill.
3. Thermodynamics – J.P.Holman , McGrawHill
4. An Introduction to Thermodynamics - Y.V.C.Rao – Universities press.
5. Thermodynamics – W.Z.Black & J.G.Hartley, 3rd Edn Pearson Publ.
6. Engineering Thermodynamics – D.P.Misra, Cengage Publ.
7. Engineering Thermodynamics – P.Chattopadhyay – Oxford Higher Edn Publ.

COURSE OUTCOMES:

After undergoing the course the student is expected to learn

CO1: Basic concept of thermodynamics
CO2: Laws of thermodynamics
CO3: Concept of entropy
CO4: Property evaluation of vapors and their depiction in tables and charts
CO5: Evaluation of properties of perfect gas mixtures.

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L	T	P	C
0	0	3	1.5

II Year B.Tech. – I Sem.

MECHANICS OF SOLIDS & METALLURGY LAB

Course Objective: To impart practical exposure on the microstructures of various materials and their hardness evaluation. Also to impart practical knowledge on the evaluation of material properties through various destructive testing procedures.

NOTE: Any 6 experiments from each section A and B.

(A) MECHANICS OF SOLIDS LAB:

1. Direct tension test
2. Bending test on
a) Simple supported
b) Cantilever beam
3. Torsion test
4. Hardness test
a) Brinells hardness test
b) Rockwell hardness test
5. Test on springs
6. Compression test on cube
7. Impact test
8. Punch shear test

(B) METALLURGY LAB**:**

1. Preparation and study of the Microstructure of pure metals like Iron, Cu and Al.
2. Preparation and study of the Microstructure of Mild steels, low carbon steels, high – C steels.
3. Study of the Micro Structures of Cast Irons.
4. Study of the Micro Structures of Non-Ferrous alloys.
5. Study of the Micro structures of Heat treated steels.
6. Hardeneability of steels by Jominy End Quench Test.
7. To find out the hardness of various treated and untreated steels.

Course Outcome: Upon successful completion of the lab the student should be able to

1. Model & Analyze the behavior of basic structural members subjected to various loading and support conditions.
2. Study and analyze various micro structures of materials.

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L	T	P	C
0	0	3	1.5

II Year B.Tech. – I Sem.

PRODUCTION TECHNOLOGY LAB

Course Objective: To impart hands-on practical exposure on manufacturing processes and equipment.

1. Design and making of pattern
   i. Single piece pattern
   ii. Split pattern
2. Sand properties testing
   i. Sieve analysis (dry sand)
   ii. Clay content test
   iii. Moisture content test
   iv. Strength test (Compression test & Shear test)
   v. Permeability test
3. Mould preparation
   i. Straight pipe
   ii. Bent pipe
   iii. Dumble
   iv.Gear blank
4. Gas cutting and welding
5. Manual metal arc welding
   i. Lap joint
   ii. Butt joint
   iii. Spot welding
   iv. Brazing and soldering
6. Injection Molding
7. Blow Molding
8. Simple models using sheet metal operations
9. Study of deep drawing and extrusion operations
10. Study of Basic powder compaction and sintering
11. Study of TIG/MIG Welding
12. Study of Plastic Moulding Process.

Course Outcomes: The student will be able to understand the various manufacturing processes and their relevance in current manufacturing industry

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B.Tech II Year I Semester

L	T	P	C
3	0	0	0

Environmental Science

(Common to all Branches)

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.

UNIT – I: MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES

Definition, Scope and Importance – Need for Public Awareness.

Natural Resources : Renewable and non-renewable resources – Natural resources and associated problems – Forest resources – Use and over – exploitation, deforestation, case studies – Timber extraction – Mining, dams and other effects on forest and tribal people – Water resources – Use and over utilization of surface and ground water – Floods, drought, conflicts over water, dams – benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. – Energy resources:

UNIT – II: ECOSYSTEMS, BIODIVERSITY AND ITS CONSERVATION

Ecosystems: Concept of an ecosystem. – Structure and function of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Ecological succession – Food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the ecosystems: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Biodiversity and its Conservation : 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, National and local levels – India as a mega-diversity nation – Hot-sports of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

UNIT – III: Environmental Pollution and Solid Waste Management

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

Social Issues and the Environment: From Unsustainable to Sustainable development – Urban problems related to energy – Water conservation, rain water harvesting, watershed management – Resettlement and rehabilitation of people; its problems and concerns. Case studies – Environmental ethics: Issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies – Wasteland reclamation. – Consumerism and waste products. – Environment Protection Act. – Air (Prevention and Control of Pollution) Act. – Water (Prevention and control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – Issues involved in enforcement of environmental legislation – Public awareness.

UNIT – V: HUMAN POPULATION AND THE ENVIRONMENT

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

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..

Course Outcomes:

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

- Gain a higher level of personal involvement and interest in understanding and solving environmental problems
- Comprehend environmental problems from multiple perspectives with emphasis on human modern lifestyles and developmental activities
- Demonstrate knowledge relating to the biological systems involved in the major global environmental problems of the 21st century
- Influence their society in proper utilization of goods and services

- Learn the management of environmental hazards and to mitigate disasters and have a clear understanding of environmental concerns and follow sustainable development practices.
- Recognize the interconnectedness of human dependence on the earth's ecosystems

TEXT BOOKS :

1. Text book of Environmental Studies for Undergraduate Courses by Erach Bharucha for University Grants Commission, Universities Press.
2. Environmental Studies by Palaniswamy – Pearson education
3. Environmental Studies by Dr.S.Azeem Unnisa, Academic Publishing Company

REFERENCES :

1. Textbook of Environmental Science by Deeksha Dave and E.Sai Baba Reddy, Cengage Publications.
2. Text book of Environmental Sciences and Technology by M.Anji Reddy, BS Publication.
3. Comprehensive Environmental studies by J.P.Sharma, Laxmi publications.
4. Environmental sciences and engineering – J. Glynn Henry and Gary W. Heinke – Prentice hall of India Private limited.
5. A Text Book of Environmental Studies by G.R.Chatwal, Himalaya Publishing House
6. Introduction to Environmental engineering and science by Gilbert M. Masters and Wendell P. Ela - Prentice hall of India Private limited.

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EFFECTIVE FROM 2019-20 BATCH

B.Tech II Year II Semester

L	T	P	C
3	0	0	3

INDUSTRIAL MANAGEMENT
(Common to Mechanical, Metallurgical Engineering)

Course Objectives:

- To impart knowledge on scientific principles of management to improve productivity in manufacturing Industry.
- To impart knowledge on fundamentals of functional management to improve performance in industry.

Unit – I

Introduction: Definition of Industrial Engineering, Development, Applications, Role of an industrial engineer, Quantitative tools of IE and productivity measurement, Concepts of Management, Importance, Functions of management, Scientific management, Taylor's principles, Douglas McGregor's Theory X andTheory Y, Fayol's principles of management.

Unit-II:

Functional Management: Human Resource management: Concept and functions of Human Resource Management, Concept of HRM and HRD Industrial relations, Job-evaluation and merit rating, wage and salary administration.- Marketing Management: Marketing mix and elements of marketing, strategies.- Financial management: objective and functions of Financial Management.

Unit – III

Operations Management: Importance, types of production, applications, work study, method study and time study, work sampling, PMTS, micro-motion study, rating techniques, MTM, work factor system, principles of Ergonomics, flow process charts, string diagrams and Therbligs.

Unit – IV

Plant location and layout: Types and principles of plant layouts, Factors affecting plant location and layout, -Statistical Quality Control: Types of control charts, control charts for variables and control charts for attributesand its applications with numerical examples.

Unit – V

Project management: Basics for construction of network diagram,Program Evaluation and Review Technique (PERT), Critical Path Method (CPM) – PERT Vs. CPM, determination of floats, Project

crashing and its procedure.

Course Outcomes:

- After completion of the course the student will familiarize with the fundamentals, basic tools of Operations Management, Statistical quality control Techniques, and the fundamental principles of project management,
- The student will familiarize with concepts of management, functional management, Wage and Salary administration.

Text Books:

1. Industrial Engineering and Management by O.P Khanna, Khanna Publishers
2. Industrial Engineering and Management by N.V.S. Raju, Cengage Learning

Reference Books:

1. Industrial Engineering and Production Management, Martand Telsang,S.Chand& Company Ltd. New Delhi
2. Operations Management by J.G Monks, Mc Graw Hill Publishers.
3. Production and Operations Management – R.Panneerselvam- PHI- 3rdEdition
4. Principles of Management by Koontz O' Donnel, McGraw Hill Publishers.
5. PERTandCPM by L.S Srinath, East west Press.
6. Production and operations management by K.C Arora.
7. Statistical Quality Control by Gupta.
8. Manufacturing Organization and Management, Harold T. Amrine, John
9. I.M Pandey, Financial Management , Vikas Publishing House Pvt Ltd

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B.Tech II Year II Semester

L	T	P	C
3	0	0	3

Complex Variables and Statistical Methods
(Common to ECE, EEE of II B.Tech-I Semester & Civil, ME, MET of II B.Tech-II Semester)

Course Objectives:

- To familiarize the complex variables.
- To familiarize the students with the foundations of probability and statistical methods.
- To equip the students to solve application problems in their disciplines.

UNIT-I: Functions of a complex variable and Complex integration: (10 hrs)

Introduction – Continuity – Differentiability – Analyticity – Properties – Cauchy-Riemann equations in Cartesian and polar coordinates – Harmonic and conjugate harmonic functions – Milne – Thompson method.

Complex integration: Line integral – Cauchy's integral theorem – Cauchy's integral formula – Generalized integral formula (all without proofs).

UNIT-II: Series expansions and Residue Theorem: (10 hrs)

Radius of convergence – Expansion in Taylor's series, Maclaurin's series and Laurent series.

Types of Singularities: Isolated – pole of order m – Essential – Residues – Residue theorem (without proof) – Evaluation of real integral of the type $\int_{-\infty}^{\infty} f(x)dx$

UNIT – III: Probability and Distributions: (10 hrs)

Review of probability and Baye's theorem – Random variables – Discrete and Continuous random variables – Distribution function – Mathematical Expectation and Variance – Binomial, Poisson, Uniform and Normal distributions.

UNIT – IV: Sampling Theory: (8 hrs)

Introduction – Population and samples – Sampling distribution of Means and Variance (definition only) – Central limit theorem (without proof) – Introduction to t, χ^2 and F-distributions – Point and Interval estimations – Maximum error of estimate.

UNIT – V: Tests of Hypothesis: (10 hrs)

Introduction – Hypothesis – Null and Alternative Hypothesis – Type I and Type II errors – Level of significance – One tail and two-tail tests – Tests concerning one mean and two means (Large and Small samples) – Tests on proportions.

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

- apply Cauchy-Riemann equations to complex functions in order to determine whether a given continuous function is analytic
- find the differentiation and integration of complex functions used in engineering problems
- make use of the Cauchy residue theorem to evaluate certain integrals
- apply discrete and continuous probability distributions
- design the components of a classical hypothesis test
- infer the statistical inferential methods based on small and large sampling tests

Text Books:

1. **B. S. Grewal,** Higher Engineering Mathematics, 43rd Edition, Khanna Publishers.
2. **Miller and Freund's,** Probability and Statistics for Engineers, 7/e, Pearson, 2008.

Reference Books:

1. **S. C. Gupta and V. K. Kapoor**, Fundamentals of Mathematical Statistics, 11/e, Sultan Chand & Sons Publications, 2012.
2. **Jay l. Devore,** Probability and Statistics for Engineering and the Sciences, 8th Edition, Cengage.
3. **Shron L. Myers, Keying Ye, Ronald E Walpole,** Probability and Statistics Engineers and the Scientists, 8th Edition, Pearson 2007.
4. **Sheldon, M. Ross**, Introduction to probability and statistics Engineers and the Scientists, 4th Edition, Academic Foundation, 2011

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
B.TECH (MECHANICAL ENGINEERING) - R19
EFFECTIVE FROM 2019-20 BATCH

L	T	P	C
3	0	0	3

II Year B.Tech. – II Sem.

KINEMATICS OF MACHINERY

Course Objective: The students completing this course are expected to understand the nature and role of the kinematics of machinery, mechanisms and machines. The course includes velocity and acceleration diagrams, analysis of mechanisms joints, Cams and their applications. It exposes the students to various kinds of power transmission devices like belt, rope, chain and gear drives and their working principles and their merits and demerits**.**

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.

Grashoff's law , Degrees of freedom ,Kutzbach criterian for planar mechanisms, Mechanism and machines – classification of machines – kinematic chain – inversion of mechanism – inversions of quadric cycle chain – single and double slider crank chains.

UNIT – II

LOWER PAIR MECHANISM: Exact and approximate copiers and generated types – Peaucellier, Hart and Scott Russul – Grasshopper – Watt T. Chebicheff and Robert Mechanisms and straight line motion, Pantograph.

Conditions for correct steering – Davis Steering gear, Ackermans steering gear – velocity ratio; Hooke's Joint: Single and double – Universal coupling–application–problems.

UNIT – III

KINEMATICS: Velocity and acceleration – Motion of a link in machine – Determination of Velocity and acceleration diagrams – Graphical method – Application of relative velocity method four bar chain. Velocity and acceleration analysis of for a given mechanism, Klein's construction, determination of Coriolis component of acceleration.

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.

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 and retardation. Maximum velocity and maximum acceleration during outward and return strokes in the above 3 cases.

Analysis of motion of followers: Roller follower – circular cam with straight, concave and convex flanks.

BELT DRIVES: Introduction, Belt and rope drives, selection of belt drive- types of belt drives,V-belts, materials used for belt and rope drives, velocity ratio of belt drives, slip of belt, creep of belt, tensions for flat belt drive, angle of contact, centrifugal tension, maximum tension of belt, Chains- length, angular speed ratio, classification of chains.

UNIT – V

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GEARS

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 – Introduction to Helical, Bevel and worm gearing.

GEAR TRAINS : Introduction to gear Trains, Train value, Types – Simple and reverted wheel train – Epicyclic gear Train. Methods of finding train value or velocity ratio – Epicyclic gear trains. Selection of gear box-Differential gear for an automobile.

TEXT BOOKS:

1. Theory of Machines & Mechanisms - P.L Ballaney- Khanna Publishers
2. Theory of Machines by Thomas Bevan/ CBS Publishers

REFERENCES:

1. Theory of Machines – S. S Rattan- TMH Publishers
2. Theory of machines and Machinery /Vickers / Oxford .
3. Theory of Mechanisms and machines – A.Ghosh & A.K.Malik – East West Press Pvt. Ltd.
4. Kinematics and dynamics of Machinery by R.L Norton; TATA McGraw-Hill

Course outcomes:

The student should be able to

CO1: Contrive a mechanism for a given plane motion.

CO2: analyze motion of different planar mechanisms with lower and higher pairs (Cams and Gears)

CO3: To choose a power transmission system for a given application and analyze different transmission systems.

CO4: Suggest and analyze the mechanisms for prescribed intermittent motion like opening and closing of IC engine valves etc.

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II Year B.Tech. – II Sem.

APPLIED THERMODYNAMICS - I
(Use of steam tables and Mollier chart is allowed)

Course objectives:
This course is intended to study the thermodynamic analysis of major components of Rankine cycle, refrigeration cycles and compressible fluids and to analyze the energy transfers and transformations in these components including individual performance evaluation.

UNIT – I
VAPOUR POWER CYCLES: Carnot, Rankine cycle - schematic layout, thermodynamic analysis, concept of mean temperature of heat addition, methods to improve cycle performance – regeneration & reheating.

UNIT II
COMBUSTION: Fuels and combustion, concepts of heat of reaction, adiabatic flame temperature, Stoichiometry, flue gas analysis.
BOILERS : Classification – working principles of L.P & H.P boilers with sketches – mountings and accessories – working principles, boiler horse power, equivalent evaporation, efficiency and heat balance – Draught: classification – height of chimney for given draught and discharge, condition for maximum discharge, efficiency of chimney – artificial draught, induced and forced.

UNIT – III
STEAM NOZZLES: Function of a nozzle – applications - types, flow through nozzles, thermodynamic analysis – assumptions -velocity of fluid at nozzle exit-Ideal and actual expansion in a nozzle, velocity coefficient, condition for maximum discharge, critical pressure ratio, criteria to decide nozzle shape: Super saturated flow - its effects, degree of super saturation and degree of under cooling, Wilson line.
STEAM TURBINES: Classification – impulse turbine; mechanical details – velocity diagram – effect of friction – power developed, axial thrust, blade or diagram efficiency – condition for maximum efficiency. De-laval turbine - methods to reduce rotor speed-velocity compounding, pressure compounding and velocity & pressure compounding, velocity and pressure variation along the flow – combined velocity diagram for a velocity compounded impulse turbine, condition for maximum efficiency

UNIT IV
REACTION TURBINE: Mechanical details – principle of operation, thermodynamic analysis of a stage, degree of reaction –velocity diagram – Parson's reaction turbine – condition for maximum efficiency – calculation of blade height.
STEAM CONDENSERS: Requirements of steam condensing plant – classification of condensers – working principle of different types – vacuum efficiency and condenser efficiency – air leakage, sources and its affects, air pump, cooling water requirement.

UNIT – V
COMPRESSORS – Classification – fan, blower and compressor - positive displacement and non positive displacement type – reciprocating and rotory types.
Reciprocating: Principle of operation, work required, Isothermal efficiency, volumetric efficiency and effect of clearance, multi stage compression, saving of work, minimum work condition for two stage compression.
Rotary (Positive displacement type)
Roots Blower, vane sealed compressor, Lysholm compressor – mechanical details and principle of working – efficiency considerations.
Rotary (non positive displacement type)
Centrifugal compressors: Mechanical details and principle of operation – velocity and pressure variation. Energy transfer-impeller blade shape-losses, slip factor, power input factor, pressure coefficient and adiabatic coefficient – velocity diagrams – power.

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TEXT BOOKS:

1. Heat Engineering (MKS and SI units), VP Vasandani, DS Kumar, Metropolitan books
2. Basics & Applied Thermodynamics- P.K.Nag – 4th edition- McGraw Hill

REFERENCES:

3. Thermal Engineering- Mahesh Rathore, TataMcGrawHill
4. Applied Thermodynamics by R Yadhav
5. Applied Thermodynamics by Eastop & McConkey, 5th Edn, Pearson

5. Fluid Mechanics Fundementals and Applications by Y.A.Cengel, J.M.Cimbala, McGrawHill
6. Thermal Engineering-M.L.Marthur & Mehta/Jain bros. Publishers
7. Thermal Engineering / RK Rajput/ Lakshmi Publications

Course outcomes:

CO1**:** Expected to learn the working of steam power cycles and also should be able to analyze and evaluate the performance of individual components
CO2: Student is able to learn the principles of combustion , stochiometry and flue gas analysis
CO3: Students will be able to design the components and calculate the losses and efficiency of the boilers, nozzles, turbines and condensers**.**
CO4: Student is able to learn various types of compressors, principles of working and their performance evaluation.

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II Year B.Tech. – II Sem

FLUID MECHANICS & HYDRAULIC MACHINES

Course Objectives: The students completing this course are expected to understand the properties of fluids, its kinematic and dynamic behavior through various laws of fluids like continuity, Euler's, Bernoulli's equations, energy and momentum equations. Further, the student shall be able to understand the theory of boundary layer, working and performance characteristics of various hydraulic machines like pumps and turbines.

UNIT I

Fluid statics: Dimensions and units: physical properties of fluids - specific gravity, viscosity and its significance, surface tension, capillarity, vapor pressure. Atmospheric, gauge and vacuum pressure, Measurement of pressure – Manometers - Piezometer, U-tube, inverted and differential manometers. Pascal's & hydrostatic laws.
Buoyancy and floatation: Meta center, stability of floating body. Submerged bodies. Calculation of metacenter height. Stability analysis and applications.

UNIT II

Fluid kinematics: Introduction, flow types. Equation of continuity for one dimensional flow, circulation and vorticity, Stream line, path line and streak lines and stream tube. Stream function and velocity potential function, differences and relation between them. Condition for irrotational flow, flow net, source and sink, doublet and vortex flow.

Fluid dynamics: surface and body forces –Euler's and Bernoulli's equations for flow along a stream line, momentum equation and its applications, force on pipe bend.
Closed conduit flow: Reynold's experiment- Darcy Weisbach equation- Minor losses in pipes- pipes in series and pipes in parallel- total energy line-hydraulic gradient line.
Introduction to Compressible fluid flow (Qualitative Treatment only)

UNIT III

Boundary Layer Theory: Introduction, momentum integral equation, displacement, momentum and energy thickness, separation of boundary layer, control of flow separation, Stream lined body, Bluff body and its applications, basic concepts of velocity profiles.
Dimensional Analysis: Dimensions and Units, Dimensional Homogeneity, Non dimensionalization of equations, Method of repeating variables and Buckingham Pi Theorem.

UNIT IV

Basics of turbo 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, flow over radial vanes.
Centrifugal pumps: classification, working, work done – manometric head- losses and efficiencies- specific speed- pumps in series and parallel-performance characteristic curves, cavitation & NPSH.
Reciprocating pumps: Working, Discharge, slip, indicator diagrams.

UNIT V

Hydraulic Turbines: classification of turbines, impulse and reaction turbines, Pelton wheel, Francis turbine and Kaplan turbine-working proportions, work done, efficiencies, hydraulic design – draft tube- theory- functions and efficiency.

Performance of hydraulic turbines: Geometric similarity, Unit and specific quantities, characteristic curves, governing of turbines, selection of type of turbine, cavitation, surge tank, water hammer. Hydraulic systems- hydraulic ram, hydraulic lift, hydraulic coupling.

TEXT BOOKS:

1. Fluid Mechanics- Fundementals and Applications by Y.A. Cengel, J.M.Cimbala, 6th Edn, McGrawHill
2. Fluid Mechanics and Fluid Power Engineering by D.S. Kumar, Kotaria & Sons.

REFERENCE BOOKS:

1. Hydraulics, fluid mechanics and Hydraulic machinery Modi and Seth
2. Fluid Mechanics and Hydraulic Machines/ RK Bansal/Laxmi Publications (P) Ltd.
3. Fluid Mechanics and Hydraulic Machines by Rajput
4. Fluid Mechanics & Turbo machinery by Dixon, 7th Edn, Elesvier
5. Fluid Mechanics and Machinery by D. Rama Durgaiah, New Age International.

COURSE OUTCOMES:

From this course the student is expected to learn
CO1: The basic concepts of fluid properties.
CO2: The mechanics of fluids in static and dynamic conditions.
CO3: Working Principles and performance evaluation of hydraulic pump and turbines.
CO4: Hydrodynamic forces of jet on vanes in different positions.

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II Year B.Tech. – II Sem.

DESIGN OF MACHINE MEMBERS – I

Course Objectives:

1. The student shall gain appreciation and understanding of the design function in mechanical engineering, the steps involved in designing and the relation of design activity with manufacturing activity
2. Able to select proper materials to different machine elements based on their physical and mechanical properties.
3. Learn and understand of the different types of failure modes and criteria.
4. Procedure for the different machine elements such as fasteners, shafts, couplings, keys, axially know loaded joints etc.

UNIT – I

INTRODUCTION: General considerations in the design of Engineering Materials and their properties – selection –Manufacturing consideration in design, tolerances and fits –BIS codes of steels.

STRESSES IN MACHINE MEMBERS: Simple stresses – combined stresses – torsional and bending stresses – impact stresses – stress strain relation – various theories of failure – factor of safety – design for strength and rigidity – preferred numbers. the concept of stiffness in tension, bending, torsion and combined situations – static strength design based on fracture toughness.

UNIT – II

STRENGTH OF MACHINE ELEMENTS: Stress concentration – theoretical stress concentration factor – fatigue stress concentration factor notch sensitivity – design for fluctuating stresses – endurance limit – estimation of endurance strength – goodman's line – soderberg's line – modified goodman's line.

UNIT – III

RIVETED AND WELDED JOINTS – design of joints with initial stresses – eccentric loading.
Bolted joints – design of bolts with pre-stresses – design of joints under eccentric loading – locking devices – both of uniform strength, different seals.

KEYS, COTTERS AND KNUCKLE JOINTS: Design of keys-stresses in keys-cotter joints-spigot and socket, sleeve and cotter, jib and cotter joints- knuckle joints.

UNIT – IV

SHAFTS: Design of solid and hollow shafts for strength and rigidity – design of shafts for combined bending and axial loads – shaft sizes – BIS code. Use of internal and external circlips, gaskets and seals (stationary & rotary).

SHAFT COUPLING: Rigid couplings – muff, split muff and flange couplings, flexible couplings – flange coupling (modified).

UNIT – V

MECHANICAL SPRINGS:

Stresses and deflections of helical springs – extension -compression springs – springs for fatigue loading, energy storage capacity – helical torsion springs – co-axial springs, leaf springs.

Note: Design data book is NOT Permitted for examination

TEXT BOOKS:

1. Machine design / NC Pandya & CS Shah/Charotar Publishing House Pvt. Limited
2. Machine Design/V.B.Bhandari/ McGrawHill Education

REFERENCES:

1. Design of Machi**n**e Elements / V.M. Faires/McMillan
2. Machine design / Schaum Series/McGrawHill Professional
3. Machine Design/ Shigley, J.E/McGraw Hill.
4. Design data handbook/ K.Mahadevan & K. Balaveera Reddy/ CBS publishers.
5. Design of machine elements-Spotts/Pearson Publications
6. Machine Design –Norton/ Pearson publishers

Course outcomes:

Upon successful completion of this course student should be able to:

1. Apply the design procedure to engineering problems, including the consideration of technical and manufacturing constraints.
2. Select suitable materials and significance of tolerances and fits in critical design applications.
3. Utilize design data hand book and design the elements for strength, stiffness and fatigue.
4. Identify the loads, the machine members subjected and calculate static and dynamic stresses to ensure safe design.

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L	T	P	C
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II Year B.Tech. – II Sem.

FLUID MECHANICS & HYDRAULIC MACHINERY LAB

Course Objective: To impart practical exposure on the performance evaluation methods of various flow measuring equipment and hydraulic turbines and pumps.

1. Impact of jets on Vanes.
2. Performance Test on Pelton Wheel.
3. Performance Test on Francis Turbine.
4. Performance Test on Kaplan Turbine.
5. Performance Test on Single Stage Centrifugal Pump.
6. Performance Test on Multi Stage Centrifugal Pump.
7. Performance Test on Reciprocating Pump.
8. Calibration of Venturimeter.
9. Calibration of Orifice meter.
10. Determination of friction factor for a given pipe line.
11. Determination of loss of head due to sudden contraction in a pipeline.
12. Turbine flow meter.
13. Determination of boundary layer thickness over an object using wind tunnel setup

Course Outcome: The students can operate and analyze various performance evaluation methods of different flow measuring equipment, hydraulic turbines and pumps.

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II Year B.Tech. – II Sem.

MACHINE DRAWING

Course Objective: The student will acquire knowledge in national and International standards while drawing machine components students will also familiarize in drawing assembly, orthographic and sectional views of various machine components.

Machine Drawing Conventions:

Need for drawing conventions – introduction to IS conventions-Standardization-Interchangeability-Selective assembly-Tolerance

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

PART-A

I. Drawing of Machine Elements and simple parts

Selection of Views, additional views for the following machine elements and parts with every drawing proportions.

a) Popular forms of Screw threads, bolts, nuts, stud bolts, tap bolts, set screws.
b) Keys, cottered joints, knuckle joint, Hook's joints
c) Rivetted joints for plates
d) Shaft coupling, spigot and socket pipe joint.
e) Journal, pivot and collar and foot step bearings.

PART-B

II. Assembly Drawings:

Drawings of assembled views for the part drawings of the following using conventions and easy drawing proportions.

a) Engine parts –Gear pump, Fuel pump, petrol Engine connecting rod, piston, stuffing box and eccentric assembly.
b) Other machine parts - Screws jack, Machine swivel vice, Plummer block, Tailstock and Tool post.

III. Manufacturing Drawing

Introduction of Limits and fits, fundamental deviations for Hole based and Shaft based systems, alpha numeric designation of limits & fits. Types of Fits. Form and positional tolerances.

Conventional practices of indicating limits and fits, geometrical form and position tolerances, surface finish and surface treatments requirements. Study of Examples involving selection of fits and calculation of limits. Suggestion of suitable fits for mating parts.

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

TEXT BOOKS:

1. Machine Drawing – N.Siddeswar, K.Kannaiah&V.V.S.Sastry - TMH
2. Machine Drawing –K.L.Narayana, P.Kannaiah& K. Venkata Reddy / New Age/ Publishers
3. Production Drawing- K.L.Narayana, P.Kannaiah& K. Venkata Reddy / New Age/ Publishers

REFERENCES:

1. Machine Drawing – P.S.Gill,
2. Machine Drawing – Luzzader
3. Machine Drawing – Rajput
4. Machine Drawing – N.D. Junnarkar, Pearson
5. Machine Drawing – Ajeeth Singh, McGraw Hill
6. Machine Drawing – KC John, PHI
7. Machine Drawing – B Battacharya, Oxford
8. Machine Drawing – Gowtham and Gowtham, Pearson
9. Machine Drawing- Dhawan R K- S.chand&Company

Course Outcome:

CO1. Ability to understand the importance of drawing in the field of design and manufacturing.
CO2. Ability to understand the method of representing basic machine elements like screws, nuts, bolts etc.
CO3. Ability to represent the engine parts like gear & fuel pump, Connecting rod etc.
CO4. Ability to represent the machine parts like Joints, bearings, Plummer block, etc.
CO5: Ability to assemble the individual elements to represent a machine component as well as engine components.
CO6: Ability to represent limits, fits & Tolerances in manufacturing drawing.

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B.Tech II Year II Semester

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INTELLECTUAL PROPERTY RIGHTS AND PATENTS

(Common to All Branches)

Course Objectives:

- To know the importance of Intellectual property rights, which plays a vital role in advanced Technical and Scientific disciplines.
- Imparting IPR protections and regulations for further advancement, so that the students can familiarize with the latest developments.

Unit I: Introduction to Intellectual Property Rights (IPR)

Concept of Property - Introduction to IPR – International Instruments and IPR - WIPO - TRIPS – WTO -Laws Relating to IPR - IPR Tool Kit - Protection and Regulation - Copyrights and Neighboring Rights – Industrial Property – Patents - Agencies for IPR Registration – Traditional Knowledge –Emerging Areas of IPR - Layout Designs and Integrated Circuits – Use and Misuse of Intellectual Property Rights.

Unit II: Copyrights and Neighboring Rights

Introduction to Copyrights – Principles of Copyright Protection – Law Relating to Copyrights - Subject Matters of Copyright – Copyright Ownership – Transfer and Duration – Right to Prepare Derivative Works –Rights of Distribution – Rights of Performers **–** Copyright Registration – Limitations – Infringement of Copyright – Relief and Remedy – Case Law - Semiconductor Chip Protection Act.

UNIT III: Patents

Introduction to Patents - Laws Relating to Patents in India – Patent Requirements – Product Patent and Process Patent - Patent Search - Patent Registration and Granting of Patent - Exclusive Rights – Limitations - Ownership and Transfer — Revocation of Patent – Patent Appellate Board - Infringement of Patent – Compulsory Licensing — Patent Cooperation Treaty – New developments in Patents – Software Protection and Computer related Innovations

UNIT IV: Trademarks

Introduction to Trademarks – Laws Relating to Trademarks – Functions of Trademark – Distinction between Trademark and Property Mark – Marks Covered under Trademark Law - Trade Mark Registration – Trade Mark Maintenance – Transfer of rights - Deceptive Similarities Likelihood of Confusion - Dilution of Ownership – Trademarks Claims and Infringement – Remedies – Passing Off Action.

UNIT V: Trade Secrets & Cyber Law and Cyber Crime

Introduction to Trade Secrets – General Principles - Laws Relating to Trade Secrets –
Maintaining Trade Secret – Physical Security – Employee Access Limitation – Employee Confidentiality Agreements – Breach of Contract –Law of Unfair Competition – Trade Secret Litigation – Applying State Law.
Cyber Law – Information Technology Act 2000 - Protection of Online and Computer Transactions – E-commerce - Data Security – Authentication and Confidentiality - Privacy - Digital Signatures – Certifying Authorities - Cyber Crimes - Prevention and Punishment – Liability of Network Providers.

Course Outcome:

- IPR Laws and patents pave the way for innovative ideas which are instrumental for inventions to seek Patents.
- Student get an insight on Copyrights, Patents and Software patents which are instrumental for further advancements.

References:

1. Intellectual Property Rights (Patents & Cyber Law), Dr. A. Srinivas. Oxford University Press, New Delhi.
2. Deborah E. Bouchoux: Intellectual Property, Cengage Learning, New Delhi.
3. Prabhuddha Ganguli: Intellectual Property Rights, Tata Mc-Graw –Hill, New Delhi
4. Richard Stim: Intellectual Property, Cengage Learning, New Delhi.
5. Kompal Bansal &Parishit Bansal Fundamentals of IPR for Engineers, B. S. Publications (Press).
6. Cyber Law - Texts & Cases, South-Western's Special Topics Collections.
7. R.Radha Krishnan, S.Balasubramanian: Intellectual Property Rights, Excel Books. New Delhi.
8. M.Ashok Kumar and MohdIqbal Ali: Intellectual Property Rights, Serials Pub.

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III Year - I Semester

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DYNAMICS OF MACHINERY

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Course Objectives:
The Students will acquire the knowledge

1. To analyze stabilization of sea vehicles, aircrafts and automobile vehicles
2. To solve frictional losses, torque transmission of mechanical systems.
3. To analyze dynamic forces of slider crank mechanism and design of flywheel
4. To understand the methods of balancing reciprocating and rotary masses.
5. To understand the concept of vibrations and its significance on engineering design

UNIT – I
PRECESSION: Gyroscopes, effect of precession motion on the stability of moving vehicles such as motor car, motor cycle, aero planes and ships, static and dynamic force analysis of planar mechanisms, (Demonstration of models in video show).

UNIT – II
FRICTION: Inclined plane, friction of screw and nuts, pivot and collar, uniform pressure, uniform wear, friction circle and friction axis: lubricated surfaces, boundary friction, film lubrication.
CLUTCHES: Friction clutches- single disc or plate clutch, multiple disc clutch, cone clutch, centrifugal clutch.
BRAKES AND DYNAMOMETERS: Simple block brakes, internal expanding brake, band brake of vehicle. General description and operation of dynamometers: Prony, Rope brake, Epicyclic, Bevis Gibson and belt transmission,

UNIT – III
TURNING MOMENT DIAGRAMS: Dynamic force analysis of slider crank mechanism**,** inertia torque, angular velocity and acceleration of connecting rod, crank effort and turning moment diagrams – fluctuation of energy – fly wheels and their design.
GOVERNERS: Watt, porter and proell governors, spring loaded governors – Hartnell and Hartung with auxiliary springs. sensitiveness, isochronism and hunting.

UNIT – IV
BALANCING: Balancing of rotating masses single and multiple – single and different planes, use analytical and graphical methods. Primary, secondary, and higher balancing of reciprocating masses. analytical and graphical methods, unbalanced forces and couples –

examination of "V" multi cylinder in line and radial engines for primary and secondary balancing, locomotive balancing, hammer blow, swaying couple, variation of tractive effort.

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UNIT – V

VIBRATIONS: Free Vibration of spring mass system –Natural frequency-types of damping – damped free vibration, Simple problems on forced damped vibration, vibration isolation and transmissibility transverse loads, vibrations of beams with concentrated and distributed loads. Dunkerly's methods, Raleigh's method, whirling of shafts, critical speeds, torsional vibrations, two and three rotor systems.

Text Books :

1. Theory of Machines / S.S Rattan/ Mc. Graw Hill
2. Mechanism and machine theory /Ashok G. Ambedkar/PHI Publications.

References :

1. Mechanism and Machine Theory / JS Rao and RV Dukkipati / New Age
2. Theory of Machines / Shigley / MGH
3. Theory of Machines / Thomas Bevan / CBS Publishers
4. Theory of machines / Khurmi/S.Chand.

Course outcomes:

Upon successful completion of this course the student should be able to:

1. Understand the stabilization of sea vehicles, aircrafts and automobile vehicles (BL-2)
2. Solve frictional losses, torque transmission of mechanical systems. (BL-3)
3. Analyze dynamic forces of slider crank mechanism and design of flywheel (BL-4)
4. Understand the methods of balancing reciprocating and rotary masses. (BL-2)
5. Illustrate the concept of vibrations and its significance on engineering design (BL-2)

CO-PO Mapping

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

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III Year - I Semester	**L**	**T**	**P**	**C**
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DESIGN OF MACHINE MEMBERS– II

Course Objectives:

The Students will acquire the knowledge

1. Understand to select the suitable bearing based on the application of the loads and predict the life of the bearing
2. Design of engine parts such as connecting rod, crank, crank shaft and engine parts such as piston, cylinder and cylinder liners
3. Design of curved beams with various cross sections and crane hooks
4. Design power transmission elements such as belts, chains, ropes. power screws and gear drives
5. Design of the machine tool elements such as levers and brackets

UNIT – I

BEARINGS: Classification of bearings- applications, types of journal bearings – lubrication – bearing modulus – full and partial bearings – clearance ratio – heat dissipation of bearings, bearing materials – journal bearing design – ball and roller bearings – static loading of ball & roller bearings, bearing life.

UNIT – II

ENGINE PARTS: Connecting Rod: Thrust in connecting rod – stress due to whipping action on connecting rod ends – cranks and crank shafts, strength and proportions of over hung and center cranks – crank pins, crank shafts.

Pistons, forces acting on piston – construction design and proportions of piston, cylinder, cylinder liners,

UNIT – III

Design of curved beams: introduction, stresses in curved beams, expression for radius of neutral axis for rectangular, circular, trapezoidal and t-section, design of crane hooks, c –clamps**.**

UNIT – IV

POWER TRANSMISSIONS SYSTEMS, PULLEYS: Transmission of power by belt and rope drives, transmission efficiencies, belts – flat and v types – ropes - pulleys for belt and rope drives, materials, chain drives

DESIGN OF POWER SCREWS: Design of screw, square ACME, buttress screws, design of nut, compound screw, differential screw, ball screw- possible failures.

SPUR & HELICAL GEAR DRIVES: Spur gears- helical gears – load concentration factor – dynamic load factor, surface compressive strength – bending strength – design

analysis of spur gears – estimation of centre distance, module and face width, check for plastic deformation, check for dynamic and wear considerations.

UNIT – V

MACHINE TOOL ELEMENTS: Levers and brackets: design of levers – hand levers- foot lever – cranked lever – lever of a lever loaded safety valve- rocker arm straight – angular- design of a crank pin – brackets- hangers- wall boxes.

Wire Ropes: Construction, Designation, Stresses in wire ropes, rope sheaves and drums.

Note: Design data book is permitted for examination

Text Books:

1. Machine Design/V.Bandari/TMH Publishers
2. Machine Design/ NC Pandya & CS Shaw/ Charotar publishers
3. Design data book.

References:

1. Machine Design: An integrated Approach / R.L. Norton / Pearson Education
2. Mech. Engg. Design / JE Shigley/Tata McGraw Hill education
3. Design of machine elements- spots/Pearson Publications
4. Machine Design-Norton/Pearson Publications

Course outcomes:

Upon successful completion of this course the student should be able to:

1. Select the suitable bearings based on the application of the loads and predict the life of the bearing (BL-3)
2. Interpret engine parts such as connecting rod, crank, crank shaft and engine parts such as piston, cylinder and cylinder liners (BL-2)
3. Analyze curved beams with various cross sections and crane hooks (BL-4)
4. Analyze power transmission elements such as belts, chains, ropes. power screws and gear drives (BL-4)
5. Interpret machine tool elements such as levers and brackets (BL-2)

CO-PO Mapping:

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

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B.TECH (MECHANICAL ENGINEERING) – R19
EFFECTIVE FROM 2019-20 BATCH

III Year - I Semester	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

METAL CUTTING & MACHINE TOOLS

Course Objectives:

The Students will acquire the knowledge

1. To apply the elementary theory of metal cutting and principles in material removal processes
2. To understand the working principles and operations that can be performed on different lathe machines
3. To identify the working principles and operations that can be performed on shaper, slotter, planner machines and drilling machines calculate the material removal rates
4. To understand the working principles and operations that can be performed for producing various features using milling machine tool and select appropriate machining processes for finishing operation with the desired quality
5. To apply appropriate jigs and fixtures on machine tools and write simple CNC programs and conduct CNC machining

UNIT – I

FUNDAMENTAL OF MACHINING: Elementary treatment of metal cutting theory – element of cutting process – geometry of single point cutting tool, tool angles, chip formation and types of chips – built up edge and its effects, chip breakers, mechanics of orthogonal cutting –Merchant's force diagram, cutting forces, cutting speeds, feed, depth of cut, tool life, tool wear, machinability, economics of machining, coolants, tool materials and properties.

UNIT – II

LATHE MACHINES: Engine lathe – principle of working, specification of lathe – types of lathe – work holders tool holders – box tools taper turning, thread turning – for lathes and attachments, constructional features of speed gear box and feed gear box. Turret and capstan lathes – collet chucks – other work holders – tool holding devices – box and tool layout. Principal features of automatic lathes – classification – single spindle and multi-spindle automatic lathes – tool layout and cam design for automats.

UNIT – III

SHAPING, SLOTTING AND PLANNING MACHINES: Principles of working – principal parts – specifications, operations performed, machining time calculations.

DRILLING & BORING MACHINES: Principles of working, specifications, types, operations performed – tool holding devices – twist drill – Boring Machines – fine Boring Machines – jig boring machine, deep hole Drilling Machine.

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UNIT – IV

MILLING MACHINES: Principles of working – specifications – classification of Milling Machines – principal features of horizontal, vertical and universal Milling Machine, machining operations, types of cutters, geometry of milling cutters – methods of indexing, accessories to milling machines.

FINISHING PROCESSES: Theory of grinding – classification of grinding machines, cylindrical and surface grinding machines, tool and cutter grinding machines, different types of abrasives, bonds, specification and selection of a grinding wheel. Lapping, Honing & Broaching operations, comparison to grinding.

UNIT - V

JIGS & FIXTURES: Principles of design of jigs and fixtures and uses, classification of jigs & fixtures, principles of location and clamping, types of clamping & work holding devices, typical examples of jigs and fixtures.

CNC MACHINE TOOLS: CNC Machines, working principle, classification, constructional features of CNC machines, CNC controller, types of motion controls in CNC machines, applications of CNC machines.

Text Books:

1. Manufacturing Processes / JP Kaushish/ PHI Publishers-2nd Edition
2. Manufacturing Technology Vol-II/P.N Rao/Tata McGraw Hill

References:

1. Metal cutting and machine tools /Geoffrey Boothroyd, Winston A.Knight/ Taylor & Francis
2. Production Technology / H.M.T. Hand Book (Hindustan Machine Tools).
3. Production Engineering/K.C Jain & A.K Chitaley/PHI Publishers
4. Technology of machine tools/S.F.Krar, A.R. Gill, Peter SMID/ TMH
5. Manufacturing Processes for Engineering Materials-Kalpakjian S & Steven R Schmid/Pearson Publications 5th Edition

Course Outcomes:

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

1. Apply the elementary theory of metal cutting and principles in material removal processes (BL-3)
2. Understand the working principles and operations that can be performed on different lathe machines (BL-2)
3. Identify the working principles and operations that can be performed on shaper, slotter, planner machines and drilling machines calculate the material removal rates (BL-3)
4. Understand the working principles and operations that can be performed for producing various features using milling machine tool and select appropriate machining processes for finishing operation with the desired quality (BL-2)

5. Apply appropriate jigs and fixtures on machine tools and write simple CNC programs and conduct CNC machining (BL-3)

CO-PO Mapping

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

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III Year - I Semester	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

OPERATIONS RESEARCH

Course Objectives:

The Students will acquire the knowledge

1. Understand Linear Programming models (BL-2)
2. Interpret Transportation and sequencing problems (BL-2)
3. Solve replacement problems and analyze queueing models (BL-3)
4. Understand game theory and inventory problems (BL-2)
5. Interpret dynamic programming and simulation. (BL-2)

UNIT – I

Development – definition– characteristics and phases – types of operation research models – applications.

ALLOCATION: Linear programming problem formulation – graphical solution – simplex method – artificial variables techniques -two–phase method, big-M method – duality principle.

UNIT – II

TRANSPORTATION PROBLEM: Formulation – optimal solution, unbalanced transportation problem – degeneracy, assignment problem – formulation – optimal solution - variants of assignment problem- travelling salesman problem.

SEQUENCING – Introduction – flow –shop sequencing – *n* jobs through two machines – *n* jobs through three machines – job shop sequencing – two jobs through 'm' machines.

UNIT – III

REPLACEMENT: Introduction – replacement of items that deteriorate with time – when money value is not counted and counted – replacement of items that fail completely, group replacement.

THEORY OF GAMES: Introduction – mini. max (max. mini) – criterion and optimal strategy – solution of games with saddle points – rectangular games without saddle points – 2 x 2 games – dominance principle – m x 2 & 2 x n games -graphical method.

UNIT – IV

WAITING LINES: Introduction – single channel – poison arrivals – exponential service times – with infinite population and finite population models– multichannel – poison arrivals – exponential service times with infinite population single channel poison arrivals.

INVENTORY : Introduction – single item – deterministic models – purchase inventory models with one price break and multiple price breaks – shortages are not allowed – stochastic models – demand may be discrete variable or continuous variable – instantaneous production. Instantaneous demand and continuous demand and no set up cost. ABC & VED Analysis.

UNIT – V

DYNAMIC PROGRAMMING: Introduction – Bellman's principle of optimality – applications of dynamic programming- capital budgeting problem – shortest path problem – linear programming problem.

SIMULATION: Definition – types of simulation models – phases of simulation– applications of simulation – inventory and queuing problems – advantages and disadvantages – simulation languages.

Text Books:

1. Operations Research-An Introduction/Hamdy A Taha/Pearson publishers
2. Operations Research –Theory & publications / S.D.Sharma-Kedarnath/McMillan publishers India Ltd

References:

1. Introduction to O.R/Hiller & Libermann/TMH
2. Operations Research /A.M. Natarajan, P. Balasubramani, A. Tamilarasi /Pearson Education.
3. Operations Research: Methods & Problems / Maurice Saseini, Arhur Yaspan & Lawrence Friedman/Wiley
4. Operations Research / R.Pannerselvam/ PHI Publications.
5. Operations Research / Wagner/ PHI Publications.
6. Operation Research /J.K.Sharma/MacMilan Publ.
7. Operations Research/ Pai/ Oxford Publications
8. Operations Research/S Kalavathy / Vikas Publishers
9. Operations Research / DS Cheema/University Science Press
10. Operations Research / Ravindran, Philips, Solberg / Wiley publishers

Course Outcomes:

Upon successful completion of this course the student should be able to:

1. Understand Linear Programming models (BL-2)
2. Interpret Transportation and sequencing problems (BL-2)
3. Solve replacement problems and analyze queueing models (BL-3)
4. Understand game theory and inventory problems (BL-2)
5. Interpret dynamic programming and simulation. (BL-2)

CO-PO Mapping

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

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EFFECTIVE FROM 2019-20 BATCH

III Year - I Semester	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

APPLIED THERMODYNAMICS-II

Course Objectives:

The Students will acquire the knowledge

1. To understand the different processes in air-standard cycles and differences between Air Standard and Actual Cycles
2. To interpret the working principle and various components of IC engine
3. To analyze the combustion phenomenon of CI and SI engines and their impact on engine variables.
4. To demonstrate the performance of an IC engine and gas turbine based on the performance parameters.
5. To interpret the working principles of jet propulsion and rockets

UNIT – I

Air standard Cycles: Power Cycles : Otto, Diesel, Dual Combustion cycles, Sterling Cycle, Atkinson Cycle, Ericcson Cycle, Lenoir Cycle – Description and representation on P–V and T-S diagram, Thermal Efficiency, Mean Effective Pressures on Air standard basis – comparison of Cycles, Brayton cycle

Actual Cycles and their Analysis: Introduction, Comparison of Air Standard and Actual Cycles, Time Loss Factor, Heat Loss Factor, Exhaust Blow down -Loss due to Gas exchange process, Volumetric Efficiency. Loss due to Rubbing Friction, Actual and Fuel-Air Cycles of CI Engines.

UNIT – II

I. C. ENGINES : Classification - Working principles, Valve and Port Timing Diagrams, - Engine systems – Fuel, Carburettor, Fuel Injection System, Ignition, Cooling and Lubrication, principle of wankle engine, principles of supercharging and turbo charging.

UNIT – III

Combustion in S.I. Engines : Normal Combustion and abnormal combustion – Importance of flame speed and effect of engine variables – Types of Abnormal combustion, pre-ignition and knocking (explanation of) – Fuel requirements and fuel rating, anti knock additives – combustion chamber – requirements, types.

Combustion in C.I. Engines : Four stages of combustion – Delay period and its importance – Effect of engine variables – Diesel Knock– Need for air movement, suction, compression and combustion induced turbulence – open and divided combustion chambers and nozzles used – fuel requirements and fuel rating.

UNIT – IV

Measurement, Testing and Performance: Parameters of performance - measurement of cylinder pressure, fuel consumption, air intake, exhaust gas composition, Brake power –

Determination of frictional losses and indicated power – Performance test – Heat balance sheet and chart.

GAS TURBINES: Simple gas turbine plant – ideal cycle, essential components – parameters of performance – actual cycle – regeneration, inter cooling and reheating –closed cycle type gas turbines.

UNIT –V

JET PROPULSION : Principle of operation –classification of jet propulsive engines – working principles with schematic diagrams and representation on t-s diagram - thrust, thrust power and propulsion efficiency – turbo jet engines – needs and demands met by turbo jet – schematic diagram, thermodynamic cycle, performance evaluation (Definitions and Simple Problems).

ROCKETS: Application – working principle – classification – propellant type – thrust, propulsive efficiency – specific impulse – solid and liquid propellant rocket engines (only Theoretical concepts).

Text Books:

1. I.C. Engines - V. Ganesan- Tata McGraw Hill Publishers
2. Gas Turbines – V.Ganesan – Tata McGraw Hill Publishers

References:

1. Thermal Engineering - Mahesh Rathore- McGraw Hill publishers
2. I.C.Engines–AppliedThermosciences–C.R.Ferguson&A.T.Kirkpatrick-2nd Edition-Wiley Publishers
3. I.C. Engines - J.B.Heywood /McGrawHIll.
4. Heat engines, Vasandani & Kumar - Thermal publications
5. Gas Turbine Theory – HIH Saravanamuttoo, Cohen, Rogers –Pearson Publishers

Course Outcomes:

Upon successful completion of this course the student should be able to:

1. Understand the different processes in air-standard cycles and differences between Air Standard and Actual Cycles (BL-2)
2. Interpret the working principle and various components of IC engine (BL-2)
3. Analyze the combustion phenomenon of CI and SI engines and their impact on engine variables. (BL-4)
4. Demonstrate the performance of an IC engine and gas turbine based on the performance parameters. (BL-2)
5. Interpret the working principles of jet propulsion and rockets(BL-2)

CO-PO Mapping:

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

UNIVERSITY COLLEGE OF ENGINEERING VIZIANAGARAM
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EFFECTIVE FROM 2019-20 BATCH

III Year - I Semester	**L**	**T**	**P**	**C**
	0	**0**	**3**	**1.5**

Course objective:

APPLIED THERMODYNAMICS LAB

The Students will acquire the knowledge

To provide hands on experience in operating various types of internal combustion engines and understands their functioning and performance.

List of experiments:

1. I.C. Engines valve / port timing diagrams.
2. Testing of Fuels – Viscosity, flash point/fire point, carbon residue, calorific value.
3. I.C. Engines performance test and Exhaust emission measurements (4 -stroke diesel engine)
4. I.C. Engines performance test and Exhaust emission measurements (2-stroke petrol engine)
5. Evaluation of engine friction by conducting Morse test on 4-stroke multi cylinder petrol engine.
6. Determination of FP by retardation and motoring test on IC engine.
7. I.C. Engines heat balance at different loads and show the heat distribution curve.
8. Economical speed test of an IC engine.
9. Performance test on variable compression ratio engines.
10. Performance test on reciprocating air compressor unit.
11. Dis-assembly / assembly of different parts of two wheelers. 3 wheelers & 4 wheelers. Tractor & Heavy duty engines covering 2-stroke and 4 stroke, SI and CI engines.
12. Study of boilers, mountings and accessories

Course outcomes:

Upon successful completion of this course the student should be able to:

1. Identify the valves and ports opening and closing of IC engines and Assembly and Dis-assembly of IC Engines. (BL-3)
2. Find the performance characteristics of an internal combustion engines (BL-1)
3. Solve the heat load by drawing the Heat Balance sheet (BL-3)
4. Demonstrate the performance of engine by economical speed tests and Study of Boilers (BL-2)
5. Understand the performance parameters like IP, BP and FP for multi cylinder engines (BL-2)

CO-PO Mapping:

SNO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√	√			√	√	√	√	√

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CO2	√	√	√	√	√			√	√	√	√	√
CO3	√	√	√	√	√			√	√	√	√	√
CO4	√	√	√	√	√			√	√	√	√	√
CO5	√	√	√	√	√			√	√	√	√	√

III Year - I Semester

L	**T**	**P**	**C**
0	**0**	**3**	**1.5**

THEORY OF MACHINES LAB

Course objective:
The Students will acquire the knowledge
To analyze gyroscope, frequency of free and forced vibration and study static and dynamic balancing.

List of experiments:

1. To determine whirling speed of shaft theoretically and experimentally.
2. To determine the position of sleeve against controlling force and speed of a Hartnell governor and to plot the characteristic curve of radius of rotation.
3. To analyse the motion of a motorized gyroscope when the couple is applied along its spin axis
4. To determine the frequency of undamped free vibration of an equivalent spring mass system.
5. To determine the frequency of damped force vibration of a spring mass system
6. To study the static and dynamic balancing using rigid blocks.
7. To find the moment of inertia of a flywheel
8. To plot follower displacement vs cam rotation for various Cam Follower systems.
9. To plot slider displacement, velocity and acceleration against crank rotation for single slider crank mechanism/Four bar mechanism
10. To find coefficient of friction between belt and pulley.
11. To study simple and compound screw jack and determine the mechanical advantage , velocity ratio and efficiency
12. To study various types of gears- Spur, Helical, Worm and Bevel Gears

Course outcomes:

Upon successful completion of this course the student should be able to:

1. Examine the motion of a motorized gyroscope when the couple is applied along its spin axis (BL-4)
2. Find the frequency of undamped and damped free vibration of an equivalent spring mass system (BL-1)

3. Find the position of sleeve against controlling force and speed of a Hartnell governor and to plot the characteristic curve of radius of rotation (BL-1)
4. Interpret the static and dynamic balancing using rigid blocks (BL-2)
5. Interpret the moment of inertia of a flywheel and Determine whirling speed of shaft theoretically and experimentally (BL-2)

CO-PO Mapping:

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

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Course Objectives:

III Year - I Semester

L	T	P	C
0	0	3	1.5

MACHINE TOOLS LAB

The Students will acquire the knowledge 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.

1. Introduction of general purpose machines -lathe, drilling machine, milling machine, shaper, planing machine, slotting machine, cylindrical grinder, surface grinder and tool and cutter grinder.
2. Step turning and taper turning on lathe machine
3. Thread cutting and knurling on lathe machine.
4. Drilling and tapping
5. Shaping and planning
6. Slotting
7. Milling
8. Cylindrical surface grinding
9. Grinding of tool angles.

Course outcome:
Upon successful completion of this course the student should be able to:

1. Make use of Lathe machine tool to produce step turning, taper turning, knurling and threading features on the given workpiece. (BL-3)
2. Understand the working of Milling machine tool to produce grooves. (BL-2)
3. Utilize Drilling machine tool to produce features of cylindrical holes on flat and round surfaces and perform tapping operation(BL-3)
4. Make use of Shaper and Planer machine tools to produce features of slots and pockets on flat surfaces to the desired quality. (BL-3)
5. Utilize Grinding machine tool to produce finished surfaces and grind cutting tools (BL-3

CO-PO Mapping

SNO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√	√			√	√	√	√	√
CO2	√	√	√	√	√			√	√	√	√	√
CO3	√	√	√	√	√			√	√	√	√	√
CO4	√	√	√	√	√			√	√	√	√	√

CO5	√	√	√	√	√			√	√	√	√	√

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Course Objectives:

	L	T	P	C
III Year - II Semester	**3**	**0**	**0**	**3**

INSTRUMENTATION & CONTROL SYSTEMS

The Students will acquire the knowledge

1. To learn basic principles of measurement systems, errors occurred in measurement systems and measurement of displacement
2. To learn the operating principles and working of different instruments used for temperature and pressuremeasurement
3. To learn the operating principles and working of different instruments used for level, flow and speed measurement
4. To learn the operating principles and working of different instruments used for acceleration, strain and humidity measurement
5. To learn the operating principles and working of different instruments used for force, torque and power and concepts of control systems

UNIT – I

Definition – Basic principles of measurement – measurement systems, generalized configuration and functional descriptions of measuring instruments – examples.dynamic performance characteristics – sources of error, classification and elimination of error.

Measurement of Displacement: Theory and construction of various transducers to measure displacement – piezo electric, inductive, capacitance, resistance, ionization and photo electric transducers, calibration procedures.

UNIT – II

MEASUREMENT OF TEMPERATURE: Classification – ranges – various principles of measurement – expansion, electrical resistance – thermister – thermocouple – pyrometers .

MEASUREMENT OF PRESSURE: Units – classification – different principles used. manometers, bourdon pressure gauges, bellows – diaphragm gauges. low pressure measurement – thermal conductivity gauges – ionization pressure gauges, Mcleod pressure gauge.

UNIT – III

MEASUREMENT OF LEVEL: Direct method – indirect methods – capacitative, ultrasonic, magnetic, cryogenic fuel level indicators – bubler level indicators.

FLOW MEASUREMENT: Rotameter, magnetic, ultrasonic, turbine flow meter, hot – wire anemometer, laser Doppler anemometer (LDA).

MEASUREMENT OF SPEED: Mechanical tachometers – electrical tachometers – stroboscope, noncontact type of tachometer

UNIT – IV

Measurement of Acceleration and Vibration: Different simple instruments – principles of seismic instruments – Vibrometer and accelerometer using this principle.

STRESS STRAIN MEASUREMENTS : Various types of stress and strain measurements – electrical strain gauge – gauge factor – method of usage of resistance strain gauge for bending compressive and tensile strains – usage for measuring torque, strain gauge rosettes.

MEASUREMENT OF HUMIDITY – Moisture content of gases, sling psychrometer, absorption psychrometer, dew point meter.

UNIT – V

MEASUREMENT OF FORCE, TORQUE AND POWER- Elastic force meters, load cells, torsion meters, dynamometers.

ELEMENTS OF CONTROL SYSTEMS : Introduction, importance – classification – open and closed systems, servomechanisms–examples with block diagrams–temperature, speed & position control systems.

Text Books:

1. Measurement Systems: Applications & design / D.S Kumar/
2. Mechanical Measurements / BeckWith, Marangoni,Linehard, Pearson

References:

1. Measurement systems: Application and design/Doeblin Earnest. O. Adaptation/ TMH
2. Experimental Methods for Engineers / J.P.Holman/McGraw Hill
3. Mechanical and Industrial Measurements / R.K. Jain/ Khanna Publishers.
4. Instrumentation, measurement & analysis / B.C.Nakra&K.K.Choudhary/TMH

Course outcomes:

Upon successful completion of this course the student should be able to:

1. Build the principles of measurement systems and construction of various transducers for displacement measurement (BL-3)
2. Classify and study the different types of temperature and pressure measuring devices (BL-2)
3. Understand the working principles of level, flow and speed measuring instruments (BL-2)
4. Utilize the principles of various types of acceleration and vibration, stress and strain and humidity measuring instruments (BL-3)
5. Illustrate the operating principles of force, torque and power measurements and different types of control systems and application of servo mechanisms (BL-2)

CO-PO Mapping

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

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
B.TECH (MECHANICAL ENGINEERING) - R19
EFFECTIVE FROM 2019-20 BATCH

III Year - II Semester

L	T	P	C
3	0	0	3

HEAT TRANSFER

(Heat transfer data book allowed)

Course Objectives:

The Students will acquire the knowledge

1. To learn the different modes of heat transfer and conduction heat transfer through various solid bodies
2. To learn the one dimensional steady state heat conduction heat transfer and one dimensional transient heat conduction
3. To learn the basic concepts of convective heat transfer and forced convection heat transfer of external flows and internal flows
4. To learn the free convection heat transfer concepts and heat transfer processes in heat exchangers
5. To learn the concepts of film wise condensation, drop wise condensation and radiation heat transfer

UNIT – I:

Introduction

Modes and mechanisms of heat transfer – Basic laws of heat transfer –General discussion about applications of heat transfer.

Conduction Heat Transfer

Fourier rate equation – General heat conduction equation in Cartesian, Cylindrical and Spherical coordinates – simplification and forms of the field equation – steady, unsteady and periodic heat transfer – Initial and boundary conditions

One Dimensional Steady State Conduction Heat Transfer

Homogeneous slabs, hollow cylinders and spheres- Composite systems– overall heat transfer coefficient – Electrical analogy – Critical radius of insulation. Variable Thermal conductivity – systems with heat sources or Heat generation-Extended surface (fins) Heat Transfer – Long Fin, Fin with insulated tip and Short Fin, Application to error measurement of Temperature

UNIT – II:

One Dimensional Transient Conduction Heat Transfer

Systems with negligible internal resistance – Significance of Biot and Fourier Numbers – Infinite bodies- Chart solutions of transient conduction systems- Concept of Semi infinite body.

Convective Heat Transfer

Classification of systems based on causation of flow, condition of flow, configuration of flow and medium of flow – Dimensional analysis as a tool for experimental investigation – Buckingham π Theorem and method, application for developing semi – empirical non-dimensional correlation for convection heat transfer – Significance of non-dimensional numbers – Concepts of Continuity, Momentum and Energy Equations

UNIT – III:

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Forced convection: External Flows:

Concepts about hydrodynamic and thermal boundary layer and use of empirical correlations for convective heat transfer -Flat plates and Cylinders.

Internal Flows:

Concepts about Hydrodynamic and Thermal Entry Lengths – Division of internal flow based on this –Use of empirical relations for Horizontal Pipe Flow and annulus flow.

Free Convection:

Development of Hydrodynamic and thermal boundary layer along a vertical plate - Use of empirical relations for Vertical plates and pipes.

UNIT – IV:

Heat Transfer with Phase Change:

Boiling: – Pool boiling – Regimes – Calculations on Nucleate boiling, Critical Heat flux and Film boiling

Condensation: Film wise and drop wise condensation –Nusselt's Theory of Condensation on a vertical plate - Film condensation on vertical and horizontal cylinders using empirical correlations.

Heat Exchangers: Classification of heat exchangers – overall heat transfer Coefficient and fouling factor – Concepts of LMTD and NTU methods - Problems using LMTD and NTU methods.

UNIT V:

Radiation Heat Transfer: Emission characteristics and laws of black-body radiation – Irradiation – total and monochromatic quantities – laws of Planck, Wien, Kirchoff, Lambert, Stefan and Boltzmann– heat exchange between two black bodies – concepts of shape factor – Emissivity – heat exchange between grey bodies – radiation shields – electrical analogy for radiation networks.

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TEXT BOOKS:

1. Heat Transfer by HOLMAN, Tata McgrawHill
2. Heat Transfer by P.K.Nag, TMH

REFERENCE BOOKS:

1. Fundamentals of Heat Transfer by Incropera& Dewitt, John wiley
2. Fundamentals of Engineering, Heat& Mass Transfer by R.C.Sachdeva, NewAge.
3. Heat& Mass Transfer by Amit Pal – Pearson Publishers
4. Heat Transfer by Ghosh dastidar, Oxford University press.
5. Heat Transfer by a Practical Approach, YunusCengel, Boles, TMH
6. Engineering Heat and Mass Transfer by Sarit K. Das, DhanpatRai Pub

Note: Heat and Mass transfer Data Book by C P Kothandaraman and Subrahmanyan is used to design and analyze various thermal processes and thermal equipment.

Course Outcomes:

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

1: Find heat transfer rate for 1D, steady state composite systems with heat generation and performance of pins. (BL-1)

2: Understand the concepts transient heat conduction and basic laws involved in the convection heat transfer. (BL-2)

3: Apply the empirical equations for forced convection and free convection problems (BL-3)

4: Examine the rate of heat transfer with phase change and in the heat exchangers. (BL-4)

5: Illustrate the concepts of radiation heat transfer(BL-2)

CO-PO Mapping

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

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EFFECTIVE FROM 2019-20 BATCH

III Year - II Semester

L	T	P	C
3	0	0	3

FINITE ELEMENT METHODS

Course Objectives:

The Students will acquire the knowledge

1. To learn basic principles of finite element analysis procedure
2. To learn the theory and characteristics of finite elements that represent engineering structures of trusses and beams
3. To learn finite element modeling of two dimensional stress analysis
4. To learn the finite modelling for high order and isoparametric elements
5. To learn the usage of finite element method for the steady state heat transfer analysis

UNIT-I

Introduction to finite element method, stress and equilibrium, strain –displacement relations, stress–strain relations, plane stress and plane strain conditions, Discretization of domain, element shapes, discretization procedures, assembly of stiffness matrix, band width, node numbering, mesh generation, interpolation functions, local and global coordinates, convergence requirements, treatment of boundary conditions.

UNIT – II

Analysis of Trusses: Finite element modelling coordinates and shape functions, assembly of global stiffness matrix and load vector, finite element equations, treatment of boundary conditions, stress, strain and support reaction calculations.

Analysis of Beams: Element stiffness matrix for Hermite beam element, derivation of load vector for concentrated and UDL, simple problems on beams.

UNIT – III

Finite element modelling of two dimensional stress analysis with constant strain triangles and treatment of boundary conditions, formulation of axi-symmetric problems.

UNIT-IV

Higher order and isoparametric elements: One dimensional quadratic and cubic elements in natural coordinates, two dimensional four noded isoparametric elements and numerical integration.

UNIT – V

Steady state heat transfer analysis: one dimensional analysis of a fin and two dimensional analysis of thin plate, analysis of a uniform shaft subjected to torsion. Dynamic Analysis: Formulation of finite element model, element consistent and lumped mass matrices, evaluation of Eigen values and Eigen vectors, free vibration analysis.

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TextBooks:

1.The Finite Element Methods in Engineering /SSRao/Pergamon.

References:

1. Finite Element Method with applications in Engineering / YM Desai, Eldho& Shah /Pearson publishers
2. An introduction to Finite Element Method /JNReddy/McGrawHill
3. The Finite Element Method for Engineers–KennethH.Huebner, Donald L. Dewhirst, Douglas E. Smith and TedG. Byrom/John Wiley & sons (ASIA)PteLtd.
4. Finite Element Analysis: Theory and Application with Ansys, Saeed Moaveniu, Pearson Education
5. Finite Element Methods / Chen
6. Finite Element Analysis: for students & Practicing Engineers / G.Lakshmi Narasaiah / BSP Books Pvt. Ltd.

Course outcomes:

Upon successful completion of this course you should be able to:

1. Understand the concepts discretization procedures and convergence requirements (BL-2)
2. Identify the application and characteristics of FEA elements such as bars and beams. (BL-3)
3. Understand the finite element method for the two dimensional stress analysis.(BL-2)
4. Apply FEM for one dimensional and two dimensional higher order and isoparametric elements.(BL-3)
5. Identify how the finite element method can apply for steady state heat transfer analysis.(BL-3)

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√	√							√
CO2	√	√	√	√	√							√
CO3	√	√	√	√	√							√
CO4	√	√	√	√	√							√
CO5	√	√	√	√	√							√

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EFFECTIVE FROM 2019-20 BATCH

	L	T	P	C
III Year - II Semester	**3**	**0**	**0**	**3**

CAD/CAM

Course Objectives:

The Students will acquire the knowledge

1. To understand the basic fundamentals of computer aided design and manufacturing.
2. To learn 2D & 3D transformations of the basic entities like line, circle, ellipse etc
3. To understand the different geometric modeling techniques like solid modeling, surface modeling, feature based modeling etc. and to visualize how the components look like before its manufacturing or fabrication
4. To learn the part programming, importance of group technology, computer aided process planning, computer aided quality control
5. To learn the overall configuration and elements of computer integrated manufacturing systems.

UNIT – I

Computers in industrial manufacturing, product cycle, CAD / CAM Hardware, basic structure, CPU, memory types, input devices, display devices, hard copy devices, storage devices.

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

GEOMETRIC MODELING: Requirements, geometric models, geometric construction models, curve representation methods, surface representation methods, modeling facilities desired.

DRAFTING AND MODELING SYSTEMS: Basic geometric commands, layers, display control commands, editing, dimensioning, solid modelling.

UNIT – III

PART PROGRAMMING FOR NC MACHINES: NC, NC modes, NC elements, CNC machine tools, structure of CNC machine tools, features of Machining center, turning center, CNC Part Programming: fundamentals, manual part programming methods, Computer Aided Part Programming. Direct Numerical Control, Adaptive Control

UNIT – IV

GROUP TECHNOLOGY: Part family, coding and classification, production flow analysis, types and advantages. Computer aided processes planning – importance, types. FMS-Introduction, Equipment, Tool management systems, Layouts, FMS Control

UNIT – V

COMPUTER AIDED QUALITY CONTROL: Terminology used in quality control, use of computers in Quality control. Inspection methods- contact and noncontact types, computer aided testing, integration of CAQC with CAD/CAM.

COMPUTER INTEGRATED MANUFACTURING SYSTEMS: Types of manufacturing systems, machine tools and related equipment, material handling systems, material requirement planning, computer control systems, human labor in manufacturing systems, CIMS benefits.

Text Books:

1. CAD / CAM Principles and Applications/PN Rao / McGraw-Hill
2. Automation, Production systems & Computer integrated Manufacturing/ M.P. Groover/Pearson Education

References:

1. Mastering CAD / CAM / Ibrahim Zeid / McGraw-Hill
2. Principles of Computer Aided Design and Manufacturing / FaridAmirouche / Pearson
3. Computer Numerical Control Concepts and programming / Warren S Seames / Thomson learning, Inc
4. Product manufacturing and cost estimation using CAD/CAE/ Kuang Hua Chang/Elsevier Publishers

Course Outcome:

At the end of the course the students shall be able to:

1. Understand the basic fundamentals of computers in industrial manufacturing and applications of computer graphics. (BL-2)
2. Interpret geometric modeling techniques and requirements. (BL-2)
3. Develop part programming for NC and CNC machines. (BL-3)
4. Illustrate the concepts of group technology and computer aided process planning for the product development.(BL-2)
5. Understand the concepts of computer aided quality control and Computer Integrated Manufacturing Systems. (BL-2)

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√	√							√
CO2	√	√	√	√	√							√
CO3	√	√	√	√	√							√
CO4	√	√	√	√	√							√
CO5	√	√	√	√	√							√

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NON-DESTRUCTIVEEVALUATION

III Year - II Semester

L	T	P	C
3	0	0	3

(PEC- 1)

Course Objectives:

The Students will acquire the knowledge

1. To learn basic concepts of non-destructive testing and industrial applications
2. To learn the elements of ultrasonic test and limitations of ultrasonic test
3. To learn the concepts involved in the liquid penetrant test and eddy current test
4. To learn the basic principles and operating procedures of magnetic particle testing
5. To learn the basic concepts involved in the infrared and thermal testing

(At least, two equipments on Non-destructive evaluation process are to be demonstrated)

UNIT–I

Introduction to non-destructive testing and 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

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: 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 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

UNIT–IV

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–V

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 behaviour of materials–IR imaging in aerospace applications, electronic components, Honey comb and sandwich structures–Case studies.

TextBooks:

1.Non destructive test and evaluation of Materials/J Prasad, GCK Nair/TMH Publishers
2. Ultrasonic testing of materials/ H Krautkramer/Springer
3. Non destructive testing/Warren, J Mc Gonnagle / Godan and Breach Science publishers
4.Nondestructive evaluation of materials by infrared thermography / X. P. V. Maldague, Springer-Verlag, 1st edition, (1993)

References:

1. Ultrasonic inspection training for NDT/E.A.Gingel/PrometheusPress,
2. ASTMStandards,Vol3.01,Metalsandalloys
3. Non-destructive, Hand Book – R. Hamchand

Course Outcomes

At the end of the course the students shall be able to:

1. Understand the concepts of various NDE techniques and the requirements of radiography techniques and safety aspects. (BL-2)
2. Interpret the principles and procedure of ultrasonic testing (BL-2)
3. Understand the principles and procedure of Liquid penetration and eddy current testing (BL-2)
4. Illustrate the principles and procedure of Magnetic particle testing (BL-2)
5. Interpret the principles and procedure of infrared testing and thermal testing (BL-2)

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√	√							√
CO2	√	√	√	√	√							√
CO3	√	√	√	√	√							√
CO4	√	√	√	√	√							√
CO5	√	√	√	√	√							√

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III Year - II Semester

L	T	P	C
3	0	0	3

JOINING PROCESSES

(PEC- 1)

Course Objectives:

The Students will acquire the knowledge

1. To learn basic principles of metal joining process
2. To learn the theory and procedure involved in the fusion welding process
3. To learn the basic concepts of the pressure welding
4. To Learnthe basic steps of soldering operational steps of brazing.
5. To learn the concepts of modern welding processes

Unit-I: Metal Joining Processes: Joining process as a manufacturing route, relevance of joining process to metallurgy. Different types of joining process, classification of joining process, safety aspects in Metal joining processes, types of joints used in welding.

Unit – II:Fusion Welding Process: Classification of welding process, gas welding, arc welding process (equipments, fluxes, electrodes, procedures, limitations and advantages of various arc welding process), relative advantages and limitations and applications of gas welding and arc welding, thermit welding.

Unit – III:PressureWelding: Resistance welding, cold welding. forge welding. relative advantages, limitation and applications of pressure welding. spot welding, explosion welding, flash welding

Unit – IV: Soldering and Brazing: Basic operational steps of Soldering, Basic operational steps of Brazing, flux and its role in joining process, different types of fluxes, metallurgical aspects of soldering and brazing, applications of soldering and brazing, soldering and Brazing Alloys, adhesive joining.

Unit – V: Modern Welding Processes: Electron beam welding. laser beam welding. Submerged arc welding.ultrasonic welding. under water welding.magnetic pulse welding.

Text Books:

1. Welding technology O.P.KhannaDhanpatRai Publications Ltd. New Delhi

2. Soldering, welding and brazing Lankester George Allen and Unwin, London.

3. Modern arc welding techniques S.V. Nadkarni Oxford IBH Publishers.

References:

1. Engineering metallurgy I and II R.A.Higgins The English University Press Ltd.

2. Welding technology R.S.Parmar Khanna Publishers, NewDelhi

3. Welding engineering Richard little Tata McGraw Hill, NewDelhi

Course Outcomes

At the end of the course the students shall be able to:
1. Understand the concepts of various types of metal joining process (BL-2)
2. Interpret the principles and procedure of fusion welding process (BL-2)
3. Understands the principles and procedure of pressure welding (BL-2)
4. Illustrate the principles and procedure of brazing and soldering(BL-2)
5. Apply the principles and procedures of different modern welding processes (BL-3)

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√	√							√
CO2	√	√	√	√	√							√
CO3	√	√	√	√	√							√
CO4	√	√	√	√	√							√
CO5	√	√	√	√	√							√

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III Year - II Semester

L	T	P	C
3	0	0	3

AUTOMOBILE ENGINEERING

(PEC- 1)

Course Objectives:

The Students will acquire the knowledge

1. To learn basic components and functions of automobile
2. To learn the various elements and working of transmission system of automobile
3. To learn the working of steering system, suspension system and braking system of automobile
4. To learn the concepts involved in the electrical system of automobile, engine specifications and safety systems
5. To learn the concepts involved in the emission control and engine service of different parts

UNIT – I

INTRODUCTION: Components of four wheeler automobile – chassis and body – power unit – power transmission – rear wheel drive, front wheel drive, 4 wheel drive – types of automobile engines, engine construction, turbo charging and super charging – engine lubrication, splash and pressure lubrication systems, oil filters, oil pumps – crank case ventilation – engine service, reboring, decarbonisation, Nitriding of crank shaft.

UNIT – II

TRANSMISSION SYSTEM: Clutches, principle, types, cone clutch, single plate clutch, multi plate clutch, magnetic and centrifugal clutches, fluid fly wheel – gear boxes, types, sliding mesh, construct mesh, synchro mesh gear boxes, epicyclic gear box, over drive torque converter. propeller shaft – Hotch – Kiss drive, Torque tube drive, universal joint, differential rear axles – types – wheels and tyres.

UNIT – III

STEERING SYSTEM: Steering geometry – camber, castor, king pin rake, combined angle toein, center point steering. types of steering mechanism – Ackerman steering mechanism, Davis steering mechanism, steering gears – types, steering linkages.

SUSPENSION SYSTEM: Objects of suspension systems – rigid axle suspension system, torsion bar, shock absorber, Independent suspension system.

UNIT – IV: BRAKING SYSTEM: Mechanical brake system, hydraulic brake system, master cylinder, wheel cylinder tandem master cylinder requirement of brake fluid, pneumatic and vacuum brakes.

ELECTRICAL SYSTEM: Charging circuit, generator, current – voltage regulator – starting system, bendix drive mechanism solenoid switch, lighting systems, horn, wiper, fuel gauge – oil pressure gauge, engine temperature indicator etc.

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UNIT – V

ENGINE SPECIFICATION AND SAFETY SYSTEMS: Introduction- engine specifications with regard to power, speed, torque, no. of cylinders and arrangement, lubrication and cooling etc.

SAFETY: Introduction, safety systems - seat belt, air bags, bumper, anti lock brake system (ABS), wind shield, suspension sensors, traction control, mirrors, central locking and electric windows, speed control

ENGINE EMISSION CONTROL: Introduction – types of pollutants, mechanism of formation, concentration measurement, methods of controlling-engine modification, exhaust gas treatment-thermal and catalytic converters-use of alternative fuels for emission control – National and International pollution standards

ENGINE SERVICE: Introduction, service details of engine cylinder head, valves and valve mechanism, piston-connecting rod assembly, cylinder block, crank shaft and main bearings, engine reassembly-precautions.

Text Books:

1. Automotive Mechanics – Vol. 1 & Vol. 2 / Kirpal Singh/standard publishers
2. Automobile Engineering / William Crouse/TMH Distributors
3. Automobile Engineering/P.S Gill/S.K. Kataria& Sons/New Delhi.

References:

1. Automotive Engines Theory and Servicing/James D. Halderman and Chase D. Mitchell Jr.,/ Pearson education inc.
2. Automotive Engineering / K Newton, W.Steeds& TK Garrett/SAE
3. Automotive Mechanics : Principles and Practices/ Joseph Heitner/Van Nostrand Reinhold
4. Automobile Engineering / C Srinivasan/McGrawHill

Course Outcomes:

At the end of the course the students shall be able to:

1. Acquire the basic knowledge of anatomy of an automobile and its components(BL-2)
2. Analyze the systems of automobile transmission systems(BL-3)
3. Realize the functions of various steering systems, suspension and braking systems (BL-2)
4. Illustrate the functions of electrical systems and understands the concepts of engine specifications and safety systems(BL-2)
5. Analyze the systems of engine servicing and emission control systems(BL-3)

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√	√							√
CO2	√	√	√	√	√							√
CO3	√	√	√	√	√							√
CO4	√	√	√	√	√							√
CO5	√	√	√	√	√							√

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III Year - II Semester

L	T	P	C
3	0	0	3

MECHANICAL VIBRATIONS

(PEC- 1)

Course Objectives:
The Students will acquire the knowledge

1. To learn basic principles of mathematical modeling of vibrating systems
2. To learn the basic concepts free and forced multi degree freedom systems
3. To learn concepts involved in the torsional vibrations
4. To learn the principles involved in the critical speed of shafts
5. To learn the basic concepts of transient vibrations

UNIT-I: INTRODUCTION

Relevance of and need for vibrational analysis – Basics of SHM - Mathematical modelling of vibrating systems - Discrete and continuous systems - single-degree freedom systems - free and forced vibrations, damped and undamped systems.

UNIT-II: MULTI DEGREE FREEDOM SYSTEMS

Free and forced vibrations of multi-degree freedom systems in longitudinal, torsional and lateral modes - Matrix methods of solution- normal modes - Orthogonality principle-Energy methods, Eigen values and Eigen vectors, modal analysis.

UNIT-III: CONTINUOUS SYSTEMS

Torsional vibrations - Longitudinal vibration of rods - transverse vibrations of beams – Governing equations of motion - Natural frequencies and normal modes - Energy methods, Introduction to non linear and random vibrations.

UNIT-IV:CRITICAL SPEEDS OF SHAFTS: Critical speed of a light shaft having a single disc without damping and with damping, critical speeds of shaft having multiple discs, secondary critical speed, critical speeds light cantilever shaft with a large heavy disc at its end.

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UNIT-V: TRANSIENT VIBRATIONS:

Laplace transformations response to an impulsive input, response to a step input, response to pulse(rectangular and half sinusoidal pulse), phase plane method.

Text books:

1. S.S.Rao, "Mechanical Vibrations ", 5th Edition, Prentice Hall, 2011.
2. L.Meirovitch, "Elements of vibration Analysis", 2nd Edition, McGraw-Hill, New York, 1985.

References:

1. W.T. Thomson, M.D. Dahleh and C Padmanabhan, "Theory of Vibration with Applications", 5thEdition,Pearson Education, 2008.
2 M.L.Munjal, "Noise and Vibration Control", World Scientific, 2013.
3. Beranek and Ver, "Noise and Vibration Control Engineering: Principles and Applications", JohnWiley and Sons, 2006.
4. Randall F. Barron, "Industrial Noise Control and Acoustics", Marcel Dekker, Inc., 2003.

Course Outcomes:

At the end of the course the students shall be able to:

1. Understand the concepts of vibrational analysis (BL-2)
2. Understand the concepts of free and forced multi degree freedom systems(BL-2)
3. Summarize the concepts of torsional vibrations (BL-2)
4. Solve the problems on critical speed of shafts (BL-3)
5. Analyze the systems subjected to transient vibrations (BL-4)

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√	√							√
CO2	√	√	√	√	√							√
CO3	√	√	√	√	√							√
CO4	√	√	√	√	√							√
CO5	√	√	√	√	√							√

UNIVERSITY COLLEGE OF ENGINEERING VIZIANAGARAM
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B.TECH (MECHANICAL ENGINEERING) - R19
EFFECTIVE FROM 2019-20 BATCH

III Year - II Semester

L	T	P	C
3	0	0	3

MOOCS

(PEC- 1)

According to R19 regulations, a MOOCS course may be studied either in online or in conventional manner. Evaluation of the course is done as per the R19 regulations

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III Year - II Semester

L	T	P	C
0	0	3	1.5

INSTRUMENTATION & CONTROL SYSTEMS LAB

Course Objectives:

To study and calibrate displacement, temperature, speed, capacitance and pressure measuring instruments

List of Experiments

1. Calibration of pressure gauge.
2. Calibration of transducer for temperature measurement.
3. Study and calibration of LVDT transducer for displacement measurement.
4. Calibration of strain gauge.
5. Calibration of thermocouple.
6. Calibration of capacitive transducer.
7. Study and calibration of photo and magnetic speed pickups.
8. Calibration of resistance temperature detector.
9. Study and calibration of a rotameter.
10. Study and use of a seismic pickup for the measurement of vibration amplitude of an engine bed at various loads.
11. Study and calibration of Mcleod gauge for low pressure.

Course Outcomes:

At the end of the course the students shall be able to:

1. Understand the usage of pressure gauge, Mcleod gauge and temperature measurement transducer.(BL-2)

2. Analyze the usage of LVDT transducer and strain gauge (BL-3)

3. Illustrate concept of applications of thermo couple and capacitive transducer (BL-2)

4. Demonstrate the usage of photo and magnetic speed pickups and resistance temperature detector. (BL-2)

5. Understand the calibration of Rotameter and seismic pickup for measurement of vibrational amplitude (BL-2)

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√	√			√	√	√	√	√
CO2	√	√	√	√	√			√	√	√	√	√
CO3	√	√	√	√	√			√	√	√	√	√

CO4	√	√	√	√	√			√	√	√	√	√
CO5	√	√	√	√	√			√	√	√	√	√

III Year - II Semester

L	**T**	**P**	**C**
0	**0**	**3**	**1.5**

HEAT TRANSFER LAB

Course objectives:

The student will acquire

The laboratory course is aimed to provide the practical exposure to the students with regard to the determination of amount of heat exchange in various modes of heat transfer including condensation & boiling for several geometries.

1. Determination of overall heat transfer co-efficient of a composite slab
2. Determination of heat transfer rate through a lagged pipe.
3. Determination of heat transfer rate through a concentric sphere
4. Determination of thermal conductivity of a metal rod.
5. Determination of efficiency of a pin-fin
6. Determination of heat transfer coefficient in natural and forced convection
7. Determination of effectiveness of parallel and counter flow heat exchangers.
8. Determination of emissivity of a given surface.
9. Determination of Stefan Boltzman constant.
10. Determination of heat transfer rate in drop and film wise condensation.
11. Determination of critical heat flux.
12. Determination of Thermal conductivity of liquids and gases.
13. Investigation of Lambert's cosine law.

Course Outcomes:

At the end of the course the students shall be able to:

1. Find the thermal conductivity of different materials, composite slabs and powders. (BL-1)
2. Solve heat transfer coefficient for free and forced convectionand pin fin efficiency for forced and free convection (BL-2)
3. Examine the Stefan Boltzmann Constant and emissivity of grey body.(BL-4)
4. Compare parallel and counter flow heat exchanger performance characteristics and investigation of Lambert's cosine law (BL-2)
5. Solve the heat transfer rate through lagged pipes and heat transfer rate in film and drop wise condensation (BL-2)

CO-PO Mapping

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S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√	√			√	√	√	√	√
CO2	√	√	√	√	√			√	√	√	√	√
CO3	√	√	√	√	√			√	√	√	√	√
CO4	√	√	√	√	√			√	√	√	√	√
CO5	√	√	√	√	√			√	√	√	√	√

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L	T	P	C
0	0	3	1.5

SIMULATION LAB-I

Course Objectives:

The Students will acquire the knowledge

1. To impart the fundamental knowledge on using various analytical tools like ANSYS, FLUENT, etc., for Engineering Simulation
2. To know various fields of engineering where these tools can be effectively used to improve the output of a product.
3. To impart knowledge on how these tools are used in Industries by solving some real time problems using these tools..

1. **DRAFTING:** Development of part drawings for various components in the form of orthographic and isometric representation of dimensioning and tolerances scanning and plotting. study of script, DXE and IGES files.
2. **PART MODELING:** Generation of various 3D models through protrusion, revolve, shell sweep. creation of various features. study of parent child relation. feature based and boolean based modelling surface and assembly modelling. study of various standard translators. design simple components.

3. a). Determination of deflection and stresses in 2D and 3D trusses and beams.
   b). Determination of deflections component and principal and Von-mises stresses in planestress, plane strain and Axisymmetric components.
   c). Determination of stresses in 3D and shell structures (at least one example in each case)
   d). Estimation of natural frequencies and mode shapes, Harmonic response of 2D beam.
   e). Steady state heat transfer Analysis of plane and Axisymmetric components.

4. a). Study of various post processors used in NC Machines.
   b). Machining of simple components on NC lathe and Mill by transferring NC Code / from aCAM package. Through RS 232.
   c) Practice on CNC Sinutrain Turning
   d) Practice on CNC Sinutrain Milling
   e) CNC programming for turned components using FANUC Controller
   f) CNC programming for milled components using FANUC Controller
   g) Automated CNC Tool path & G-Code generation using Pro/E/MasterCAM

Packages to be provided to cater to drafting, modelling & analysis from the following:
CATIA, Pro-E, I-DEAS, ANSYS, NISA, CAEFEM, Gibbs CAM, Master CAM etc

Course outcomes:

Upon successful completion of this course student should be able to:

1. Understand the concepts of part drawings and assembly of various mechanical parts (BL-2)
2. Understand the concepts of surface and assembly modeling .(BL-2)
3. Solve displacements, stress and reactions in a the 2D bar, beam and truss elements(BL-3)
4. Solve displacements, stress and reactions in a the 3D bar, beam and truss elements(BL-3)
5. Understand the study various post processors used in NC machines and concepts of CNC programming for various operations of milling(BL-2)

CO-PO Mapping

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

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L	T	P	C
0	0	60hrs	2

SUMMER INTERNSHIP / DESIGN / FABRICATION PROJECT / INDUSTRY ORIENTED MINI PROJECT

According to R19 regulations, a Summer Internship / Design / Fabrication Project / Industry Oriented Mini Projectcourse may be completed as per the specified guidelines.

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IV Year - I Semester

L	T	P	C
3	0	0	3

ENGINEERING METROLOGY

Course Objectives:

The students will acquire the knowledge:

1. To build the principles of different types of limits of fits.
2. To understand the use of angle & taper measuring instrument and basic principles of optical measuring instruments
3. To classify the different types of comparators and understanding the principles of surface roughness measurement
4. To understand the concepts of gear and screw thread measurements.
5. To apply the knowledge on principles of flatness measurement and machine tool alignment tests

UNIT-I

SYSTEMS OF LIMITS AND FITS: Introduction, nominal size, tolerance, limits, deviations, fits - Unilateral and bilateral tolerance system, hole and shaft basis systems- interchangeability, deterministic & statistical tolerances, selective assembly. International standard system of tolerances, selection of limits and tolerances for correct functioning.

LINEAR MEASUREMENT: Length standards, end standards, slip gauges- calibration of the slip gauges, dial indicators, micrometers.

UNIT-II

MEASUREMENT OF ANGLES AND TAPERS:

Different methods – bevel protractor, angle slip gauges- angle dekkor- spirit levels- sine bar- sine table, rollers and spheres used to measure angles and tapers.

LIMIT GAUGES:

Taylor's principle – design of go and no go gauges; plug, ring, snap, gap, taper, profile and position gauges.

OPTICAL MEASURING INSTRUMENTS: Tools maker's microscope and uses- autocollimators, optical projector, optical flats and their uses.

INTERFEROMETRY:

Interference of light, Michelson's interferometer, NPL flatness interferometer, and NPL gauge interferometer.

UNIT-III

SURFACE ROUGHNESS MEASUREMENT: Differences between surface roughness and surface waviness –Numerical assessment of surface finish-CLA, Rt., R.M.S. Rz, R10 values, Method of measurement of surface finish – Profilograph, Talysurf, ISI symbols for indication of surface finish.

COMPARATORS: Types - mechanical, optical, electrical and electronic, pneumatic comparators and their uses.
Introduction to Geometric Dimensioning and Tolerance(GD&T) and Coordinate Measuring Machines (CMM)

UNIT – IV
GEAR MEASUREMENT: Nomenclature of gear tooth, tooth thickness measurement with gear tooth vernier & flange micro meter, pitch measurement, total composite error and tooth to tooth composite errors, rolling gear tester, involute profile checking.
SCREW THREAD MEASUREMENT: Elements of measurement – errors in screw threads- concept of virtual effective diameter, measurement of effective diameter, angle of thread and thread pitch, and profile thread gauges.

UNIT – V
FLATNESS MEASUREMENT:
Measurement of flatness of surfaces- instruments used- straight edges- surface plates – auto collimator.
MACHINE TOOL ALIGNMENT TESTS: Principles of machine tool alignment testing on lathe, drilling and milling machines.

Text Books:
1. Dimensional Metrology/Connie Dotson/Cengage Learning
2. Engineering Metrology / R.K.Jain / Khanna Publishers
References:
1. Engineering Metrology / Mahajan / Dhanpat Rai Publishers
2. Engineering Metrology / I.C.Gupta / Dhanpat Rai Publishers
3. Precision Engineering in Manufacturing / R.L.Murthy / New Age
4. Engineering Metrology and Measurements / NV Raghavendra, L Krishna murthy/ Oxford publishers.
5. Engineering Metrology / KL Narayana/Scitech publishers

Course outcomes:
Upon successful completion of this course the student should be able to:
1. Understand the principles of different types of limits of fits. (BL-2)
2. Make use of angle & taper measuring instrument and basic principles of optical measuring instruments (BL-3)
3. Classify the different types of comparators and understanding the principles of surface roughness measurement (BL-2)
4. Understand the concepts of gear and screw thread measurements.(BL-2)
5. Apply the knowledge on principles of flatness measurement and machine tool alignment tests (BL-3)

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CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√	√							√
CO2	√	√	√	√	√							√
CO3	√	√	√	√	√							√
CO4	√	√	√	√	√							√
CO5	√	√	√	√	√							√

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IV Year - I Semester

L	T	P	C
3	0	0	3

ADDITIVE MANUFACTURING
(PEC-2)

Course Objectives:
The students will acquire the knowledge:

1. To identify the use of Rapid Prototyping Techniques and principles of liquid-based rapid prototyping systems
2. To understand the principles of solid-based rapid prototyping systems
3. To understand the principles of powder based rapid prototyping systems and classify rapid tooling
4. To identify rapid prototyping data formats
5. To interpret the application of rapid prototyping in engineering, analysis and planning

UNIT – I

INTRODUCTION: Prototyping fundamentals, historical development, fundamentals of rapid prototyping, advantages and limitations of rapid prototyping, commonly used terms, classification of RP process.

LIQUID-BASED RAPID PROTOTYPING SYSTEMS: Stereo lithography Apparatus (SLA): models and specifications, process, working principle, photopolymers, photo polymerization, layering technology, laser and laser scanning, applications, advantages and disadvantages, case studies. Solid Ground Curing (SGC): models and specifications, process, working principle, applications, advantages and disadvantages, case studies.

UNIT-II

SOLID-BASED RAPID PROTOTYPING SYSTEMS: Laminated object manufacturing (LOM) - models and specifications, process, working principle, applications, advantages and disadvantages, case studies. Fused deposition modelling (FDM) - models and specifications, process, working principle, applications, advantages and disadvantages, case studies.

Introduction to Wire arc additive manufacturing and surface treatment techniques required for rapid prototype models

UNIT – III

POWDER BASED RAPID PROTOTYPING SYSTEMS: Selective laser sintering (SLS): models and specifications, process, working principle, applications, advantages and disadvantages, case studies. three dimensional printing (3DP): models and specifications, process, working principle, applications, advantages and disadvantages, case studies.

RAPID TOOLING: Introduction to rapid tooling (RT), conventional tooling Vs RT, Need for RT. rapid tooling classification: indirect rapid tooling methods: spray metal deposition, RTV epoxy tools, Ceramic tools, investment casting, spin casting, die casting, sand casting, 3D Keltool

process. Direct rapid tooling: direct AIM, LOM Tools, DTM Rapid Tool Process, EOS Direct Tool Process and Direct Metal Tooling using 3DP.

UNIT – IV

RAPID PROTOTYPING DATA FORMATS: STL Format, STL File Problems, consequence of building valid and invalid tessellated models, STL file Repairs: Generic Solution, other Translators, Newly Proposed Formats.

RAPID PROTOTYPING SOFTWARE'S: Features of various RP software's like Magics, Mimics, Solid View, View Expert, 3 D View, Velocity 2, Rhino, STL View 3 Data Expert and 3 D doctor.

UNIT –V

RP APPLICATIONS: 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 bimolecular.

Text Books:

1. Rapid prototyping: Principles and Applications /Chua C.K., Leong K.F. and LIMC.S/World Scientific publications

Reference Books:

1. Rapid Manufacturing / D.T. Pham and S.S. Dimov/Springer
2. Wohlers Report 2000 /Terry T Wohlers/Wohlers Associates
3. Rapid Prototyping & Manufacturing / Paul F.Jacobs/ASME Press
4. Rapid Prototyping / Chua &Liou

Course Outcomes:

Upon successful completion of this course the student should be able to:

1. Identify the use of Rapid Prototyping Techniques and principles of liquid-based rapid prototyping systems(BL-3)
2. Understand the principles of solid-based rapid prototyping systems (BL-2)
3. Understand the principles of powder based rapid prototyping systems and classify rapid tooling (BL-2)
4. Identify rapid prototyping data formats (BL-3)
5. Interpret the application of rapid prototyping in engineering, analysis and planning (BL-2)

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√	√							√
CO2	√	√	√	√	√							√
CO3	√	√	√	√	√							√
CO4	√	√	√	√	√							√
CO5	√	√	√	√	√							√

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IV Year - I Semester

L	T	P	C
3	0	0	3

REFRIGERATION & AIR CONDITIONING

(PEC-2)
(Refrigeration and Psychrometric tables and charts allowed)

Course Objectives:

The students will acquire the knowledge:

1. To illustrate the operating cycles and different systems of refrigeration
2. To analyze cooling capacity and coefficient of performance of vapour compression refrigeration systems and understand the properties of refrigerants
3. To identify VCR system components and calculate coefficient of performance by conducting test on vapour absorption and steam jet refrigeration systems
4. To calculate cooling load for air conditioning systems and identify the requirements of comfort air conditioning
5. To describe different component of refrigeration and air conditioning systems

UNIT – I

INTRODUCTION TO REFRIGERATION: Necessity and applications – unit of refrigeration and C.O.P. – Mechanical refrigeration – types of ideal cycles of refrigeration. air refrigeration: Bell Coleman cycle - open and dense air systems – refrigeration systems used in air crafts and problems.

UNIT – II

VAPOUR COMPRESSION REFRIGERATION: Working principle and essential components of the plant – simple vapour compression refrigeration cycle – COP – representation of cycle on T-S and p-h charts – effect of sub cooling and super heating – cycle analysis – actual cycle influence of various parameters on system performance – use of p-h charts – numerical problems.

VCR SYSTEM COMPONENTS: Compressors – general classification – comparison – advantages and disadvantages. condensers – classification – working principles evaporators – classification – working principles expansion devices – types – working principles

REFRIGERANTS – Desirable properties – classification - refrigerants used – nomenclature – ozone depletion – global warming

UNIT III

VAPOR ABSORPTION SYSTEM: Calculation of maximum COP – description and working of NH_3 – water system and Li Br –water (Two shell & Four shell) System, principle of operation three fluid absorption system, salient features.

STEAM JET REFRIGERATION SYSTEM: Working Principle and basic components. principle and operation of (i) thermoelectric refrigerator (ii) vortex tube.

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UNIT IV

INTRODUCTION TO AIR CONDITIONING: Psychometric properties & processes – characterization of sensible and latent heat loads — need for ventilation, consideration of infiltration – load concepts of RSHF, GSHF- problems, concept of ESHF and ADP temperature. Requirements of human comfort and concept of effective temperature- comfort chart –comfort air conditioning – requirements of industrial air conditioning, air conditioning load calculations.

UNIT – V

AIR CONDITIONING SYSTEMS: Classification of equipment, cooling, heating humidification and dehumidification, filters, grills and registers, fans and blowers. heat pump – heat sources – different heat pump circuits.

Text Books:

1. A Course in Refrigeration and Air conditioning / SC Arora &Domkundwar / Dhanpatrai
2. Refrigeration and Air Conditioning / CP Arora / TMH.

References:

1. Refrigeration and Air Conditioning / Manohar Prasad / New Age.
2. Principles of Refrigeration /Dossat / Pearson Education.
3. Basic Refrigeration and Air-Conditioning / Ananthanarayanan / TMH

Course outcomes:

Upon successful completion of this course the student should be able to:

1. Illustrate the operating cycles and different systems of refrigeration (BL-2)
2. Analyze cooling capacity and coefficient of performance of vapour compression refrigeration systems and understand the properties of refrigerants (BL-3)
3. Identify VCR system components and calculate coefficient of performance by conducting test on vapour absorption and steam jet refrigeration systems (BL-3)
4. Solve cooling load for air conditioning systems and identify the requirements of comfort air conditioning (BL-2)
5. Demonstrate different component of refrigeration and air conditioning systems.(BL-2)

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√	√							√
CO2	√	√	√	√	√							√
CO3	√	√	√	√	√							√
CO4	√	√	√	√	√							√
CO5	√	√	√	√	√							√

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IV Year - I Semester

L	T	P	C
3	0	0	3

ADVANCED MECHANICS OF SOLIDS

(PEC-2)

Course Objectives:

The students will acquire the knowledge:

1. To understand theories of stress and strain and Stress –strain temperature relations
2. To determine failure criteria and elastic deflections for statically indeterminate members and structures
3. To study the effect of unsymmetrical bending and curved beam theory
4. To determine the effect of Torsion with Linear elastic solution and Prandtl elastic membrane (Soap-Film) Analogy
5. To solve the problems for determining contact stresses and deflections of bodies with point contact.

UNIT I

A brief review onfailure criteria andmodes of failure, Excessive deflections, Yield initiation, fracture, Progressive fracture, High Cycle fatigue for number of cycles $N > 10^6$, buckling.Concept of Creep. Application of energy methods: Elastic deflections and statically indeterminate members and structures: Principle of stationary potential energy, Castiglione's theorem on deflections, Castiglione's theorem on deflections for linear load deflection relations, deflections of statically determinate structures.

UNIT II

Unsymmetrical bending: Bending stresses in Beams subjected to Non-symmetrical bending; Deflection of straight beams due to non-symmetrical bending.

UNIT III

Curved beam theory: Winkler Bach formula for circumferential stress – Limitations – Correction factors –Radial stress in curved beams – closed ring subjected to concentrated and uniform loads-stresses in chain links.

UNIT IV

Torsion : Linear elastic solution; Prandtl elastic membrane (Soap-Film) Analogy; Narrow rectangular cross Section ;Hollow thin wall torsion members ,Multiply connected Cross Section.

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UNIT V

Contact stresses: Introduction; problem of determining contact stresses; Assumptions on which a solution for contact stresses is based; Expressions for principal stresses; Method of computing contact stresses; Deflection of bodies in point contact; Stresses for two bodies in contact over narrow rectangular area (Line contact), Loads normal to area; Stresses for two bodies in line contact, Normal and Tangent to contact area.

Text Books:

1.Advanced Mechanics of materials by Boresi& Sidebottom-Wiely International.

2. Theory of elasticity by Timoschenko S.P. and Goodier J.N. McGraw-Hill Publishers 3rd Edition

3. Advanced Mechanics of Solids, L.S Srinath

Reference Books:

1. Advanced strength of materials by Den Hortog J.P.
2. Theory of plates – Timoshenko.
3. Strength of materials & Theory of structures (Vol I & II) by B.C Punmia
4. Strength of materials by Sadhu Singh

Course outcomes:

Upon successful completion of this course the student should be able to:

1. Interpret failure criteria and elastic deflections for statically indeterminate members and structures(BL-2)
2. Summarize the effect of unsymmetrical bending (BL-2)
3. Understand the effect of curved beam theory (BL-2)
4. Find the effect of Torsion with Linear elastic solution and Prandtl elastic membrane (Soap-Film) Analogy(BL-1)
5. Solve the problems for determining contact stresses and deflections of bodies with point contact(BL-3)

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√	√							√
CO2	√	√	√	√	√							√
CO3	√	√	√	√	√							√
CO4	√	√	√	√	√							√
CO5	√	√	√	√	√							√

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IV Year - I Semester

L	T	P	C
3	0	0	3

CONDITION MONITORING

(PEC-2)

Course Objectives:
The students will acquire the knowledge:

1. To introduce the basics of vibration
2. To analyze vibration measurement and analysis using transducers and mounting methods
3. To understand fault diagnosis andinterpret vibration measurements
4. To understandoil and wear debris analysis
5. To interpret Ultrasonic monitoring and analysis

UNIT-I

BASICS OF VIBRATION: Basic motion: amplitudes, period, frequency, basic parameters: displacement, velocity, acceleration, units (including dB scales) and conversions, Mass, spring and damper concept, Introduction to SDOF and MDOF systems, Natural frequencies and resonance, Forced response.

UNIT-II

VIBRATION MEASUREMENTS AND ANALYSIS: Transducers and mounting methods, data acquisition using instrumentation recorders/data loggers, time domain signal analysis, orbit analysis, Filters, Frequency domain analysis (Narrow band FFT analysis), Nyquist criteria, Sampling, aliasing, windowing and averaging.

UNIT-III

Fault Diagnosis, Interpreting vibration measurements for common machine faults , imbalance, misalignment, mechanical looseness, bearing and gearing faults, faults in induction motors, resonances, some case studies, static and dynamic balancing, international standards for vibration condition monitoring.

THERMOGRAPHY: The basics of infrared thermography, differences in equipment and specific wave length limitations, application of ir to: electrical inspection, mechanical inspection, energy conservation, how to take good thermal images, hands-on demonstrations focusing on proper camera settings and image interpretation, analysis of thermal images and report generation, study of thermography applications

UNIT-IV

OIL AND WEAR DEBRIS ANALYSIS: Basics of oil analysis, monitoring condition of oil, lubricant analysis, physio – chemical properties, moisture, tan tbn, wear debris analysis, particle counting, spectroscopy, uses & limitations, ferrography wear particle analysis, concept of ferrography, principle particle classification, size, shape, composition, concentration, analysis procedure, sampling & analytical ferrography equipments, severity rating.

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UNIT-V

ULTRASONIC MONITORING AND ANALYSIS: Ultrasonic monitoring (leak, crack and thickness) basics of ultrasonic monitoring , ultrasonic theory, test taking philosophy, ultrasonic theory, mathematics of ultrasound, equipment and transducers, inspection parameters and calibration, immersion theory, equipment quality control, flaw origins and inspection methods, UT Procedure familiarization, and study recommendations, application of ultrasound to: air leaks, steam trap testing, bearing lubrication, electrical inspection, case studies.

Text Books:

1. The Vibration Analysis Handbook/J I Taylor (1994)/Vibration consultants Incorporate Publishers
2. Machinery Vibration Condition Monitoring/Lynn/Butterworth(1989)

References:

1. Machinery Vibration: Measurement and Analysis/Victor Wowk/Mc GrawHill Professional
2. Mechanical fault diagnosis and condition monitoring/RA Collacott(1977) /Chapman and Hall
3. The Vibration Monitoring Handbook/Charles W Reeves/Coxmoor publishing company

Course outcomes:
Upon successful completion of this course the student should be able to:

1. Understand the basics of vibration (BL-2)
2. Analyze vibration measurement and analysis using transducers and mounting methods (BL-3)
3. Understand fault diagnosis andinterpret vibration measurements (BL-2)
4. Understand oil and wear debris analysis (BL-2)
5. Interpret Ultrasonic monitoring and analysis(BL-2)

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√	√							√
CO2	√	√	√	√	√							√
CO3	√	√	√	√	√							√
CO4	√	√	√	√	√							√
CO5	√	√	√	√	√							√

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EFFECTIVE FROM 2019-20 BATCH

IV Year - I Semester

L	T	P	C
3	0	0	3

ADVANCED MANUFACTURING PROCESSES

(PEC-3)

Course Objectives:

The students will acquire the knowledge:

1. To interpret the methods of surface treatment such as electro forming, chemical vapour deposition, thermal spraying etc.
2. To identify the need of non-traditional machining processes and understand their principles and process characteristics
3. To understand the principle of working, process parameters and applications of laser beam machining, plasma arc machining and electron beam machining
4. To understand processing of ceramics and composites
5. To understand fabrication of micro electron devices, e-manufacturing, nanotechnology, and micromachining, High speed Machining

UNIT - I:

Surface treatment: Scope, Cleaners, Methods of cleaning, Surface coating types, andceramic and organic methods of coating, economics of coating. Electro forming, Chemicalvapour deposition, thermal spraying, Ion implantation, diffusion coating, Diamond coatingand cladding.

UNIT - II:

Non-Traditional Machining: Introduction, need ,AJM, Parametric Analysis, Processcapabilities, USM –Mechanics of cutting, models, Parametric Analysis, WJM –principle,equipment ,process characteristics , performance, EDM – principles, equipment, generators,analysis of R-C circuits, MRR , Surface finish, WEDM.

Electro Chemical Machining – Principle of working, equipment, Material removal rate, Process parameters, performance characterization, Applications.

UNIT - III:

Laser Beam Machining – Principle of working, equipment, Material removal rate, Processparameters, performance characterization, Applications.

Plasma Arc Machining – Principle of working, equipment, Material removal rate, Process parameters, performance characterization, Applications.

Electron Beam Machining - Principle of working, equipment, Material removal rate, Processparameters, performance characterization, Applications.

UNIT - IV:

Processing of ceramics: Applications, characteristics, classification .Processing ofparticulate ceramics, Powder preparations, consolidation, Drying, sintering, Hot compaction,Area of application , finishing of ceramics. Processing of Composites: Composite Layers, Particulate and fiber reinforced composites, Elastomers, Reinforced plastics, MMC, CMC, Polymer matrix composites.

UNIT - V:

Fabrication of Microelectronic devices: Crystal growth and wafer preparation, FilmDeposition oxidation, lithography, bonding and packaging, reliability and yield, Printed Circuitboards, computer aided design in microelectronics, surface mount technology, Integratedcircuit economics, High speed Machining

TEXT BOOKS:

1. Manufacturing Engineering and Technology, Kalpakijian, Adisson Wesley, 1995.
2. Process and Materials of Manufacturing, R. A. Lindburg, 4th edition, PHI 1990.
3. Foundation of MEMS/ Chang Liu/Pearson, 2012.

REFERENCE BOOKS:

1. Advanced Machining Processes, V.K.Jain, Allied Publications.
2. Introduction to Manufacturing Processes, John A Schey, Mc Graw Hill.

Course Out comes:

Upon successful completion of this course student should be able to:

1. Interpret the methods of surface treatment such as electro forming, chemical vapour deposition, thermal spraying etc. (BL-2)
2. Identify the need of non-traditional machining processes and understand their principles and process characteristics (BL-3)
3. Understand the principle of working, process parameters and applications of laser beam machining, plasma arc machining and electron beam machining (BL-2)
4. Understand processing of ceramics and composites (BL-2)
5. Understand fabrication of micro electron devices, and High speed Machining (BL-2)

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CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√	√							√
CO2	√	√	√	√	√							√
CO3	√	√	√	√	√							√
CO4	√	√	√	√	√							√
CO5	√	√	√	√	√							√

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IV Year - I Semester

L	T	P	C
3	0	0	3

AUTOMATION IN MANUFACTURING

(PEC-III)

Course Objectives:

The students will acquire the knowledge:

1. To understands the types and strategies and various components in Automated Systems
2. To classify the types of automated flow lines and analyze automated flow lines
3. To solve the line balancing problems in the various flow line systems with and without buffer storage
4. To interpret different automated material handling systems, storage and retrieval systems and automated inspection systems
5. To understand the principles of Adaptive Control systems and recognize the types of automated inspection techniques and their applications

UNIT-I

INTRODUCTION: Types and strategies of automation, pneumatic andhydraulic components, circuits, automation in machine tools, mechanicalfeeding and tool changing and machine tool control.

UNIT – II

AUTOMATED FLOW LINES: Methods of part transport, transfermechanism, buffer storage, control function, design and fabricationconsiderations.Analysis of automated flow lines - General terminology and analysis oftransfer lines without and with buffer storage, partial automation,implementation of automated flow lines.

UNIT – III

ASSEMBLY SYSTEM AND LINE BALANCING: Assembly process andsystems, assembly line, line balancing methods, ways of improving linebalance, flexible assembly lines.

UNIT – IV

AUTOMATED MATERIAL HANDLING and STORAGE SYSTEMS:

Types of equipment, functions, analysis and design of material handlingsystems, conveyor systems, automated guided vehicle systems. Automatedstorage and retrieval systems; work in process storage, interfacing handlingand storage with manufacturing.

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UNIT – V

ADAPTIVE CONTROL SYSTEMS: Introduction, adaptive control withoptimization, adaptive control with constraints, application of adaptivecontrol in machining operations. Consideration of various parameters such ascutting force, temperatures, vibration and acoustic emission in the adaptivecontrols systems.

AUTOMATED INSPECTION: Fundamentals, types of inspectionmethods and equipment, Coordinate Measuring Machines, Machine Vision.

TEXT BOOK:

1. Automation, Production Systems and Computer IntegratedManufacturing : M.P. Groover./ PE/PHI.

REFERENCES:

1. Computer Control of Manufacturing Systems by YoramCoren.
2. CAD / CAM/ CIM by Radhakrishnan.
3. Automation by W. Buekinsham.

Course outcomes:

Upon successful completion of this course student should be able to :

1. Understands the types and strategies and various components in Automated Systems (BL-2)
2. Classify the types of automated flow lines and analyze automated flow lines (BL-2)
3. Solves the line balancing problems in the various flow line systems with and without buffer storage (BL-3)
4. Interpret different automated material handling systems, storage and retrieval systems and automated inspection systems (BL-2)
5. Understand the principles of Adaptive Control systems and recognize the types of automated inspection techniques and their applications (BL-2)

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√	√							√
CO2	√	√	√	√	√							√
CO3	√	√	√	√	√							√
CO4	√	√	√	√	√							√
CO5	√	√	√	√	√							√

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IV Year - I Semester

L	T	P	C
3	0	0	3

COMPUTATIONAL FLUID DYNAMICS

(PEC-III)

Course Objectives:

The students will acquire the knowledge:

1. To explain elementary details and numerical techniques for solving various engineering problems involving fluid flow.
2. To solve problems of fluid flow using applied numerical methods and understand equations governing fluid flow and heat transfer
3. To interpret fluid flow problems with steady flow and finite difference in heat conduction and convention
4. To understand the concepts of finite differences, discretization, consistency, stability and fundamentals of fluid flow modelling
5. To understand the concepts of first order wave equation and finite volume method.

UNIT-I

ELEMENTARY DETAILS AND NUMERICAL TECHNIQUES Number system and errors, representation of integers, fractions, floating point arithmetic, loss of significance and error propagation, condition and instability, computational methods for error estimation, convergence of sequences.

UNIT – II

APPLIED NUMERICAL METHODS: Solution of a system of simultaneous linear algebraic equations, iterative schemes of matrix inversion, direct methods for matrix inversion, direct methods for banded matrices.

REVIEWOFEQUATIONSGOVERNINGFLUIDFLOWANDHEATTRANSFER:

Introduction, conservation of mass, Newton's second law of motion, expanded form sofnavier-stokes equations, conservation of energy principle, special forms of the Navier-stokes equations.

UNIT –III

Steady flow, dimensionless form of momentum and energy equations, stokes equation, conservative body force fields, stream function -vorticity formulation.

Finite difference applications in heat conduction and convention –heat conduction, steady heat conduction in a rectangular geometry, transient heat conduction, finite difference application in convective heat transfer, closure.

UNIT – IV

Finite differences, discretization, consistency, stability and fundamentals of fluid flow modelling: introduction, elementary finite difference quotients, implementation aspectsoffinite-differenceequations, consistency, explicit and implicit methods.

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UNIT –V

Introduction to first order wave equation, stability of hyperbolic and elliptic equations, fundamentals of fluid flow modelling, conservative property, the upwind scheme.

FINITE VOLUMEMETHOD: Approximation of surface integrals, volume integrals, interpolation and differentiation practices, upwind interpolation, linear interpolation and quadratic interpolation.

TextBooks:

1.Numericalheat transferandfluidflow/SuhasV.Patankar/Butter-worthPublishers
2.Computationalfluiddynamics-Basics with applications/John.D.Anderson/McGrawHill.

References:

1.ComputationalFluidFlowand Heat Transfer/ Niyogi/Pearson Publications
2.FundamentalsofComputationalFluidDynamics /TapanK.Sengupta/Universities Press.
3.Computationalfluiddynamics: An introduction, 3rd edition/John.F Wendt/Springer publishers

Course Outcomes:

Upon successful completion of this course student should be able to:

1. Find elementary details and numerical techniques for solving various engineering problems involving fluid flow. (BL-1)
2. Solve problems of fluid flow using applied numerical methods and understand equations governing fluid flow and heat transfer (BL-3)
3. Interpret fluid flow problems with steady flow and finite difference in heat conduction and convention (BL-2)
4. Understand the concepts of finite differences, discretization, consistency, stability and fundamentals of fluid flow modelling (BL-2)
5. Understand the concepts of first order wave equation and finite volume method. (BL-2)

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√	√							√
CO2	√	√	√	√	√							√
CO3	√	√	√	√	√							√
CO4	√	√	√	√	√							√
CO5	√	√	√	√	√							√

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IV Year - I Semester

L	T	P	C
3	0	0	3

NOISE & VIBRATION CONTROL

(PEC-3)

Course Objectives:

The students will acquire the knowledge:

1. To understand the concept of two degree of freedom system with free and forced vibrations
2. To interpret the concept of multi degree of freedom system and perform free un-damped analysis
3. To understand the concept of numerical methods and continuous systems
4 To perform analysis and measurement of sound for one dimensional waves in a gas
5. To understand the noise criteria and noise controlling techniques

UNIT- I

Two degree of freedom system:

Free vibrations of spring coupled system, general solution, torsional vibrations, two degree of freedom, mass coupled system, bending vibrations in two degree of freedom system, forced vibrations of an undampedtwo degree of freedom system, dynamic vibration absorber, forced damped vibrations.

Vibration measurement devices and analysers, balancing of rigid rotors, Experimental methods in vibration analysis

UNIT- II

Multi-degree of freedom system:

Free un-damped analysis and forced vibrations of multi-degree freedom systems in longitudinal, torsional and lateral modes - Matrix methods of solution- normal modes - Orthogonality principle- Energy methods, Eigen values and Eigen vectors, Modal analysis

UNIT-III:

NUMERICAL METHODS: Dunkerley's, Rayleigh, Holzer methods. Stodola methods

CONTINUOUS SYSTEMS: Torsional vibrations - Longitudinal vibration of rods - transverse vibrations of beams – Governing equations of motion - Natural frequencies and normal modes - Energy methods, Introduction to non linear and random vibrations.

UNIT- IV

Analysis and measurement of sound:

One dimensional waves in a gas, sound perception and the decibel scale, the ear, combining sound levels in decibels, octave bands, loudness, weightings, directionality of acoustic sources and receivers, directivity index

Noise: Noise dose level, measurement and analysis of noise, measurement environment, equipment, frequency analysis, tracking analysis, sound quality analysis.

UNIT- V

Noise control:

Noise criteria, sound absorption and insulation, noise barriers, acoustic enclosures, silencers

Text Books

1. Mechanical Vibrations – W.T. Thomson W.T.- Prentice Hill India
2. Theory & Practice of Mechanical Vibrations – J.S. Rao, Gupta – New Age International.

Reference Books

1. Mechanical Vibrations – G.K. Grover – S. Chand & CO.
2. Acoustics for Engineers – Turner &Pretlove – Macmillan
3. Acoustics and Noise Control – Smith, Peters & Owen – Addison-Wesley-Longman, 2nd Edition
4. Industrial Noise Control: Fundamentals and Applications – Bell and Bell, Marcel-Dekker

Course Out comes:

Upon successful completion of this course student should be able to:

1. Understand the concept of two degree of freedom system with free and forced vibrations (BL-2)
2. Interpret the concept of multi degree of freedom system and perform free un-damped analysis (BL-2)
3. .Analyze the concepts of numerical methods and continuous systems (BL-4)
4. Understand the noise levels and impact on environment (BL-2)
5. Interpret the noise criteria and noise controlling techniques (BL-2)

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CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√	√							√
CO2	√	√	√	√	√							√
CO3	√	√	√	√	√							√
CO4	√	√	√	√	√							√
CO5	√	√	√	√	√							√

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IV Year - I Semester

L	T	P	C
3	0	0	3

OPERATIONS MANAGEMENT

(OEC-1)

Course Objectives:

The students will acquire the knowledge:

1. To identify types of forecasting techniques and their principles
2. To analyze plant and process layout
3. To understand about material management and MRP logic
4. To apply the concepts of aggregate planning and scheduling
5. To understand the concepts of inventory control, MRP-II, JIT, ERP and supply chain management

UNIT-I

Forecasting: Introduction, types of forecasting and their uses, General principles of forecasting, forecasting techniques: qualitative and quantitative methods of Forecasting.
Production Systems: Types of production systems: job, batch, mass and flow type production.

UNIT-II

Plant Location: Factors affecting the plant location, comparison of rural and urban sites.
Plant Layout: Introduction, principles of plant layout, types of plant layouts

UNIT-III

Materials Management: Introduction, functions of materials management, inventory, inventory management, types of inventories, Selective inventory control techniques: ABC analysis, VED analysis. Material Requirement Planning: Introduction, Inputs, outputs and MRP logic.

UNIT-IV

Aggregate Planning: Introduction, aggregate planning strategies, aggregate planning methods mathematical planning models, heuristic and computer search models, problems. Scheduling: Introduction, difference with loading, scheduling policies, techniques, standard scheduling methods.

UNIT-V

Inventory Control: Deterministic models, safety stock inventory control systems Contemporary management techniques: Introduction to MRP-II, JIT, ERP and Supply chain management

TEXT BOOKS:

1. Operations Management /Joseph. G.Monks, International (3rd) Edition
2. Elements of Production Planning and Control / Samuel Eilon.
3. Modern Production/ operation managements / Baffa& Rakesh Sarin

REFERENCES:

1. Operations Management – S.N. Chary.
2. Inventory Control Theory and Practice / Martin K. Starr and David W. Miller.
3. Production And Operation Management / MartandTelsang
4. Production Control A Quantitative Approach / John E. Biegel.
5. Production Control / Moore.

Course Out comes:

Upon successful completion of this course student should be able to:

1. Identify types of forecasting techniques and their principles (BL-2)
2. Analyze plant and process layout (BL-4)
3. Understand about material management and MRP logic (BL-2)
4. Applythe concepts of aggregate planning and scheduling (BL-3)
5. Understand the concepts of inventory control, MRP-II, JIT, ERP and supply chain management (BL-2)

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√	√							√
CO2	√	√	√	√	√							√
CO3	√	√	√	√	√							√
CO4	√	√	√	√	√							√
CO5	√	√	√	√	√							√

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IV Year - I Semester

L	T	P	C
3	0	0	3

OPTIMIZATION TECHNIQUES

(OEC-1)

COURSE OBJECTIVES:

The students will acquire the knowledge:

1. To understand classification of optimization problem and apply classical optimization techniques
2. To apply unconstrained optimization techniques using various methods
3. To understand the characteristics and approaches of constrained optimization techniques
4. To obtain optimized solutions using constrained and unconstrained geometric programming
5. To understand integer programming methods

UNIT I

INTRODUCTION TO OPTIMIZATION: Engineering applications of optimization- statement of an optimization problem- classification of optimization problem- optimization techniques.
CLASSICAL OPTIMIZATION TECHNIQUES: Single variable optimization- multivariable optimization with equality constraints- multivariable optimization with inequality constraints.

UNIT-II

UNCONSTRAINED OPTIMIZATION TECHNIQUES: Pattern search method- Rosenbrock's method of rotating coordinates- Simplex method- Descent methods- Gradient of function- Steepest Descent method.

UNIT-III

CONSTRAINED OPTIMIZATION TECHNIQUES: Characteristics of constrained problem methods of feasible directions - basic approach in the penalty function method- interior penalty function method- convex programming problem- exterior penalty function method.

UNIT-IV

GEOMETRIC PROGRAMMING (G.P): Solution of an unconstrained geometric programming, differential calculus method and arithmetic method. primal dual relationship and sufficiency conditions.
Solution of a constrained geometric programming problem (G.P.P). Complimentary geometric programming (C.G.P)

UNIT-V

INTEGER PROGRAMMING (I.P): Graphical representation. Gomory's cutting plane method. Bala's algorithm for zero-one programming problem. Integer non linear programming.

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TEXT BOOK:
1. Optimization Theory and Applications/ S.S.Rao/Wiley Eastern Limited, New Delhi.

REFERENCES:
1. Engineering Optimization / Kalyanmanai Deb/Prentice Hall of India, New Delhi.
2. Optimization Techniques-Theory and applications/C.Mohan&Kusum Deep/New Age International
3. Operations Research /S.D.Sharma / MacMillan Publishers

Course Out comes:
Upon successful completion of this course student should be able to:

1. Understand classification of optimization problem and apply classical optimization techniques (BL-2)
2. Apply unconstrained optimization techniques using various methods (BL-3)
3. Understand the characteristics and approaches of constrained optimization techniques (BL-2)
4. Identify optimized solutions using constrained and unconstrained geometric programming (BL-3)
5. Understand integer programming methods (BL-2)

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√	√							√
CO2	√	√	√	√	√							√
CO3	√	√	√	√	√							√
CO4	√	√	√	√	√							√
CO5	√	√	√	√	√							√

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IV Year - I Semester

L	T	P	C
3	0	0	3

INDUSTRIAL ROBOTICS

(OEC-1)

Course Objectives:
The students will acquire the knowledge:

1. To understand various applications of robotics and classification of coordinate system and control systems
2. To build the concepts of components of industrial robotics.
3. To determine kinematic analysis with D-H notation, forward and inverse kinematics and Solve dynamic analysis with Lagrange – Euler and Newton – Euler formulations
4. To model trajectory planning for a manipulator by avoiding obstacles
5. To understand different types of actuators and applications of robots in manufacturing

UNIT-I
INTRODUCTION: Automation and Robotics, CAD/CAM and Robotics – An over view of Robotics – present and future applications – classification by coordinate system and control system.

UNIT – II
COMPONENTS OF THE INDUSTRIAL ROBOTICS: Function line diagram representation of robot arms, common types of arms. Components, Architecture, number of degrees of freedom – Requirements and challenges of end effectors, determination of the end effectors, comparison of Electric, Hydraulic and Pneumatic types of locomotion devices.

UNIT – III
MOTION ANALYSIS: Homogeneous transformations as applicable to rotation and translation – problems.
MANIPULATOR KINEMATICS: Specifications of matrices, D-H notation joint coordinates and world coordinates Forward and inverse kinematics – problems.Differential transformation and manipulators, Jacobians – problems. Dynamics: Lagrange – Euler and Newton – Euler formulations – Problems.

UNIT IV
General considerations in path description and generation. Trajectory planning and avoidance of obstacles, path planning, Skew motion, joint integrated motion –straight line motion – Robot programming, languages and software packages-description of paths with a robot programming language.

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UNIT V

ROBOT ACTUATORS AND FEED BACK COMPONENTS:

Actuators: Pneumatic, Hydraulic actuators, electric & stepper motors. Feedback components: position sensors – potentiometers, resolvers, encoders – Velocity sensors.

ROBOT APPLICATIONS IN MANUFACTURING: Material Transfer - Material handling, loading and unloading- Processing - spot and continuous arc welding & spray painting - Assembly and Inspection.

TEXT BOOKS:

1. Industrial Robotics / Groover M P /Mc Graw Hill
2. Introduction to Robotics / John J. Craig/ Pearson

REFERENCE BOOKS:

1. Theory of Applied Robotics /Jazar/Springer.
2. Robotics / Ghosal / Oxford

Course outcomes:

Upon successful completion of this course student should be able to:

1. Understand various applications of robotics and classification of coordinate system and control systems (BL-2)
2. Build the concepts of components of industrial robotics. (BL-3)
3. Apply kinematic analysis with D-H notation, forward and inverse kinematics and Solve dynamic analysis with Lagrange – Euler and Newton – Euler formulations (BL-3)
4. Model trajectory planning for a manipulator by avoiding obstacles (BL-3)
5. Understand different types of actuators and applications of robots in manufacturing (BL-2)

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√	√							√
CO2	√	√	√	√	√							√
CO3	√	√	√	√	√							√
CO4	√	√	√	√	√							√
CO5	√	√	√	√	√							√

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IV Year - I Semester

L	T	P	C
3	0	0	3

TOTAL QUALITY MANAGEMENT

(OEC-1)

Course Objectives

The students will acquire the knowledge:

1. To understand the concepts of TQM, Quality and Business performance
2. To understand importance of customer satisfaction and loyalty
3. To analyze Organizing for quality implementation
4. To learn the concept of cost of quality
5. To understand ISO 9000 universal standards of quality

UNIT – I:

INTRODUCTION: The concept of TQM, Quality and Business performance, attitude and involvement of top management, communication, culture and management systems. Management of Process Quality: Definition of quality, Quality Control, a brief history, Product Inspection vs, Process Control, Statistical Quality Control, Control Charts and Acceptance Sampling.

UNIT – II:

CUSTOMER FOCUS AND SATISFACTION: The importance of customer satisfaction and loyalty- Crating satisfied customers, Understanding the customer needs, Process Vs. Customer, internal customer conflict, quality focus, Customer Satisfaction, role of Marketing and Sales, Buyer – Supplier relationships. Bench Marketing: Evolution of Bench Marketing, meaning of Bench marketing, benefits of bench marketing, the bench marketing process, pitfalls of bench marketing.

UNIT – III:

ORGANIZING FOR TQM: The systems approach, Organizing for quality implementation, making the transition from a traditional to a TQM organizing, Quality Circles. Productivity, Quality and Reengineering: The leverage of Productivity and Quality, Management systems Vs. Technology, Measuring Productivity, Improving Productivity Re-engineering.

UNIT – IV:

THE COST OF QUALITY: Definition of the Cost of Quality, Quality Costs, Measuring Quality Costs, use of Quality Cost Information, Accounting Systems and Quality Management.

UNIT – V:

ISO9000: Universal Standards of Quality: ISO around the world, The ISO9000 ANSI/ASQCQ-Series Standards, benefits of ISO9000 certification, the third party audit, Documentation ISO9000 and services, the cost of certification implementing the system.

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TEXT BOOKS:

1. Total Quality Management / Joel E.Ross/Taylor and Franscis Limited
2. Total Quality Management/P.N.Mukherjee/PHI

REFERENCES:

1 Beyond TQM / Robert L.Flood
2 Statistical Quality Control / E.L. Grant / McGraw Hill.
3 Total Quality Management- A Practical Approach/H. Lal
4 Quality Management/KanishkaBedi/Oxford University Press/2011
5 Total Engineering Quality Management/Sunil Sharma/Macmillan

Course Outcomes:

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

1. Understand the concepts of TQM, Quality and Business performance(BL-2)
2. Understand importance of customer satisfaction and loyalty(BL-2)
3. Analyze Organizing for quality implementation(BL-3)
4. Summarize the concept of cost of quality(BL-2)
5. Understand ISO 9000 universal standards of quality(BL-2)

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√	√							√
CO2	√	√	√	√	√							√
CO3	√	√	√	√	√							√
CO4	√	√	√	√	√							√
CO5	√	√	√	√	√							√

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IV Year - I Semester

L	T	P	C
0	0	3	1.5

ENGINEERING METROLOGY LAB

Course Objectives:

The students will acquire the knowledge:
The Engineering Metrology Lab course is designed for measuring and gauging instruments for inspection of precision linear, geometric forms, angular and surface finish measurements. The student can learn the measurements with and calibration of instruments.

List of Experiments

1. Measurement of lengths, heights, diameters by vernier calipers, micrometers etc.
2. Measurement of bores by internal micrometers and dial bore indicators.
3. Use of gear tooth vernier caliper for tooth thickness inspection and flange micro meter for checking the chordal thickness of spur gear.
4. Measurement using Mechanical comparator.
5. Measurements using Optical Projector.
6. Measurement of alignment using Autocollimator.
7. Angle and taper measurements with bevel protractor, Sine bar, rollers and balls.
8. Use of spirit level in finding the straightness of a bed and flatness of a surface.
9. Thread inspection with two wire/ three wire method & tool makers microscope.
10. Surface roughness measurement with roughness measuring instrument.

Course Outcomes:
Upon successful completion of this course student should be able to:

1. Measure length, height, diameter and angles using various instruments (BL-5)
2. Measure surface roughness with roughness measurement instrument and alignment tests on Lathe Machine tool (BL-5)
3. Apply resistant temperature detector for temperature measurement (BL-3)
4. Utilize LVDT transducer and of rotameter (BL-3)
5. Utilize displacement strain measurement trainer and capacitance measurement trainer (BL-3)

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√	√			√	√	√	√	√
CO2	√	√	√	√	√			√	√	√	√	√
CO3	√	√	√	√	√			√	√	√	√	√
CO4	√	√	√	√	√			√	√	√	√	√
CO5	√	√	√	√	√			√	√	√	√	√

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IV Year - I Semester

L	T	P	C
0	0	3	1.5

SIMULATION LAB - II

Course Objectives:

The students will acquire the knowledge:

1 To measure load and temperature using analogue and digitalsensors.

2 To measure displacement using analogue and digitalsensors.

3 To develop PLC programs for control of traffic lights, water level, lifts and conveyor belts.

4 To simulate and analyze PID controllers for a physical system usingMATLAB.

5 To develop pneumatic and hydraulic circuits using Automaton studio.

List of Experiments

1. DYNA 1750 Transducers Kit:-

   a. Characteristics of LVDT

   b. Principle & Characteristics of StrainGauge

   c. Characteristics of SummingAmplifier

   d. Characteristics of Reflective OptoTransducer

2. PLCPROGRAMMING

   a. Ladder programming on Logic gates ,Timers &counters

   b. Ladder Programming for digital & Analogysensors

   c. Ladder programming for Traffic Light control, Water level control and Lift controlModules

3. AUTOMATION STUDIOsoftware

   a. Introduction to Automation studio & itscontrol

   b. Draw & Simulate the Hydraulic circuit for series & parallel cylindersconnection

c. Draw & Simulate Meter-in, Meter-out and hydraulic press andclamping.

4. MATLABProgramming

a. Sample programmes onMatlab

b. Simulation and analysis of PID controller usingSIMULINK

Course outcomes:
Upon successful completion of this course student should be able to:

1. Measure load using analogue and digital sensors (BL-5)
2. Measure displacement using analogue and digital sensors (BL-5)
3. Develop PLC programs for control of traffic lights, water level and lift system (BL-3)
4. AnalyzePID controllers for a physical system using MATLAB(BL-4)
5. Develop pneumatic and hydraulic circuits (BL-3)

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√	√			√	√	√	√	√
CO2	√	√	√	√	√			√	√	√	√	√
CO3	√	√	√	√	√			√	√	√	√	√
CO4	√	√	√	√	√			√	√	√	√	√
CO5	√	√	√	√	√			√	√	√	√	√

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IV Year - I Semester

L	T	P	C
0	0	8	4

PROJECT-I

Objectives:

The aim of the course is to make the student perform a comprehensive project work that involves either or all of the following: optimum design of a mechanical component or an assembly, thermal analysis, computer aided design & analysis, cost effective manufacturing process, material selection, testing procedures or fabrication of components and prepare a detailed technical thesis report. The completed task should also take into account the significance of real time applications, energy management and the environmental affects.

Course Outcomes

The students will acquire the knowledge

1. Understand the need of optimum design of a mechanical component or an assembly
2. Study the procedure to bring cost effective manufacturing process with proper material selection
3. Able to learn the technical procedure of planning the work and recognize the need of scheduling the and realizing an engineering product design
4. Realize the significance of real time applications, energy management and environmental affects
5. Obtain the skill of data collection and technical report writing.

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√	√	√	√	√	√	√	√	√
CO2	√	√	√	√	√	√	√	√	√	√	√	√
CO3	√	√	√	√	√	√	√	√	√	√	√	√
CO4	√	√	√	√	√	√	√	√	√	√	√	√
CO5	√	√	√	√	√	√	√	√	√	√	√	√

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IV Year - II Semester

L	T	P	C
3	0	0	3

PRODUCTION PLANNING AND CONTROL

(PEC-4)

Course objectives:

The students will acquire the knowledge:

1. To understand the different types of production systems and the internal organization of production planning and control
2. To estimate forecasts in the manufacturing and service sectors using selected quantitative and qualitative techniques
3. To understands the importance and function of inventory and to be able to apply for its control and management
4. To apply routing procedures and differentiate schedule and loading and interpret scheduling policies and aggregate planning
5. To understand dispatching procedure and applications of computers in production planning and control

UNIT – I

Introduction: Definition – objectives and functions of production planning and control – elements of production control – types of production – organization of production planning and control department – internal organization of department.

UNIT – II

Forecasting – importance of forecasting – types of forecasting, their uses – general principles of forecasting – forecasting techniques – qualitative methods and quantitive methods.

UNIT – III

Inventory management – functions of inventories – relevant inventory costs – ABC analysis – VED analysis – EOQ model – Inventory control systems – P–Systems and Q-Systems
Introduction to MRP I, MRP II, ERP, LOB (Line of Balance), JIT and KANBAN system.

UNIT – IV

Routing – definition – routing procedure –route sheets – bill of material – factors affecting routing procedure, schedule –definition – difference with loading. Scheduling policies – techniques, standard scheduling methods.
Line Balancing, aggregate planning, chase planning, expediting, controlling aspects.

UNIT – V

Dispatching – activities of dispatcher – dispatching procedure – follow up – definition – reason for existence of functions – types of follow up, applications of computer in production planning and control.

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Text Books:

1. Elements of Production Planning and Control / Samuel Eilon/Universal BookCorp.
2. Manufacturing, Planning and Control/Partik Jonsson Stig-ArneMattsson/TataMcGrawHill

References:

1. Inventory Control Theory and Practice / Martin K. Starr and David W.Miller/Prentice-Hall
2. Production Planning andControl/Mukhopadyay/PHI.
3. Production Control A Quantitative Approach / John E.Biegel/Prentice-Hall
4. Production Control / Franklin G Moore & Ronald Jablonski/Mc-GrawHill
5. Production and Operations Management/Shailendra Kale/McGrawHill
6. Production and Operations Management/Ajay K Garg/McGrawHill

.**TEXT BOOKS:**

1. Elements of Production Planning and Control / Samuel Eilon/Universal Book Corp.
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4. Production Control / Franklin G Moore & Ronald Jablonski/ Mc-GrawHill
5.Production and Operations Management/Shailendra Kale/McGraw Hill
6.Production and Operations Management/Ajay K Garg/McGraw Hill

Course Outcome:

1. Understand the different types of production systems and the internal organization of production planning and control. (BL-2)
2. Identify forecasts in the manufacturing and service sectors using selected quantitative and qualitative techniques. (BL-3)
3. Understands the importance and function of inventory and to be able to apply for its control and management. (BL-2)
4. Apply routing procedures and differentiate schedule and loading and interpret scheduling policies and aggregate planning. (BL-4)
5. Interpret dispatching procedure and applications of computers in production planning and control. (BL-5)

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√	√							√
CO2	√	√	√	√	√							√
CO3	√	√	√	√	√							√
CO4	√	√	√	√	√							√
CO5	√	√	√	√	√							√

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IV Year - II Semester

L	T	P	C
3	0	0	3

GAS DYNAMICS AND JET PROPULSION

(PEC-4)

Course Objectives:

The students will acquire the knowledge:

1. To learn basic concepts of compressible fluid flow
2. To learn the isentropic flow of an ideal gas and effects of back pressure on nozzles
3. To learn the simple frictional flow in constant area duct of adiatatic and isothermal flows
4. To learn the conditions to form the shock waves due to the effect of heat transfer in convergent-divergent nozzle
5. To learn the basic concepts of jet propulsions systems and working of liquid propellant engines and Rockets

UNIT-I

Introduction to gas dynamics: control volume and system approaches acoustic waves and sonic velocity -Mach number - classification of fluid flow based on mach number - mach cone-compressibility factor - general features of one dimensional flow of a compressible fluid - continuity and momentum equations for a control volume.

UNIT-II

Isentropic flow of an ideal gas: basic equation - stagnation enthalpy, temperature, pressure and density stagnation, acoustic speed - critical speed of sound- dimensionless velocity-governing equations for isentropic flow of a perfect gas - critical flow area - stream thrust and impulse function.

Steady one dimensional isentropic flow with area change-effect of area change on flow parameters chocking- convergent nozzle - performance of a nozzle under decreasing back pressure -De lavel nozzle - optimum area ratio effect of back pressure - nozzle discharge coefficients - nozzle efficiencies.

UNIT- III

Simple frictional flow: adiabatic flow with friction in a constant area duct-governing equations – fanno line limiting conditions - effect of wall friction on flow properties in an Isothermal flow with friction in a constant area duct-governing equations - limiting conditions.

Steady one dimensional flow with heat transfer in constant area ducts- governing equations – Rayleigh line entropy change caused by heat transfer - conditions of maximum enthalpy and entropy.

UNIT-IV

Effect of heat transfer on flow parameters: Intersection of Fanno and Rayleigh lines. Shock waves in perfect gas- properties of flow across a normal shock - governing equations - Rankine Hugoniat equations - Prandtl's velocity relationship - converging diverging nozzle flow with shock thickness - shock strength.

UNIT-V

Propulsion: Air craft propulsion: - types of jet engines - energy flow through jet engines, thrust, thrust power and propulsive efficiency turbojet components-diffuser, compressor, combustion chamber, turbines, exhaust systems.

Performance of turbo propeller engines, ramjet and pulsejet, scramjet engines. Rocket propulsion – rocket engines, Basic theory of equations - thrust equation - effective jet velocity - specific impulse – rocket engine performance - solid and liquid propellant rockets - comparison of various propulsion systems.

Text Books:

1. Compressible fluid flow /A. H. Shapiro / Ronald Press Co., 1953
2. Fundamentals of compressible flow with aircraft and rocket propulsion/S. M. Yahya/New Age international Publishers
3. Fundamental of Gas dynamics-2nd edition/ M J Zucker/ Wiley publishers

References:

1. Elements of gas dynamics / HW Liepman & A Roshko/Wiley
2. Aircraft & Missile propulsion /MJ Zucrow/Wiley
3. Gas dynamics / M.J. Zucrow & Joe D.Holfman / Krieger Publishers

Course outcomes:

Upon successful completion of this course the student should be able to:

1. Illustrate fluid flow systems (BL-2)
2. Analyze the isotropic flow of an ideal gas and its parameter (BL-4)
3. Solve frictional flow with heat transfer problems (BL-3)
4. Analyze the impact of heat transfer on flow parameters. (BL-4)
5. Interpret the working of different propulsion systems.(BL-2)

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√	√							√
CO2	√	√	√	√	√							√
CO3	√	√	√	√	√							√
CO4	√	√	√	√	√							√
CO5	√	√	√	√	√							√

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IV Year - II Semester

L	T	P	C
3	0	0	3

INDUSTRIAL HYDRAULICS AND PNEUMATICS

(PEC-4)

Course Objectives:
The students will acquire the knowledge:

1. To learn basic concepts of fluid power
2. To learn the functions and working of basic elements of Hydraulic and Pneumatic systems
3. To learn the basic components and their functions of Hydraulic and Pneumatic circuits
4. To learn the operating principles and working of hydraulic and pneumatic devices
5. To learn the procedures of installation, Maintenance and Trouble shooting of Hydraulic and pneumatic systems

Unit – I:

Fluid Power: Power transmission modes, hydraulic systems, pneumatic systems, laws governing fluid flow: Pascal's law, continuity equation, Bernoulli's theorem, Boyle's, Charles', Gay-lussec' laws, flow through pipes - types, pressure drop in pipes, Working fluids used in hydraulic and pneumatic systems- types, ISO/BIS standards and designations, properties.

Unit– II:

Hydraulic and Pneumatic Elements:

Hydraulic pipes-Types, standards, designation methods and specifications, pressure ratings, applications and selection criteria, pumping theory, Hydraulic Pumps - types, construction, working principle, applications, selection criteria and comparison, hydraulic Actuators, Control valves, Accessories - their types, construction and working, pneumatic Pipes - materials, designations, standards, properties and piping layout, air compressors, Air receivers, air dryers, Air Filters, Regulators, Lubricators (FRL unit): their types, construction, working, specifications and selection criteria of following air preparation and conditioning elements, pneumatic Actuators and Control valves - types, construction, working, materials and specifications

Unit– III:

Hydraulic and Pneumatic Circuits:

ISO symbols used in hydraulic and pneumatic circuit, basic Hydraulic Circuits – types (such as intensifier, regenerative, synchronizing, sequencing, speed control, safety), circuit diagram, components, working and applications, basic Pneumatic Circuits – types (such as speed control, two step feed control, automatic cylinder reciprocation, time delay, quick exhaust), circuit diagram, components, working and applications, pneumatic Logic circuit design - classic method, cascade method, step counter method, karnaughveitch maps and combinational circuit design.

Unit-IV

Hydraulic and Pneumatic Devices:

Hydraulic and Pneumatic devices – Concept and applications, construction, working principle, major elements, performance variables of: Automotive hydraulic brake, Industrial Fork lift, Hydraulic jack, Hydraulic press, Automotive power steering, Automotive pneumatic brake, Automotive air suspension, Pneumatic drill, Pneumatic gun.

Unit-V

Installation, Maintenance and Trouble-Shooting:

Installation of hydraulic and pneumatic system causes and remedies for common troubles arising in hydraulic elements, maintenance of hydraulic systems, causes and remedies for troubles arising in pneumatic elements, maintenance of pneumatic systems.

Textbooks:

1. Majumdar, S.R. Oil Hydraulic Systems Tata Mcgraw-Hill Publication, New Delhi,3/e, 2013
2. Majumdar, S.R. Pneumatic Systems Tata Mcgraw-Hill Publication, New Delhi,3/e, 2013

References:

1. Srinivasan, R. Hydraulic and Pneumatic Controls Vijay Nicole Imprints Private, New Delhi, Limited, 2/e, 2008
2. Jagadeesha, T. Fluid Power Generation, Transmission and Control Universities Press (India) Private Limited, New Delhi,1/e, 2014
3. Jagadeesha, T. Pneumatics Concepts, Design And Applications Universities Press (India) Private Limited, New Delhi,1/e, 2014
4. Parr, Andrew Hydraulic And Pneumatics A Technician's and Engineer's Guide Jaico Publishing House, New Delhi,2/e, 2013

5. Shanmuga Sundaram, K . Hydraulic And Pneumatics Controls - Understanding Made Easy S. Chand Company Ltd., New Delhi, 1/e, 2006

Course outcomes:

Upon successful completion of this course the student should be able to:

1. Illustrate the basic concepts of fluid power (BL-2)
2. Understand the functions of elements of Hydraulic and Pneumatic systems (BL-2)
3. Analyze the functions of hydraulic and Pneumatic circuits (BL-4)
4. Illustrate the working of various hydraulic and pneumatic devices. (BL-2)
5. Interpret the procedure of installation, maintenance and trouble shooting of hydraulic and Pneumatic systems (BL-5)

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√	√							√
CO2	√	√	√	√	√							√
CO3	√	√	√	√	√							√
CO4	√	√	√	√	√							√
CO5	√	√	√	√	√							√

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IV Year - II Semester

L	T	P	C
3	0	0	3

STATISTICAL QUALITY CONTROL

(PEC-4)

Course objectives:

The students will acquire the knowledge:

1. To understand the approaches and techniques of quality value and engineering
2. To interpret statistical process control with $\overline{X}$, R, p, c charts and other types of control charts.
3. To understand tolerance design and quality function deployment
4. To understand techniques of modern reliability engineering tools.
5. To interpret the concepts of complex system and reliability techniques

UNIT-I

Quality value and engineering – quality systems – quality engineering in product design and production process – system design – parameter design – tolerance design, quality costs – quality improvement.

UNIT-II

Statistical process control $\overline{X}$, R, p, c charts, other types of control charts, process capability, process capability analysis, process capability index. (SQC tables can be used in the examination)
Acceptance sampling by variables and attributes, design of sampling plans, single, double, sequential and continuous sampling plans, design of various sampling plans.

UNIT-III

Loss function, tolerance design – N type, L type, S type; determination of tolerance for these types. online quality control – variable characteristics, attribute characteristics, parameter design.
Quality function deployment – house of quality, QFD matrix, total quality management concepts. quality information systems, quality circles, introduction to ISO 9000 standards.

UNIT-IV

Reliability – Evaluation of design by tests - Hazard Models, Linear, Releigh, Weibull. Failure Data Analysis, reliability prediction based on weibull distribution, Reliability improvement.

UNIT-V

Complex system, reliability, reliability of series, parallel & standby systems & complex systems & reliability prediction and system effectiveness.
Maintainability, availability, economics of reliability engineering, replacement of items, maintenance costing and budgeting, reliability testing.

Text Books:

1. Quality Engineering in Production Systems / G Taguchi /McGraw Hill
2. Reliability Engineering/ E.Bala Guruswamy/Tata McGraw Hill,
3. Statistical Quality Control : A Modern Introduction/ Montgomery/Wiley

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References:

1. Jurans Quality planning & Analysis/ Frank.M.Gryna Jr. / McGraw Hill.
2. Taguchi Techniques for Quality Engineering/ Philipposs/ McGraw Hill,
3. Reliability Engineering / LS Srinath / Affiliated East West Pvt. Ltd.,
4. Statistical Process Control/ Eugene Grant, Richard Leavenworth / McGraw Hill.
5. Optimization & Variation Reduction in Quality / W.A. Taylor / Tata McGraw Hill
6. Quality and Performance Excellence/ James R Evans/ Cengage learning

Course Outcomes:

Upon successful completion of this course the student should be able to:

1. Understand the approaches and techniques of quality value and engineering (BL-2)
2. Identify significance of statistical process control with $\overline{X}$, R, p, c charts and other types of control charts.(BL-3)
3. Understand tolerance design and quality function deployment (BL-2)
4. Illustrate techniques of modern reliability engineering tools.(BL-2)
5. Interpret the concepts of complex system and reliability techniques (BL-5)

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√	√							√
CO2	√	√	√	√	√							√
CO3	√	√	√	√	√							√
CO4	√	√	√	√	√							√
CO5	√	√	√	√	√							√

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IV Year - II Semester

L	T	P	C
3	0	0	3

COMPOSITE MATERIALS

(PEC-5)

Course Objectives

The students will acquire the knowledge:

1. To classify the composite materials and identify the applications
2. To understand strengthening mechanisms of fiber composites
3. To understand Major composite classes and role of interfaces in composites
4. To interpret the Fabrication of PMC's, CMC's and MMC'S
5. To understand applications of advanced composite materials.

UNIT-I

Introduction to Composites: Matrices, Reinforcements, Classifications, Applications, Comparison with Metals and Importance over other materials, design fabrication and economic consideration, General requirements. Classification of composites on the basis of reinforcement and matrix, Classification of Reinforcement, Form and functions of reinforcement, Functions of matrices. Dispersion strengthened, particle strengthened and fiber-reinforced composites. Fibres and resin materials.

UNIT-II

Strengthening mechanisms, Aspect Ratio, Rule of Mixture, discontinuous and continuous fiber composites and their comparison, Characteristics and materials of reinforcements and matrices. Critical Fiber Length, Short and Continuous Fibers, Fiber Orientation.

UNIT-III

Major composite classes: polymer matrix, métal matrix, ceramic matrix, carbon-carbon, and intermetallic composites. Hybrid composites, Laminated composites. Polymer composites, thermoplastics, thermosetting plastics, manufacturing of PMC, MMC & CCC and their applications.

Role of interfaces in composites, Interfacial Bonding Mechanisms. Pullout & Push-out Testing. Control of Bond Strength. Toughening mechanisms in PMCs, MMCs, and CMCs.

UNIT-IV

Fabrication of PMC's :- Fabrication of Fibers, Plastic Fiber Forms, Prepregs, Molding Compounds-Processes, Lay-Ups, Filament Winding,Pultrusion, and Recycling. ; Matrix – Reinforcement Interface, Wettability.

Fabrication of CMC's: Hot-Pressing, Infilration,In Situ Chemical reaction Techniques.CVD & CVI, Sol-gel.

Fabrication of MMC'S: Liquid Infiltration- Casting, Solid State Processes-Diffusion Bonding & In Situ Technique.

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UNIT-V

Applications of advanced composite materials. Environmental effects in Composites, Green composites, Synthesis and Properties of Nanocomposites. Surface Composites & Surface metal matrix composites: Need, Synthesis, Properties and applications

.

Text Books:

1. Nano material /A.K. Bandyopadyay/New age Publishers
2. Material science and Technology: A comprehensive treatment/Robert W.Cahn,/VCH
3. Engineering Mechanics of Composite Materials / Isaac and M Daniel/Oxford University Press

References:

1. Mechanics of Composite Materials / R. M. Jones/ Mc Graw Hill Company, New York, 1975.
2. Analysis of Laminated Composite Structures / L. R. Calcote/Van Nostrand Rainfold,NY 1969
3. Analysis and performance of fibre Composites /B. D. Agarwal and L. J. Broutman /Wiley-Interscience,New York, 1980
4. Mechanics of Composite Materials - Second Edition (Mechanical Engineering) /Autar K.Kaw / CRC Press

Course Outcomes:

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

1. Classify the composite materials and identify the applications (BL-2)
2. Apply strengthening mechanisms of fiber composites (BL-3)
3. Understand Major composite classes and role of interfaces in composites(BL-2)
4. Interpret the Fabrication of PMC's, CMC's and MMC'S(BL-5)
5. Utilize applications of advanced composite materials.(BL-2)

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√	√							√
CO2	√	√	√	√	√							√
CO3	√	√	√	√	√							√
CO4	√	√	√	√	√							√
CO5	√	√	√	√	√							√

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IV Year - II Semester

L	T	P	C
3	0	0	3

NANO MATERIALS

(PEC-5)

Course Objectives:

The students will acquire the knowledge:

1. To understand historical development and classification of nano materials
2. To interpret structure and bonding in nano materials
3. To analyze the size dependence of properties
3. To understand nano material Synthesis techniques
5. To interpret nano material characterization techniques

Unit-I.

Introduction: Definitions, historical development of nano materials, classification of nano materials, Size & Scale Units Scaling Atoms, Molecules, Clusters and Supramolecules.

Unit-II

Structure and Bonding in Nano materials

Chemical Bonds (types and strength), intermolecular forces, molecular and crystalline structures, hierarchical structures, bulk to surface transition, surface reconstruction

Unit-III

Properties and Size dependence of properties: Chemical Optical, vibrational, thermal, Electrical, Magnetic, Mechanical, Theoretical Aspects-e.g. density functional theory

Unit-IV

Nano material Synthesis: Chemical routes, Electrochemical methods, Vapor growth, Thin films methods: chemical vapor deposition, physical vapor deposition (sputtering, laser ablation), Langmuir-Blodgett growth Mechanical methods: ball milling, mechanical attrition Sol-gel methods , Special nanomaterials: carbon nanotubes, fullerenes, nanowires, porous silicon, Bio-inspired synthesis, Nanocomposite fabrication, Nanolithography

Unit-V

Nano material characterization techniques: Scanning and Transmission Electron Microscopy, Scanning Probe Microscopies: Atomic Force, scanning tunneling microscopy, Diffraction and scattering techniques, Vibrational spectroscopy, Surface techniques

Applications: Nano-electronics, Nano optics, Nanoscale chemical- and bio-sensing, Biological/bio-medical applications, Photovoltaic, fuel cells, batteries and energy-related applications, High strength nanocomposites, Nanoenergetic materials

Textbook

1.The Physics and Chemistry of NanoSolids by Frank J. Owens and Charles P. Poole Jr, Wiley-Interscience, 2008.

Reference Books

1.Nanomaterials- Synthesis, Properties and Applications, Edited by A.S. Edelstein and R.C. Cammarata, Institute of Physics Publishing, London, 1998 (paper back edition)

2.Nanochemistry: A Chemical Approach to Nanomaterials, by G. Ozin and A. Arsenault, RSC Publishing, 2005

3.Nanophysics and Nanotechnology: An Introduction to Modern Concepts in Nanoscience, Edward L. Wolf, Wiley-VCH, 2nd Reprint (2005)

Course Outcomes:

Upon successful completion of this course the student should be able to:

1. Understand historical development and classification of nanomaterials (BL-2)
2. Interpret structure and Bonding in nanomaterials (BL-2)
3. Analyze the size dependence of properties(BL-4)
3. Understand nanomaterial Synthesis techniques (BL-2)
5. Interpret nanomaterial characterization techniques(BL-5)

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√	√							√
CO2	√	√	√	√	√							√
CO3	√	√	√	√	√							√
CO4	√	√	√	√	√							√
CO5	√	√	√	√	√							√

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IV Year - II Semester

L	T	P	C
3	0	0	3

THERMAL EQUIPMENT & DESIGN

(PEC-5)

Course Objectives:
The students will acquire the knowledge:

1. To learn different types of heat exchangers
2. To learn the calculation of design parameters for the different flows in the heat exchanger
3. To learn the basic components and design procedure for shell and tube heat exchanger
4. To learn the design calculations of condensers, Vaporizers, Evaporators and reboilers
5. To learn the basic design calculations of cooling towers

UNIT - I:
Classification of heat exchangers: Introduction, Recuperation & Regeneration – Tubular heat exchangers: double pipe, shell & tube heat exchanger, Plate heat exchangers, Gasketed plate heat exchanger, spiral plate heat exchanger, Lamella heat exchanger, extended surface heat exchanger, Plate fin, and Tubular fin.
UNIT - II:
Basic Design Methods of Heat Exchanger: Introduction, Basic equations in design, Overall heat transfer coefficient – LMTD method for heat exchanger analysis – parallel flow, counter flow, multipass, cross flow heat exchanger design calculations.
Double Pipe Heat Exchanger: Film Coefficient for fluids in annulus, fouling factors, calorific temperature, average fluid temperature, the calculation of double pipe exchanger, Double pipe exchangers in series-parallel arrangements.
UNIT - III:
Shell & Tube Heat Exchangers: Tube layouts for exchangers, baffle Heat exchangers, calculation of shell and tube heat exchangers – shell side film coefficients, Shell side equivalent diameter, the true temperature difference in a 1-2 heat exchanger, influence of approach temperature on correction factor, shell side pressure drop, tube side pressure drop, Analysis of performance of 1-2 heat exchanger, and design calculation of shell & tube heat exchangers. Flow arrangements for increased heat recovery, the calculations of 2-4 exchangers.

UNIT - IV:
Condensation of single vapors: Calculation of a horizontal condenser, vertical condenser, De-super heater condenser, vertical condenser – sub-cooler, horizontal condenser – subcooler, vertical reflux type condenser, condensation of steam.
Vaporizers, Evaporators and Reboilers: Vaporizing processes, forced circulation vaporizing exchangers, natural circulation vaporizing exchangers, calculations of a reboiler.
UNIT - V:
Direct Contact Heat Exchanger: Cooling towers, relation between wet bulb & dew point temperatures, the Lewis number, and classification of cooling towers, cooling tower internals and the roll of fill, Heat balance, heat transfer by simultaneous diffusion and convection. Analysis of

cooling tower requirements, Design of cooling towers, Determination of the number of diffusion units, calculation of cooling tower performance.

Text Books:

1. Process Heat Transfer – D.Q. Kern, TMH.
2. Heat Exchanger Design – A.P.Fraas and M.N. Ozisick. John Wiely & sons, New York.
3. Cooling Towers by J.D. Gurney

Reference Book:

1. Thermal system design and optimization by C.Balaji, 2nd edition, Springer publishers

Course outcomes:

Upon successful completion of this course the student should be able to:

1. Illustrate the different types of heat exchangers(BL-2)
2. Understand the design principles for different flows in the heat exchanger(BL-2)
3. Analyze the design parameters of shell and tube heat exchanger(BL-4)
4. Interpret the design procedures of different condensers, Vaporizers, Evaporators and Reboilers.(BL-2)
5. Understands the design parameters of the cooling towers.(BL-2)

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√	√							√
CO2	√	√	√	√	√							√
CO3	√	√	√	√	√							√
CO4	√	√	√	√	√							√
CO5	√	√	√	√	√							√

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L	T	P	C
3	0	0	3

POWER PLANT ENGINEERING

(PEC-5)

Course Objectives:

The students will acquire the knowledge:

1. To learn the working of different circuits of the steam power plant
2. To learn the layout and auxiliaries of the diesel and Gas power plants
3. To learn the different elements in the hydro electric and Nuclear power plants
4. To learn the basic concepts for power production in combined plants and usage of different instrument to measure the operating parameters of the power plant
5. To learn the concepts of power plant economics and pollution standards to be observed in the power plants.

UNIT – I

6. Introduction to the sources of energy – resources and development of power in india.

STEAM POWER PLANT: Plant layout, working of different circuits, fuel and handling equipments, types of coals, coal handling, choice of handling equipment, coal storage, ash handling systems. Combustion: properties of coal – overfeed and underfeed fuel beds, traveling grate stokers, spreader stokers, retort stokers, pulverized fuel burning system and its components, combustion needs and draught system, cyclone furnace, design and construction, dust collectors, cooling towers and heat rejection. corrosion and feed water treatment.

UNIT – II

INTERNAL COMBUSTION AND GAS TURBINE POWER PLANTS:

DIESEL POWER PLANT: Plant layout with auxiliaries – fuel supply system, air starting equipment, super charging.

GAS TURBINE PLANT: Introduction – classification - construction – layout with auxiliaries, combined cycle power plants and comparison.

UNIT – III

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 AND PLANT: Classification – typical layouts – plant auxiliaries – plant operation pumped storage plants.

NUCLEAR POWER STATION: Nuclear fuel – 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.

UNIT – IV

COMBINED OPERATIONS OF DIFFERENT POWER PLANTS: Introduction, advantages of combined working, load division between power stations, storage type hydro-electric plant in combination with steam plant, run-of-river plant in combination with steam plant, pump storage plant in combination with steam or nuclear power plant, co-ordination of hydro-electric and gas turbine stations, co-ordination of hydro-electric and nuclear power stations, co-ordination of different types of power plants.

POWER PLANT INSTRUMENTATION AND CONTROL: Importance of measurement and instrumentation in power plant, measurement of water purity, gas analysis, O2 and CO2 measurements, measurement of smoke and dust, measurement of moisture in carbon dioxide circuit, nuclear measurements.

UNIT – V

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 – related exercises. effluents from power plants and Impact on environment – pollutants and pollution standards – methods of pollution control.

Text Books:

1. A course in Power Plant Engineering /Arora and Domkundwar/Dhanpatrai & Co.
2. Power Plant Engineering /P.C.Sharma / S.K.Kataria Pub

References:

1. Power Plant Engineering: P.K.Nag/ II Edition /TMH.
2. Power station Engineering – ElWakil / McGrawHill.
3. An Introduction to Power Plant Technology / G.D. Rai/Khanna Publishers

Course outcomes:

Upon successful completion of this course the student should be able to:

1. Identify the different circuits of the steam power plant for power production (BL-3)
2. Illustrate the layouts and different auxiliaries used in the diesel and gas power plant for power production(BL-2)
3. Understand how the power can be produced by hydro-electric and Nuclear

power plants(BL-2)

4. Interpret the power production by combined power plants and operating principles of different instruments used in power plants(BL-5)
5. Analyze power plant economics and implementation of pollution standards and control of pollution caused by the power plants(BL-4

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√	√							√
CO2	√	√	√	√	√							√
CO3	√	√	√	√	√							√
CO4	√	√	√	√	√							√
CO5	√	√	√	√	√							√

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IV Year - II Semester

L	T	P	C
3	0	0	3

SUPPLY CHAIN MANAGEMENT

(Open Elective-II)

Course Objectives:
The students will acquire the knowledge:

1. To explain the importance of Supply chain management frame work in business management
2. To understand basic concepts of Supply Chain Drivers and Metrics
3. To interpret the Design of Supply Chain Network and factors influencing distribution network design
4. To understand role of forecasting in a supply chain
5. To analyze aggregate Planning and inventories in supply chain

Unit-I
Strategic Framework: Introduction to Supply Chain Management, Decision phases in a supply chain, Process views of a supply chain: push/pull and cycle views, Achieving Strategic fit, Expanding strategic scope.

Unit-II
Supply Chain Drivers and Metrics: Drivers of supply chain performance, Framework for structuring Drivers, Obstacles to achieving strategic fit.

Unit-III
Designing Supply Chain Network: Factors influencing Distribution Network Design, Design options for a Distribution network, E-Business and Distribution network, Framework for Network Design Decisions, Models for Facility Location and Capacity Allocation.

Unit-IV
Forecasting in SC: Role of forecasting in a supply chain, Components of a forecast and forecasting methods, Risk management in forecasting.

Unit-V
Aggregate Planning and Inventories in SC: Aggregate planning problem in SC, Aggregate Planning Strategies, Planning Supply and Demand in a SC, Managing uncertainty in a SC: Safety Inventory. Coordination in SC: Modes of Transportation and their performance characteristics, Supply Chain IT framework, Coordination in a SC and Bullwhip Effect.

Text Books:

1. Sunil Chopra and Peter Meindl, Supply Chain Management - Strategy, Planning and Operation, 4th Edition, Pearson Education Asia, 2010.
2. David Simchi-Levi, PhilpKamintry and Edith Simchy Levy, Designing and Managing the Supply Chain - Concepts Strategies and Case Studies, 2nd Edition, Tata-McGraw Hill, 2000.

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Course Outcomes:

Up on completion of course students will be able to

1.Illustrate the importance of Supply chain management frame work in business management.(BL-2)

2. Understand basic concepts of Supply Chain Drivers and Metrics.(BL-2)

3. Interpret the Design of Supply Chain Network and factors influencing distribution network design.(BL-3)

4. Apply role of forecasting in a supply chain.(BL-3)

5. Analyze aggregate Planning and inventories in supply chain.(BL-4)

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√	√							√
CO2	√	√	√	√	√							√
CO3	√	√	√	√	√							√
CO4	√	√	√	√	√							√
CO5	√	√	√	√	√							√

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IV Year - II Semester

L	T	P	C
3	0	0	3

ENERGY CONSERVATION MANAGEMENT

(Open Elective-II)

Course Objectives:
The students will acquire the knowledge:

1. To illustrate the importance and role of energy
2. To analyze the energy audit methods
3. To interpret the economics of energy conversion
4. To apply the methods of evaluation of projects.
5. To understand various types of alternative energy sources

UNIT-I: INTRODUCTION: Principles of energy management Managerial organization, Functional areas for i) manufacturing industry, ii) Process industry, iii) Commerce, iv) Government, Role of Energy manager in each of these organizations. Initiating, Organizing and managing energy management programs

UNIT-II: ENERGY AUDIT: Definition and concepts. Types of energy audits, Basic energy concepts, Resources for plant energy studies. Data gathering, Analytical techniques. Energy Conservation: Technologies for energy conservation, Design for conservation of energy materials, Energy flow networks. Critical assessment of energy usage. Formulation of objectives and constrains, Synthesis of alternative options and technical analysis of options. Process integration.

UNIT-III: ECONOMIC ANALYSIS: Scope, Characterization of an investment project. Types of depreciation, Time value of money. Budget considerations, Risk analysis.

UNIT-IV: METHODS OF EVALUATION OF PROJECTS: Payback, Annualized costs, Investor's rate of retum, Present worth, Internal rate of return. Pros and cons of the common method of analysis. Replacement analysis.

UNIT-V: ALTERNATIVE ENERGY SOURCES: SOLAR ENERGY: Types of devices for solar energy collections, Thermal storage system, Control systems. Wind Energy. Availability, Wind Devices. Wind Characteristics, performance of turbines and systems.

TEXT BOOKS:

1. Energy Management by Murfy
2. General Aspects of Energy Management and Audit, National Productivity Council of India,Chennai (Course Material- National Certification Examination for Energy Management)

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REFERENCE BOOKS:

1. Energy Management Handbook, W.C. Turner, 5th Edition, Marcel Dekker, Inc, New York, 2005.
2. Guide to Energy Management, B. L. Capehart, W. C. Turner, W. J. Kennedy, CRC Press, New York, 2005.
3. Energy Management by O.P. Collagan

Course Outcomes:

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

1. Illustrate the importance and role of energy (BL-2)
2. Analyze the energy audit methods(BL-4)
3. Interpret the economics of energy conversion(BL-2)
4. Apply the methods of evaluation of projects.(BL-3)
5. Understand various types of alternative energy sources (BL-2)

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√	√							√
CO2	√	√	√	√	√							√
CO3	√	√	√	√	√							√
CO4	√	√	√	√	√							√
CO5	√	√	√	√	√							√

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IV Year - II Semester

L	T	P	C
3	0	0	3

RENEWABLE ENERGY SOURCES

(Open Elective-II)

Course Objective:
The students will acquire the knowledge:

1. To demonstrate the importance and solar radiation, solar energy collection and storage
2. To understand the energy sources and potential from wind energy, bio-mass, geothermal energy and ocean energy
3. To interpret energy efficient electrical and mechanical systems
4. To develop energy efficient processes
5. To understand features and benefits of green buildings

UNIT-I

SOLAR RADIATION: Role and potential of new and renewable sources, the solar energy option, Environmental impact of solar power, structure of the sun, the solar constant, sun-earth relationships, coordinate systems and coordinates of the sun, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data, numerical problems. Photo voltaic energy conversion – types of PV cells.

SOLAR ENERGY COLLECTION: Flat plate and concentrating collectors, classification of concentrating collectors, orientation.

SOLAR ENERGY STORAGE AND APPLICATIONS: Different methods, sensible, latent heat and stratified storage, solar ponds, solar applications- solar heating/cooling technique, solar distillation and drying, solar cookers, central power tower concept and solar chimney.

UNIT – II

WIND ENERGY: Sources and potentials, horizontal and vertical axis windmills, performance characteristics, betz criteria, types of winds, wind data measurement.
BIO-MASS: Principles of bio-conversion, anaerobic/aerobic digestion, types of bio-gas digesters, gas yield, utilization for cooking, bio fuels, I.C. engine operation and economic aspects.
GEOTHERMAL ENERGY: Resources, types of wells, methods of harnessing the energy.
OCEAN ENERGY: OTEC, Principles of utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques.

UNIT –III

ENERGY EFFICIENT SYSTEMS:

(A) ELECTRICAL SYSTEMS: Energy efficient motors, energy efficient lighting and control, selection of luminaire, variable voltage variable frequency drives (adjustable speed drives), controls for HVAC (heating, ventilation and air conditioning), demand site management.
(B) MECHANICAL SYSTEMS: Fuel cells- principle, thermodynamic aspects, selection of fuels & working of various types of fuel cells, Environmental friendly and Energy efficient compressors and pumps**.**

UNIT-IV

ENERGY EFFICIENT PROCESSES: Environmental impact of the current manufacturing practices and systems, benefits of green manufacturing systems, selection of recyclable and environment friendly materials in manufacturing, design and implementation of efficient and sustainable green production systems with examples like environmental friendly machining, vegetable based cutting fluids, alternate casting and joining techniques, zero waste manufacturing.

UNIT – V
GREEN BUILDINGS: Definition, features and benefits. Sustainable site selection and planning of buildings for maximum comfort. Environmental friendly building materials like bamboo, timber, rammed earth, hollow blocks, lime & lime pozzolana cement, agro materials and industrial waste, Ferro cement and Ferro-concrete, alternate roofing systems, paints to reduce heat gain of the buildings. Energy management.

Text Books:
1. Solar Energy – Principles of Thermal Collection and Storage/Sukhatme S.P. and J.K.Nayak/TMH
2. Non-Conventional Energy Resources- Khan B.H/ Tata McGraw Hill, New Delhi, 2006
3. Green Manufacturing Processes and Systems - J. Paulo Davim/Springer 2013

References:
1. Alternative Building Materials and Technologies - K.S Jagadeesh, B.V Venkata Rama Reddy and K.S Nanjunda Rao/New age international
2. Principles of Solar Engineering - D.Yogi Goswami, Frank Krieth & John F Kreider / Taylor & Francis
3. Non-Conventional Energy - Ashok V Desai /New Age International (P) Ltd
4. Renewable Energy Technologies -Ramesh & Kumar /Narosa
5. Non conventional Energy Source- G.D Roy/Standard Publishers
6. Renewable Energy Resources-2nd Edition/ J.Twidell and T. Weir/ BSP Books Pvt.Ltd
7. Fuel Cell Technology -Hand Book / Gregor Hoogers / BSP Books Pvt. Ltd.

Course outcome:

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

1. Illustrate the importance and solar radiation, solar energy collection and storage(BL-2)
2. Understand the energy sources and potential from wind energy, bio-mass, geothermal energy and ocean energy(BL-2)
3. Analyze energy efficient electrical and mechanical systems(BL-4)

4. Develop energy efficient processes(BL-3)
5. Understand features and benefits of green buildings(BL-2)

.

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√	√							√
CO2	√	√	√	√	√							√
CO3	√	√	√	√	√							√
CO4	√	√	√	√	√							√
CO5	√	√	√	√	√							√

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L	T	P	C
3	0	0	3

ENTREPRENEURSHIP

(OEC-2)

COURSE OBJECTIVE:

The students will acquire the knowledge:

1. To understand concept of entrepreneurship and its characteristics
2. To recognize entrepreneurial environment and policies
3. To understand business plan preparation
4. To interpret finance and Human Resource mobilization and operations planning
5. To understand management of small business

UNIT- I: ENTREPRENEURAL COMPETENCE

Entrepreneurship concept – Entrepreneurship as a Career – Entrepreneurial Personality - Characteristics of Successful, Entrepreneur – Knowledge and Skills of Entrepreneur.

UNIT- II: ENTREPRENEURAL ENVIRONMENT AND POLICIES

Business Environment - Role of Family and Society - Entrepreneurship Development Training and Other Support Organisational Services – Central and State Government Industrial Policies and Regulations - International Business.

UNIT- III: BUSINESS PLAN PREPARATION

Sources of Product for Business - Prefeasibility Study - Criteria for Selection of Product - Ownership - Capital - Budgeting Project Profile Preparation - Matching Entrepreneur with the Project - Feasibility Report Preparation and Evaluation Criteria.

UNIT- IV: LAUNCHING OF SMALL BUSINESS

Finance and Human Resource Mobilization Operations Planning - Market and Channel Selection - Growth Strategies - Product Launching – Incubation, Venture capital, IT startups.

UNIT- V: MANAGEMENT OF SMALL BUSINESS

Monitoring and Evaluation of Business - Preventing Sickness and Rehabilitation of Business Units- Effective Management of small Business.

Text Books:

1. Hisrich, Entrepreneurship, Tata McGraw Hill, New Delhi, 2001.
2. S.S.Khanka, Entrepreneurial Development, S.Chand and Company Limited, New Delhi, 2001.

References

1. Mathew Manimala, Entrepreneurship Theory at the Crossroads, Paradigms & Praxis, Biztrantra ,2nd Edition 2005

2. Prasanna Chandra, Projects – Planning, Analysis, Selection, Implementation and Reviews, Tata McGraw-Hill, 1996.
3. P.Saravanavel, Entrepreneurial Development, Ess Pee kay Publishing House, Chennai -1997.

COURSE OUTCOME:

Up on completing this course, students are able to

1. Understand concept of entrepreneurship and its characteristics(BL-2)
2. Identifyentrepreneural environment and policies (BL-3)
3. Analyze business plan preparation (BL-4)
4. Interpret finance and Human Resource mobilization and operations planning (BL-2)
5. Develop management of small business (BL-6)

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√	√							√
CO2	√	√	√	√	√							√
CO3	√	√	√	√	√							√
CO4	√	√	√	√	√							√
CO5	√	√	√	√	√							√

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
B.TECH (MECHANICAL ENGINEERING) - R19
EFFECTIVE FROM 2019-20 BATCH

IV Year - II Semester

L	T	P	C
3	0	0	3

NANO TECHNOLOGY

(Open Elective-III)

Course Objectives:
The students will acquire the knowledge:
1. To understand the classification of nano structured Materials (BL-2)
2. To understand the unique properties of nano materials (BL-2)
3. To interpret the Synthesis Routes - Bottom up and Top down approaches (BL-3)
4. To identify the tools to characterize nano materials(BL-2)
5. To understand the applications of nano materials (BL-2)

Unit I

Introduction: History and Scope, Classification of Nano structured Materials, Fascinating Nanostructures, applications of nanomaterials, challenges and future prospects.

Unit II

Unique Properties of Nano materials: Microstructure and Defects in Nano crystalline Materials: Dislocations, Twins, stacking faults and voids, Grain Boundaries, triple and disclinations. Effect of Nano-dimensions on Materials Behavior: Elastic properties, Melting Point, Diffusivity, Grain growth characteristics, enhanced solid solubility. Magnetic Properties: Soft magnetic nanocrystalline alloy, Permanent magnetic nanocrystalline materials, Giant Magnetic Resonance, Electrical Properties, Optical Properties, Thermal Properties and Mechanical Properties.

Unit III

Synthesis Routes: Bottom up approaches: Physical Vapor Deposition, Inert Gas Condensation, Laser Ablation,Chemical Vapor Deposition, Molecular Beam Epitaxy, Sol-gel method ,Self assembly. Top down approaches: Mechanical alloying, Nano-lithography.Consolidation of Nano powders: Shock wave consolidation, Hot isostatic pressing and Cold isostatic pressingSpark plasma sintering.

Unit IV

Tools to Characterize nanomaterials: X-Ray Diffraction (XRD), Small Angle X-ray scattering, Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Atomic Force Microscopy (AFM), Scanning Tunneling Microscope (STM), Field Ion Microscope (FEM), Three-dimensional Atom Probe (3DAP),Nano indentation

Unit V

Applications of Nano materials: Nano-electronics, Micro- and Nano-electromechanical systems (MEMS/NEMS),Nano sensors, Nano catalysts, Food and Agricultural Industry, Cosmetic and Consumer Goods, Structure and Engineering, Automotive Industry, Water- Treatment and the environment, Nano-medical applications, Textiles, Paints, Energy, Defense and Space Applications, Concerns and challenges of Nanotechnology

TEXT BOOKS:

1. Introduction to Nano Technology by Charles. P. Poole Jr& Frank J. Owens. Wiley India Pvt. Ltd.
2. Nano Materials- A.K.Bandyopadhyay/ New Age Publishers.
3. Nano Essentials- T.Pradeep/TMH

REFERENCE BOOKS:

1. Solid State physics by Pillai, Wiley Eastern Ltd.
2. Introduction to solid state physics 7th edition by Kittel. John Wiley & sons (Asia) Pvt Ltd.

Course Outcomes: After completing this course students will be able to:

1. Understand the classification of nanostructuredMaterials (BL-2)
2. Understand the unique properties of nano materials (BL-2)
3. Interpret the Synthesis Routes - Bottom up and Top down approaches (BL-3)
4. Identify the tools to characterize nano materials(BL-2)
5. Understand the applications of nano materials (BL-2)

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√	√							√
CO2	√	√	√	√	√							√
CO3	√	√	√	√	√							√
CO4	√	√	√	√	√							√
CO5	√	√	√	√	√							√

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IV Year - II Semester

L	T	P	C
3	0	0	3

DESIGN OF EXPERIMENTS

(Open Elective-III)

Course Objectives:

The students will acquire the knowledge:

1. To understand Probability laws, Baye's theorem and Probability distributions.
2. To understand normal and t-distributions and Central limit theorem.
3. To interpret randomization, blocking with paired comparisons and Analysis of variance
4. To develop two-way factorial designs and understand Yate's algorithm
5. To understand simple modeling with least squares

UNIT-I:

Introduction to probability, Probability laws, Baye's theorem, Probability distributions, Parameters and statistics.

UNIT-II:

Normal and t-distributions, Central limit theorem, Random sampling and declaration of independence significance tests.

UNIT-III:

Randomization and blocking with paired comparisons significance tests and confidence interval for means, variances, proportions and frequencies. Analysis of variance, Experiments to compare k-treatment means

UNIT-IV:

Two-way factorial designs, blocking, Yate's algorithm Fractional factorial designs at two levels, Concept of design resolution

UNIT-V:

Simple modeling with least squares (Regression analysis), Matrix versions of normal equations

Text Book

1. Statistics for Experimenters, G.E.P. Box, William G. Hunter and J.S. Hunter, John Wiley & Sons.

Reference Books

1. Design and Analysis of Experiments, D.C. Montgomery, 2nd Edition John Wiley and Sons.

2. Design of Experiments in Chemical Engineering: A Practical Guide, Zivorad R. Lazic, Wiley-VCH publications.

Course Outcomes

After completing this course students will be able to:

1. Illustrate Probability laws, Baye's theorem and Probability distributions. (BL-2)
2. Understand normal and t-distributions and Central limit theorem. (BL-2)
3. Analyze randomization, blocking with paired comparisons and Analysis of variance (BL-4)
4. Develop two-way factorial designs and understand Yate's algorithm (BL-3)
5. Understand simple modelling with least squares(BL-2)

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√	√							√
CO2	√	√	√	√	√							√
CO3	√	√	√	√	√							√
CO4	√	√	√	√	√							√
CO5	√	√	√	√	√							√

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L	T	P	C
3	0	0	3

PRODUCT DESIGN AND DEVELOPMENT

(Open Elective-III)

COURSE OBJECTIVES:

The students will acquire the knowledge:
1. Apply the principles of generic development process; conduct customer need analysis; and set product specification for new product design and development.
2. Generate, select, screen, and test concepts for new product design and development.
3. Apply the principles of product architecture and industrial design to design and develop new products.
4. Apply the principles of DFMA and Prototyping to design and develop new product.
5. Apply the concepts of economics principles sustainable product development and life cycle assessment.

UNIT I

INTRODUCTION
Introduction – A Generic Development Process – Adapting the Generic Product Development Process - Product Development Process Flows- Digital tools for product design– Identifying Customer Needs - Product Specifications: Establishing Target Specifications; Setting the Final Specifications.

UNIT II

CONCEPT GENERATION
Concept Generation: The Activity of Concept Generation - Concept Selection: Concept Screening; Concept Scoring – Concept Testing – Concept innovation using TRIZ

UNIT III

PRODUCT ARCHITECTURE
Implications of the Architecture; Establishing the Architecture; Delayed Differentiation; Platform Planning; Related System-Level Design Issues – Industrial Design: Assessing the Need for Industrial Design; Impact of Industrial Design; The Industrial Design Process; Management of the Industrial Design Process; Assessing the Quality of Industrial Design.

UNIT IV

DFM AND PROTOTYPING
Design for Manufacturing: Estimate the Manufacturing Costs; Reduce the Costs of Components; Reduce the Costs of Assembly; Reduce the Costs of Supporting Production; Consider the Impact of DFMA– Prototyping: Type; Uses; Principles; Technologies; Planning for Prototypes.

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UNIT V
PRODUCT DEVELOPMENT ECONOMICS
Elements of Economic Analysis; Economic Analysis Process – sustainable product development: framework and metrics – life cycle assessment of a product: stages and impact

TEXT BOOK:
1. Jamnia, A., Introduction to Product Design and Development for Engineers, CRC Press, 2018.
2. Karl, T. Ulrich and Steven, D. Eppinger, "Product Design and Development", McGraw Hill, 2003.

REFERENCES:
1. Belz A., 36-Hour Course: "Product Development" McGraw-Hill, 2010.
2. Chitale, A. K. and Gupta, R. C., Product Design and Manufacturing, PHI Learning, 2013.
3. Pugh S., "Total Design – Integrated Methods for successful Product Engineering", Addison Wesley Publishing, 1991.
4. Rosenthal S., "Effective Product Design and Development", Business One, 1992.
5. Silva, A., Handbook of Research on Trends in Product Design and Development: Technological and Organizational Perspectives: Technological and Organizational Perspectives,IGI Global, 2010.
6. Devdas Shetty, "Product design for Engineers", Cengage Learning

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Apply the principles of generic development process; conduct customer need analysis; and set product specification for new product design and development. (BL-3)
2. Select, screen, and test concepts for new product design and development. (BL-3)
3. Apply the principles of product architecture and industrial design to design and develop new products. (BL-3)
4. Apply the principles of DFMA and Prototyping to design and develop new product. (BL-3)
5. Apply the concepts of economics principles sustainable product development and life cycle assessment. (BL-3)

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√	√							√
CO2	√	√	√	√	√							√
CO3	√	√	√	√	√							√
CO4	√	√	√	√	√							√
CO5	√	√	√	√	√							√

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L	T	P	C
3	0	0	3

ADVANCED MATERIALS

(Open Elective-III)

Course Objectives

The students will acquire the knowledge:

1. To classify the composite materials and identify the applications
2. To understand manufacturing methods of PMC, MMC & CCC and their applications
3. To understand macro-mechanical analysis of a lamina
4. To interpret the functionally graded materials and their properties
5. To understand types of nano materials and their properties

UNIT-I

INTRODUCTION TO COMPOSITE MATERIALS: Introduction, classification: polymer matrix composites, metal matrix composites, ceramic matrix composites, carbon–carbon composites, fiber- reinforced composites and nature-made composites, and applications

REINFORCEMENTS: Fibres- glass, silica, kevlar, carbon, boron, silicon carbide, and born carbide fibres.

UNIT-II

AEROSPACE MATERIALS: Metallic materials- super alloys, Aluminium, Magnesium, titanium and Nickel based alloys and intermetallics, High temperature polymers, Materials for cryogenic application, Materials for space environment, Evaluation of materials for extreme environment, Materials processing and manufacturing in zero gravity.

UNIT-III

MACROMECHANICAL ANALYSIS OF A LAMINA: Introduction, generalized Hooke's law, reduction of Hooke's law in three dimensions to two dimensions, relationship of compliance and stiffness matrix to engineering elastic constants of an orthotropic lamina, laminate-laminate code.

UNIT-IV

FUNCTIONALLY GRADED MATERIALS: Types of functionally graded materials-classification different systems-preparation-properties and applications of functionally graded materials.

SHAPE MEMORY ALLOYS: Introduction-shape memory effect-classification of shape memory alloys-composition-properties and applications of shape memory alloys.

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UNIT-V

NANO MATERIALS: Introduction-properties at nano scales-advantages & disadvantages applications in comparison with bulk materials (nano – structure, wires, tubes, composites). state of art nano advanced- topic delivered by student.

Text Books:

1. Nano material /A.K. Bandyopadyay/New age Publishers
2. Material science and Technology: A comprehensive treatment/Robert W.Cahn,/VCH
3. Engineering Mechanics of Composite Materials / Isaac and M Daniel/Oxford University Press

References:

1. Mechanics of Composite Materials / R. M. Jones/ Mc Graw Hill Company, New York, 1975.
2. Analysis of Laminated Composite Structures / L. R. Calcote/Van Nostrand Rainfold,NY 1969
3. Analysis and performance of fibre Composites /B. D. Agarwal and L. J. Broutman /Wiley-Interscience, New York, 1980
4. Mechanics of Composite Materials - Second Edition (Mechanical Engineering) /Autar K.Kaw /CRC Press

Course Outcomes

After learning the course the students should be able to

1. Classify the composite materials and identify the applications (BL-2)
2. Identify the aerospace materials and their applications (BL-3)
3. Understand macro-mechanical analysis of a lamina (BL-2)
4. Interpret the functionally graded materials and their properties (BL-2)
5. Understand types of nano materials and their properties (BL-2)

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√	√							√
CO2	√	√	√	√	√							√
CO3	√	√	√	√	√							√
CO4	√	√	√	√	√							√
CO5	√	√	√	√	√							√

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L	T	P	C
0	0	12	6

PROJECT-II

Objectives:

The aim of the course is to make the student perform a comprehensive project work that involves either or all of the following: optimum design of a mechanical component or an assembly, thermal analysis, computer aided design & analysis, cost effective manufacturing process, material selection, testing procedures or fabrication of components and prepare a detailed technical thesis report. The completed task should also take into account the significance of real time applications, energy management and the environmental affects.

Outcomes

- Understand the need of optimum design of a mechanical component or an assembly
- Study the procedure to bring cost effective manufacturing process with proper material selection and technical procedure of planning the work.
- Recognize the need of scheduling the and realizing an engineering product design
- Realize the significance of real time applications, energy management and environmental affects
- Obtain the skill of data collection and technical report writing.

CO-PO Mapping

S.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√	√	√	√	√	√	√	√	√
CO2	√	√	√	√	√	√	√	√	√	√	√	√
CO3	√	√	√	√	√	√	√	√	√	√	√	√
CO4	√	√	√	√	√	√	√	√	√	√	√	√
CO5	√	√	√	√	√	√	√	√	√	√	√	√