MARRI LAXMAN REDDY
INSTITUTE OF TECHNOLOGY AND MANAGEMENT
(AN AUTONOMOUS INSTITUTION)
(Approved by AICTE, New Delhi & Affiliated to JNTUH, Hyderabad)
Accredited by NBA and NAAC with 'A' Grade & Recognized Under Section2(f) & 12(B)of the UGC act,1956

B. Tech - Mechanical Engineering
Course Structure (R24)
Applicable From 2024-25 Admitted Batch
Structure Breakup

S.No	Category	Breakup of credits (Total 160 credits)
1	Humanities and Social Sciences including Management courses (HSMC)	7
2	Basic Sciences Courses (BS)	24
3	Engineering Sciences courses including Workshop, Drawing basics of electrical/mechanical/computer etc.(ES)	26
4	Professional Core courses (PC)	59
5	Professional Electives (PE)	18
6	Open Electives (OE)	9
7	Project work, Seminar and Internship in industry or elsewhere (PS)	17
8	Mandatory Courses	0
	TOTAL	**160**

I SEMESTER

S. No.	Course Code	Course Title	Course Area	L	T	P	Credits	Internal (CIA)	External (SEE)	Total
		Theory								
1	2410001	Matrices and Calculus	BS	3	1	0	4	40	60	100
2	2410008	Applied Physics	BS	3	0	0	3	40	60	100
3	2410501	Problem Solving using C and C++	ES	3	0	0	3	40	60	100
4	2410010	English for Skill Enhancement	HSMC	3	0	0	3	40	60	100
		Laboratory								
1	2410372	Engineering Workshop	ES	0	1	4	3	40	60	100
2	2410071	Applied Physics Laboratory	BS	0	0	2	1	40	60	100
3	2410571	Problem Solving Using C and C++Laboratory	ES	0	0	2	1	40	60	100
4	2410073	English Language and Communication Skills Laboratory	HSMC	0	0	2	1	40	60	100
		Skill Development Course								
1	2410596	Web Application Development	SDC	0	0	2	1	40	60	100
		Mandatory Course								
1		Foreign Language	*MC	0	0	0	0	-	-	-
		Induction Programme	-	-	-	-	-	-	-	-
		Total Credits		12	2	12	20	360	540	900

*MC - Satisfied/Unsatisfied

Students can choose any one of the foreign language from the given list
i)   24X0FL1 French
ii)   24X0FL2German
iii)   24X0FL3Spanish
iv)   24X0FL4Korean

II SEMESTER

S. No.	Course Code	Course Title	Course Area	L	T	P	Credits	Internal (CIA)	External (SEE)	Total
				Hours Per Week				**Scheme of Examination Maximum Marks**		
		Theory								
1	2420002	Differential Equations and Vector Calculus	BS	3	1	0	4	40	60	100
2	2420009	Engineering Chemistry	BS	3	0	0	3	40	60	100
3	2420321	Applied Mechanics	ES	3	0	0	3	40	60	100
4	2420502	Essentials of Problem Solving using Python	ES	3	0	0	3	40	60	100
		Laboratory								
1	2420371	Computer Aided Engineering Graphics	ES	1	0	4	3	40	60	100
2	2420072	Engineering Chemistry Laboratory	BS	0	0	2	1	40	60	100
3	2420373	Fuels& lubricants Laboratory	ES	0	0	2	1	40	60	100
4	2420572	Essentials of Problem Solving Using Python Laboratory	ES	0	0	2	1	40	60	100
		Skill Development Course								
1	2420027	Public Speaking Skills	SDC	0	0	2	1	40	60	100
		Mandatory Course								
1	2420026	Yoga & Inner Engineering	*MC	0	0	0	0	-	-	-
		Total Credits		**13**	**1**	**12**	**20**	**360**	**540**	**900**

*MC – Satisfied/Unsatisfied

III SEMESTER

S. No.	Course Code	Course Title	Course Area	L	T	P	Credits	Internal (CIA)	External (SEE)	Total
		Theory								
1	2430322	Mechanics of Solids	PC	2	0	0	2	40	60	100
2	2430323	Metallurgy and Material Science	PC	2	0	0	2	40	60	100
3	2430324	Thermodynamics	PC	3	0	0	3	40	60	100
4	2430507	Data Structures	ES	3	0	0	3	40	60	100
5	2430007	Probability, Statistics and Numerical Methods	BS	3	1	0	4	40	60	100
	243ExL1	Design and Innovation	EL	0	0	2	1	40	60	100
		Laboratory								
1	2430374	Material Science & Mechanics of Solids Laboratory	PC	0	0	2	1	40	60	100
2	2430575	Data Structures Laboratory using Python	ES	0	0	2	1	40	60	100
3	2430375	Computer Aided Machine Drawing Practice	PC	0	0	2	1	40	60	100
1	2430391	Internship - I	*PS	0	0	2	1	100	-	100
		Skill Development Course								
1	2430395	Automotive Design Course - I	SDC	0	0	2	1	40	60	100
		Mandatory Course								
1		Indian Knowledge System	**MC	0	0	0	0	-	-	-
		Total Credits		13	1	12	20	500	600	1100

*PS – Students have to complete Internship I during the semester break for a minimum of 2 weeks after the second semester.

**MC - Satisfied/Unsatisfied

Students can choose any one of the following courses
i)   24XIKS1: Indian Science, Engineering and Technology
ii)   24XIKS2: Fundamentals and Applications of Vedic Mathematics
iii)   24XIKS3: Indian Health, Wellness and Psychology- including Ayurved
iv)   24XIKS4: Indian Town Planning and Architecture

IV SEMESTER

S. No.	Course Code	Course Title	Course Area	L	T	P	Credits	Internal (CIA)	External (SEE)	Total
		Theory								
1	2440202	Basic Electrical and Electronic Engineering	HS	2	0	0	2	40	60	100
2	2440325	Manufacturing Process	PC	3	0	0	3	40	60	100
3	2440326	Theory of Machines	PC	3	0	0	3	40	60	100
4	2440327	Thermal Engineering - I	PC	3	0	0	3	40	60	100
5	2440328	Mechanics of Fluids and Hydraulic Machinery	PC	3	1	0	4	40	60	100
6	244EXL2	Prototype / Model Development and Entrepreneurship	EL	0	0	2	1	40	60	100
		Laboratory								
1	2440376	Mechanics of Fluids and Hydraulic Machinery Laboratory	PC	0	0	2	1	40	60	100
2	2440377	Manufacturing Process Laboratory	PC	0	0	2	1	40	60	100
3	2440272	Basic Electrical and Electronic Engineering Laboratory	HS	0	0	2	1	40	60	100
		Skill Development Course								
1	2430396	Automotive Design Course - II	SDC	0	0	2	1	40	60	100
		Mandatory Course								
1	2440021	Environmental Science	*MC	0	0	0	0	-	-	-
		Total Credits		14	1	10	20	400	600	1000

*MC - Satisfied/Unsatisfied

V SEMESTER

S. No.	Course Code	Course Title	Course Area	L	T	P	Credits	Internal (CIA)	External (SEE)	Total
		Theory								
1	2450329	Design of Machine Elements	PC	3	1	0	4	40	60	100
2	2450330	Metrology and Machine Tools	PC	3	0	0	3	40	60	100
3	2450331	Thermal Engineering - II	PC	3	0	0	3	40	60	100
4		Open Elective - I	OE	3	0	0	3	40	60	100
5		Professional Elective - I	PE	3	0	0	3	40	60	100
		Laboratory								
1	2450378	Metrology and Machine Tools Laboratory	PC	0	0	2	1	40	60	100
2	2450379	Theory of Machines Laboratory	PC	0	0	2	1	40	60	100
3	2450380	Thermal Engineering Laboratory	PC	0	0	2	1	40	60	100
		Project								
1	2450387	Field Based Project	*PS	0	0	2	1	100	-	100
		Mandatory Course								
1	2450022	Gender Sensitization	**MC	0	0	0	0	-	-	-
		Total Credits		15	1	8	20	420	480	900

*PS – Students have to complete Field Based Project during the semester break for a minimum of 2 weeks after the fourth semester.

**MC - Satisfied/Unsatisfied

VI SEMESTER

S. No.	Course Code	Course Title	Course Area	L	T	P	Credits	Internal (CIA)	External (SEE)	Total
		Theory								
1	2460332	Design of Transmission Systems	PC	3	1	0	4	40	60	100
2	2460333	Heat Transfer	PC	3	1	0	4	40	60	100
3	2460334	Finite Element Analysis	PC	3	0	0	3	40	60	100
4		Open Elective - II	OE	3	0	0	3	40	60	100
5		Professional Elective - II	PE	3	0	0	3	40	60	100
		Laboratory								
1	2460381	Heat Transfer Laboratory	PC	0	0	2	1	40	60	100
2	2460382	Computer Aided Engineering Laboratory	PC	0	0	2	1	40	60	100
3	2460383	Computer Aided Production Drawing Practice Laboratory	PC	0	0	2	1	40	60	100
		Mandatory Course								
1	2460025	Human Values and Professional Ethics	*MC	0	0	0	0	-	-	-
		Total Credits		15	2	6	20	320	480	800

*MC - Satisfied/Unsatisfied

VII SEMESTER

S. No.	Course Code	Course Title	Course Area	Hours Per Week			Credits	Scheme of Examination Maximum Marks		
				L	T	P		Internal (CIA)	External (SEE)	Total
		Theory								
1	2470335	Instrumentation and ControlSystems	PC	2	0	0	2	40	60	100
2	2470336	CAD/CAM	PC	3	0	0	3	40	60	100
3	2480010	Business Economics and Financial Analysis	HSMC	3	0	0	3	40	60	100
4		Open Elective - III	OE	3	0	0	3	40	60	100
5		Professional Elective - III	PE	3	0	0	3	40	60	100
6		Professional Elective - IV	PE	3	0	0	3	40	60	100
		Laboratory								
7	2470384	CAD/CAM Laboratory	PC	0	0	2	1	40	60	100
8	2470385	Instrumentation and Control Systems Laboratory	PC	0	0	2	1	40	60	100
	2470392	Internship - II	*PS	0	0	2	1	100	-	100
		Project								
9	2470388	Project Stage - I	PS	0	0	6	3	100	-	100
		Mandatory Course								
10	2470023	Constitution of India	**MC	0	0	0	0	-	-	-
		Total Credits		17	0	12	23	520	480	1000

*PS - Students have to complete Internship - II during the semester break for a minimum of 2 weeks after the six semester.

**MC - Satisfied/Unsatisfied

VIII SEMESTER

S. No.	Course Code	Course Title	Course Area	Hours Per Week			Credits	Scheme of Examination Maximum Marks		
				L	T	P		Internal (CIA)	External (SEE)	Total
		Theory								
1		Professional Elective - V	PE	3	0	0	3	40	60	100
2		Professional Elective - VI	PE	3	0	0	3	40	60	100
		Project								
3	2480389	Technical seminar	PS	0	0	4	2	100	-	100
4	2480390	Project Stage - II	PS	0	0	18	9	40	60	100
		Total Credits		6	0	22	17	220	180	400

PROFESSIONAL ELECTIVE COURSES

PE I - Professional Elective I

S. No	Course Code	Course Title
1	2450341	Mechatronics
2	2450342	Non-Destructive Testing
3	2450343	Automation in Manufacturing
4	2450344	Microprocessor in Automation

PE II - Professional Elective II

S. No	Course Code	Course Title
1	2460345	Non-Traditional Machining Process
2	2460346	Metal forming Technology
3	2460347	Operation Research
4	2460348	Flexible Manufacturing Systems

PE III - Professional Elective III

S. No	Course Code	Course Title
1	2470349	Refrigeration and Air Conditioner
2	2470350	Automobile Engineering
3	2470351	Computational Fluid Dynamics
4	2470352	Hydraulic and Pneumatics

PE IV - Professional Elective IV

S. No	Course Code	Course Title
1	2470353	Composite Materials & Mechanics
2	2470354	Robotics
3	2470355	Production Planning Control
4	2470356	Mechanical Vibrations

PE V - Professional Elective V

S. No	Course Code	Course Title
1	2480357	Total quality management
2	2480358	Quality and reliability
3	2480359	Artificial intelligent in Mechanical Engineering
4	2480360	Surface Engineering & Tribology

PE VI - Professional Elective VI

S. No	Course Code	Course Title
1	2480361	Fuzzy logic & Artificial neural networks
2	2480362	Introduction to Industrial 4.0
3	2480363	Solar energy technology
4	2480364	Industrial Management

OPEN ELECTIVE COURSES

Open Electives

S. No	Course Code	Course Title
1	2450301	Elements of Mechanical Engineering
	2450302	Introduction to Engineering Materials
2	2460303	Introduction to Robotics
	2460304	Introduction to Automobile Engineering
3	2470305	Additive Manufacturing and its Applications
	2470306	Non Conventional Energy Sources

I-I

2410001: MATRICES AND CALCULUS
(CSE, CSD, CSM, ECE, EEE, MECH, CIVIL)

B.Tech. I Year I Sem   **L   T   P   C**

3   1   0   4

Course Overview:

Matrix algebra and calculus are essential for understanding and solving complex problems in many scientific and engineering fields. This course provides the mathematical foundation for advanced topics and applications. This course covers matrix theory, linear algebra and calculus. Linear algebra is a branch of mathematics that studies system of linear equations and the properties of matrices. The calculus part of the course typically covers differential and its applications, and integration techniques. Matrix algebra allows us to think of a matrix holistically, generalize and compute derivatives important matrix factorizations, understand how differentiation formulas must be reimagined in large scale computing. Calculus is used to model and solve real- world problems.

Pre-requisites: Mathematics courses of 10+2 year of study.

Course Objectives: The student will try to learn

- Types of matrices and their properties, concept of a rank of the matrix and applying this concept to know the consistency and solving the system of linear equations.
- Concept of eigen values, eigenvectors and reduction of quadratic form to canonical form by orthogonal transformation.
- Geometrical approach to the mean value theorems and their application to the mathematical problems. Evaluation of improper integrals using Beta and Gamma functions.
- Partial differentiation, concept of total derivative and finding maxima and minima of function of two and three variables.
- Evaluation of multiple integrals and their applications.

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

CO1: Write the matrix representation of a set of linear equations and to analyses the solution of the system of equations.

CO2: Find the Eigen values and Eigenvectors and reduce the quadratic form to canonical form using orthogonal transformations.

CO3: Solve the applications on mean value theorems and evaluate improper integrals using Beta and Gamma functions.

CO4: Find the extreme values of functions of two variables with/ withoutconstraints.

CO5: Evaluate the multiple integrals and apply the concept to find areas, volumes.

UNIT-I:Matrices   10 L

Rank of a matrix by Echelon form and Normal form, Inverse of Non-singular matrices by Gauss-Jordan method, System of linear equations: Solving system of Homogeneous and Non-Homogeneous equations, L-Udecomposition method.

UNIT-II: Eigen values and Eigenvectors   10 L

Eigen values, Eigen vectors and their properties (without proof), Diagonalization of a matrix, Cayley-Hamilton Theorem (without proof), finding inverse and power of a matrixbyCayley-

HamiltonTheorem,QuadraticformsandNatureoftheQuadraticForms,Reductionof Quadratic form to canonical forms by Orthogonal Transformation.

UNIT-III:Calculus   8 L

Mean value theorems: Rolle's Theorem, Lagrange's Mean value theorem with their Geometrical Interpretation and applications, Cauchy's Mean value Theorem, Taylor's Series (without proofs).
Beta and Gamma functions and their applications(properties without proof).

UNIT-IV: Multivariable Calculus (Partial Differentiation and applications)   10 L

Partial Differentiation: Euler's Theorem, Total derivative, Jacobian, Functional dependence-
independence.Applications:Maximaandminimaoffunctionsoftwovariablesandthreevariables using method of Lagrangemultipliers.

UNIT-V: MultivariableCalculus (Integration)   10 L

Evaluation of Double Integrals (Cartesian and polar coordinates), change of order of integration (only Cartesian form), Evaluation of Triple Integrals, Change of variables (Cartesian to polar) for double and triple integrals (Cartesian to Spherical and Cylindrical polar coordinates).
Applications: Areas (by double integrals) and volumes (by triple integral).

TEXT BOOKS:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition,2010.
2. R.K. Jain and S.R.K. Iyengar, Advanced Engineering Mathematics, Narosa Publications, 5thEditon,2016.

REFERENCE BOOKS:

1. Erwin kreyszig, Advanced Engineering Mathematics, 9thEdition, John Wiley & Sons,2006.
2. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9thEdition,Pearson, Reprint, 2002.
3. H. K. Dassand Er. RajnishVerma, Higher Engineering Mathematics, S Chand and Company Limited, NewDelhi.

2420008: APPLIED PHYSICS

B.Tech. I Year II. Sem.   **L T P C**
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Course Overview
Applied Physics is the application of the Physics to solve Scientific or Engineering Problems. It is considered as bridge between Physics and Engineering.
Applied Physics under graduate program stress the basic Physics that underlies most developments in engineering and mathematical tools that are important to engineers.

Prerequisites: 10 + 2 Physics

Course Objectives: The student will try to learn :

1.   Understand the basic principles of quantum physics and band theory of solids.
2.   Understand the underlying mechanism involved in construction and working principles of
    various semiconductor devices.
2.   Study the fundamental concepts related to the dielectric, magnetic materials.
3.   Identify the importance of nanoscale, quantum confinement and various fabrications
     techniques.
5. Study the characteristics of lasers and optical fibers.

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

1.   Understand physical world from fundamental point of view by the concepts of Quantum
    mechanics and visualize the difference between conductor, semiconductor, and an insulator by classification of solids.
2. Identify the role of semiconductor devices in science and engineering Applications.
3. Explore the fundamental properties of dielectric, magnetic materials and their applications.
4. Appreciate the features and applications of Nano materials.
5. Understand various aspects of Lasers and Optical fiber and their applications in diverse fields.

UNIT - I: QUANTUM PHYSICS AND SOLIDS
Quantum Mechanics: Introduction to quantum physics, Blackbody radiation, Photoelectric effect, de-Broglie Hypothesis and matter waves, Davisson and Germer experiment, Heisenberg uncertainty principle, Born interpretation of the wave function, Time independent Schrodinger wave equation, Particle in one dimensional potential box.
Solids: Free electron theory (Drude& Lorentz, Sommerfeld), Bloch's theorem -Kronig-Penney model, Effective mass of electron, Origin of energy bands, Classification of solids.

UNIT - II: SEMICONDUCTORS AND DEVICES
Intrinsic and extrinsic semiconductors, Hall effect, Direct and Indirect band gap semiconductors, Construction, principle of operation and characteristics of P-N Junction diode, Zener diode and Bipolar junction transistor (BJT)
Opto-devices- Light emitting diode (LED), PIN diode, and Solar cell, their structure, materials, working principle and characteristics, Solar cell application- Space craft.

UNIT - III: DIELECTRIC AND MAGNETIC MATERIALS

Dielectric Materials: Introduction to dielectrics, Polarization, Permittivity, Dielectric constant, Types of polarizations (Qualitative), Internal field in Solids, Clausius-Mossotti equation, Ferroelectric, Piezoelectric and Pyroelectric materials, Applications.

Magnetic Materials: Introduction to Magnetism, Magnetization, Permeability, Susceptibility, Classification of Magnetic Materials, Hysteresis curve, Soft and Hard magnetic materials, Magnetostriction, Magneto resistance, Magnetic field sensors and bubble memory devices.

UNIT - IV: NANOTECHNOLOGY

Nanoscale, Quantum confinement, Surface to volume ratio, Bottom-up fabrication: Sol-gel, Precipitation methods, Top-down fabrication: Ball milling, Physical Vapor Deposition (PVD), Characterization techniques - XRD, SEM and TEM, Applications of nanomaterials.

UNIT - V: LASER AND FIBER OPTICS

Lasers: Laser beam characteristics-three quantum processes-Einstein coefficients and their relations, Lasing action, Population inversion, Pumping methods, Ruby laser, He-Ne laser, CO_2 laser, Applications of laser- Medical and Military.

Fiber Optics: Introduction to optical fiber, Total internal reflection, Construction of optical fiber, Acceptance angle, Numerical aperture, Classification of optical fibers, Losses in optical fiber, Optical fiber for communication system, Applications of optical fiber-Endoscopy.

TEXT BOOKS:

1. M. N. Avadhanulu, P.G. Kshirsagar& TVS Arun Murthy" A Text book of Engineering Physics", S. Chand Publications, 11th Edition 2019.
2. Engineering Physics by Shatendra Sharma and Jyotsna Sharma, Pearson Publication,2019
3. Semiconductor Physics and Devices- Basic Principle – Donald A, Neamen, McGraw Hill,
   4[th]Edition,2021.
4. B.K. Pandey and S. Chaturvedi, Engineering Physics, Cengage Learning, 2[nd]Edition,2022.
5. Essentials of Nanoscience & Nanotechnology by Narasimha Reddy Katta, Typical Creatives NANO DIGEST, 1[st]Edition, 2021.

REFERENCE BOOKS:

1. Quantum Physics, H.C. Verma, TBS Publication, 2[nd]Edition 2012.
2. Fundamentals of Physics – Halliday, Resnick and Walker, John Wiley &Sons,11[th]Edition,
   2018.
3. Introduction to Solid State Physics, Charles Kittel, Wiley Eastern, 2019.
4. Elementary Solid State Physics, S.L. Gupta and V. Kumar, Pragathi Prakashan, 2019.
5. A.K. Bhandhopadhya - Nano Materials, New Age International, 1stEdition, 2007.

24X0501:Problem Solving Using C and C++

IB.Tech.I–Sem.   **L   T   P   C**

                                                                 3   0   0   3

Course Overview:

The Course Provides good foundation in procedural oriented and object-oriented programming concepts. It provides overview on basic building blocks of procedural oriented concepts like arrays, pointers, structures, strings**.** It comprises object-oriented concepts such as information hiding, encapsulation, inheritance and polymorphism. C programming is used in operating systems, embedded devices, OS kernels, drivers, IoT applications. C++ is widely used for creating graphics-heavy software, game engines, VR applications, and web browsers.

Prerequisites: Nil

Course Objectives: The students will try to learn
- Using of structured programming approach in solving problems
- How to use arrays ,pointers, strings and structures in solving problems
- Defining of structures in C and classes in C++
- Importance of inheritance in object-oriented programming
- Handling of exceptions in programs

Course Outcomes: After successful completion of the course, students should be able to
- Develop programs using Control statements and Repetitive statements
- Modularize the code with functions so that they can be reused
- Learn about Object oriented concepts
- Design programs by using Inheritance concepts
- Implement polymorphism and Exception Handling

Module-I:Introductiontoprogramming   **[10]**

Introduction Procedure Oriented and Object-Oriented Programming. Algorithm, Flowchart, Pseudo code. Creating and Running of C Program. Structure of C program – C character set, C Tokens: Constants, Variables, Keywords, Identifiers, C data types, C operators. Standard I/O in C (scanf, printf), Conditional Control statements (if and Switch) Statements. Repetitive statements: While, Do While and For Loops - Use of Break and Continue Statements.

Module-II: Functions, Arrays, Strings and Pointers   **[12]**

Arrays:Introduction,Declaration,CreatingandAccessingofOne-Dimensional   Arrays, Two- Dimensional Arrays.
StringsandPointers:Introductiontostrings,stringhandlingfunctions,Arraysof   strings, Introduction to pointers, Dynamic Memory allocation.
Functions: Defining Functions – User Defined Functions, Storage Classes, passing parameters:CallByValue,CallByReference,Recursion,Command-lineArguments.

Module-III: Structures and Classes   [8]

Structures: Defining structures, initializing structures, unions, Array of structures **OOPS Concepts**: Class, Object, Abstraction, Encapsulation, Inheritance and Polymorphism.
C++ Classes and Data Abstraction: Class definition, Class structure, Class objects, Class scope, this pointer, Friends to a class, Static class members, Constant member functions, Constructors and Destructors, Dynamic creation and destruction of objects, Data abstraction.

Module–IV: Inheritance   [7]

Inheritance: Defining a class hierarchy, Different forms of inheritance, Defining the Base and Derived classes, Access to the base class members, Base and Derived class construction, Destructors, Virtual base class.

Module–V: Polymorphism and ExceptionHandling   [8]

Virtual Functions and Polymorphism: Static and Dynamic binding, virtual functions, Dynamic binding through virtual functions, Virtual function call mechanism, Pure virtual functions, Abstract classes, Implications of polymorphic use of classes, Virtual destructors.
Exception handling: Try, throw and catch.

TEXTBOOKS:
1. Forouzan B.A&RichardF.Gilberg,AStructuredProgrammingApproach using C,3rd Edition(2013), Cengage Learning.
2. Jeri R. Hanly and Elliot B.Koffman, Problem solving and Program Designin C 7th Edition,Pearson
3. ANSIandTurboC++byAshokeN.Kamthane,PearsonEducation
4. RobertLaforeC++

REFERENCES:
1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India
2. E.Balagurusamy,ComputerfundamentalsandC,2ndEdition,McGraw-Hill
3. YashavantKanetkar,LetUsC,18thEdition,BPB
4. E.Balagurusamy, Object Oriented Programming using C++,2ndEdition, McGraw-Hill

24X0010: ENGLISH FOR SKILL ENHANCEMENT

B.Tech. I Year. I Sem.   **L T P C**

                                                                        3 0 0 3

Course Overview:

1. The English language plays a vital role in engineering education. Acquiring LSRW skills has become a prerequisite to learning about different technologies and their intricacies.

2. All these extracts are fascinating, thought-provoking, and contextual to engineering students. The authors have sincerely tried connecting every lesson with the modules of vocabulary, grammar, reading comprehension and writing tasks stipulated under each module. The textbook includes several exercises and activities involving the student's language skills practice. They are extremely encouraging and motivational and cater to a group of students with mixed abilities.

3. Each module starts with the preparatory task which can stimulate an interesting discussion among the students in the classroom. Adequate explanations and more examples are provided in vocabulary and grammar sections to enable students to work independently in and outside the classroom. The reading part suggests improving students' reading skills and provides reading comprehension exercises. The writing module aims at developing the learner's writing skills by providing conceptual discussions and exercises in different forms of written communication such as formal letters, CV/ résumé and job application letters, e-mails, reports, etc.

Prerequisites: Language Comprehension

Course Objectives: The students will try to learn:

1. Improve the language proficiency of students in English with an emphasis on Vocabulary, Grammar, Reading and Writing skills.
2. Develop study skills and communication skills in various professional situations.
3. Equip students to study engineering subjects more effectively and critically using the theoretical and practical components of the syllabus.

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

1. Understand the importance of vocabulary and sentence structures.

2. Choose appropriate vocabulary and sentence structures for their oral andwritten communication.

3. Demonstrate their understanding of the rules of functional grammar.

4. Develop comprehension skills from the known and unknown passages.

5. Take an active part in drafting paragraphs, letters, essays, abstracts, précis andreports in various contexts.

MODULE – I (No of Hours = 7)

Chapter entitled '*Toasted English*' **by R.K. Narayan** from *"English: Language, Context and Culture"* published by Orient BlackSwan, Hyderabad.

Vocabulary: The Concept of Word Formation -The Use of Prefixes and Suffixes - Acquaintance with Prefixes and Suffixes from Foreign Languages to Form Derivatives - Synonyms and Antonyms

Grammar: Identifying Common Errors in Writing concerning Articles and Prepositions.

Reading: Reading and Its Importance- Techniques for Effective Reading.

Writing: Sentence Structures -Use of Phrases and Clauses in Sentences- Importance of Proper Punctuation- Techniques for Writing precisely – Paragraph Writing – Types, Structures and Features of a Paragraph - Creating Coherence- Organizing Principles of Paragraphs in Documents.

MODULE – II (No of Hours = 6)

Chapter entitled **'Appro JRD' by Sudha Murthy** from *"English: Language, Context andCulture" published* by Orient BlackSwan, Hyderabad.

Vocabulary: Words Often Misspelt - Homophones, Homonyms and Homographs

Grammar: Identifying Common Errors in Writing concerning Noun-pronounAgreement and Subject-verb Agreement.

Reading: Sub-Skills of Reading – Skimming and Scanning – Exercises for Practice

Writing: Nature and Style of Writing- Defining /Describing People, Objects,Places and Events – Classifying- Providing Examples or Evidence.

MODULE – III (No of Hours = 7)

The chapter entitled **'Lessons from Online Learning' by F.Haider Alvi, Deborah Hurst et al** from

"English: Language, Context and Culture" published by Orient BlackSwan,

Hyderabad.**Vocabulary**: Words Often Confused - Words from Foreign Languages and their Use in English. **Grammar:** Identifying Common Errors in Writing Concerning Misplaced Modifiers and Tenses.

Reading: Sub-Skills of Reading – Intensive Reading and Extensive Reading – Exercises for Practice **Writing:** Format of a Formal Letter-Writing Formal Letters E.g.., Letter of Complaint, Letter of Requisition, Email Etiquette, Job Application with CV/Resume.

MODULE – IV (No of Hours = 6)

Chapter entitled **'Art and Literature' by Abdul Kalam** from *"English: Language, Contextand Culture"* published by Orient BlackSwan, Hyderabad.

Vocabulary: Standard Abbreviations in English

Grammar: Redundancies and Clichés in Oral and Written Communication.

Reading: Survey, Question, Read, Recite and Review (SQ3R Method) - Exercises for Practice

Writing: Writing Practices- Essay Writing-Writing Introduction and Conclusion -Précis Writing.

MODULE – V (No of Hours = 6)

Chapter entitled **'Go, Kiss the World' by Subroto Bagchi** from *"English: Language,Context and Culture"* published by Orient BlackSwan, Hyderabad.

Vocabulary: Technical Vocabulary and their Usage

Grammar: Common Errors in English (*Covering all the other aspects of grammar whichwere not covered in the previous modules*)

Reading: Reading Comprehension-Exercises for Practice

Writing: Technical Reports- Introduction – Characteristics of a Report – Categories of Reports Formats- Structure of Reports (Manuscript Format) -Types of Reports - Writing a Report.

Note: *Listening and Speaking Skills which are given under Module 6 in t h e AICTE ModelCurriculum are covered in the syllabus of the ELCS Lab Course.*

> **Note: 1**. As the syllabus of English given in AICTE *Model Curriculum-2018 for B.Tech First Year is Open-ended,* besides following the prescribed textbook, it is required to prepare teaching/learning materials **the teachers collectively** in the form of handouts based on the needs of the students in their

respective colleges for effective teaching/learning in the class.

➤ **Note**: **2**. Based on the recommendations of NEP2020, teachers are requested to be flexible in adopting Blended Learning in dealing with the course contents. They are advised to teach 40 per cent of each topic from the syllabus in blended mode.

TEXTBOOK:

1. "English: Language, Context and Culture" by Orient BlackSwan Pvt. Ltd, Hyderabad. 2022. Print.

REFERENCE BOOKS:

1. Effective Academic Writing by Liss and Davis (OUP)

2. Richards, Jack C. (2022) Interchange Series. Introduction, 1,2,3. Cambridge University Press

3. Wood, F.T. (2007). Remedial English Grammar. Macmillan.

4. Chaudhuri, Santanu Sinha. (2018). Learn English: A Fun Book of FunctionalLanguage, Grammar, and Vocabulary. (2nd ed.,). Sage Publications India Pvt. Ltd.

5. (2019). Technical Communication. Wiley India Pvt. Ltd.

6. Vishwamohan, Aysha. (2013). English for Technical Communication forEngineering Students. Mc Graw-Hill Education India Pvt. Ltd.

7. Swan, Michael. (2016). Practical English Usage. Oxford University Press. Fourth Edition.

24X0372: ENGINEERING WORK SHOP
(Common to all branches)

B.Tech.I Year.I Semester　　　　　　　　　　　　　　　　　　**L　T　P　C**
　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　0　1　4　3

Course Overview: After successful completion of the course, students should able to learn.

Engineering Workshops: A foundational course aimed at introducing first-year students to a variety of tools, equipment, and techniques essential for creating physical objects and mechanisms using different materials. This course provides an opportunity for students to build confidence and gain practical experience in carpentry, fitting, house wiring, tin-smithy, black smithy, welding, and principles of modern manufacturing processes.

Prerequisite: NIL

Course Objective: The student will able to
1. To gain good basic working knowledge required for the production of various engineering products.
2. To study different tools uses and their demonstration.
3. To provide hands on experience about use of different engineering materials, tools, equipments and processes those are common in engineering field.
4. To develop a right attitude, team working, precision and safety at work place.
5. It explains the construction, function use and application different working tools and equipments.

Course outcomes: At the end of the course students should able to
1. Explain the design and model different prototype in the trade of carpentry such as Cross lap joint, Dove tail joint.
2. Demonstrate the design and model various basic prototypes in the trade of fitting such as straight fit and V-fit.
3. Understand to make various basic prototypes in the trade of tin smithy such as rectangular tray and open cylinder.
4. Demonstrate the design and model various basic prototype in welding and black smithy.
5. Understand to perform various basic house wiring techniques such as connecting one lamp with one switch, connecting two lamps with one switch.

Course content:
Module -I: CARPENTRY AND FITTING
- Carpentry – Introduction, Carpentry tools, sequence of operations and applications (T-Lap Joint, Dovetail Joint, Mortise & Tenon Joint)
- Fitting – Introduction, fitting tools, sequence of operations and applications (V-Fit, Dovetail Fit & Semi-circular fit)

Module -II: TIN SMITHY AND BLACKSMITHY
- Tin-Smithy – Introduction, Tin smithy tools, sequence of operations and applications (Square Tin, Rectangular Tray & Conical Funnel).
- Blacksmithy- Introduction, Blacksmithy tools, sequence of operations and applications (Round to Square, Fan Hook and S-Hook)

Module -III: HOUSE WIRING AND WELDING

- House-wiring – Introduction, Electrical wiring tools, sequence of Operations and applications (Parallel & Series, Two-way Switch and Tube Light)
- Welding Practice – Introduction, electrode, welding tools, and sequence of Operations. Advantages and applications (Arc Welding).

Text Book:
1. Workshop practice/B.L. Juneja/ Cengage
2. Workshop manual/K.Venugopal/ Anuradha

Reference:
1. Work shop manual /P.Kannaiah/K.L. Narayana
2. Work shop Manual /Venkat Reddy /BSP

24X00071: APPLIED PHYSICS LAB

B.Tech. I Year I Sem.

L T P C
0 0 3 1.5

Course Objectives: The objectives of this course for the student to
1. Capable of handling instruments related to the Hall effect and photoelectric effect Experiment understands their measurements.
2. Understand the characteristics of various devices such as PN junction diode, Zener diode, BJT, LED, solar cell, lasers and optical fiber and measurement of energy gap.
3. Apply the analytical techniques & graphical analysis for Stewart Gees , LCR & RC .
4. Understanding the method of least squares fitting.
5. To develop intellectual communication skills through discussion on basic principles of scientific concepts in a group.

Course Outcomes: The students will be able to:
1. Know the determination of the Planck's constant using Photo electric effect and identify the material whether it is n-type or p-type by Hall experiment.
2. Appreciate quantum physics in semiconductor devices and optoelectronics.
3. Gain the knowledge in calculating the quality factor and time constant of LCR and RC circuits.
4. Understand the variation of magnetic field at various points.
5. Carried out data analysis.

LIST OF EXPERIMENTS:
1. Determination of work function and Planck's constant using photoelectric effect.
2. Determination of Hall co-efficient and carrier concentration of a given semiconductor.
3. Characteristics of series and parallel LCR circuits.
4. V-I characteristics of a p-n junction diode and Zener diode.
5. Input and output characteristics of BJT (CE, CB & CC configurations).
6. V-I and L-I characteristics of light emitting diode (LED) and LASER.
7. V-I Characteristics of solar cell.
8. Determination of Energy gap of a semiconductor.
9. To determine the time constant of R-C circuit.
10. Determination of Acceptance Angle and Numerical Aperture of an optical fiber.
11. Understanding the method of least squares – Torsional pendulum as an example.
12. Determination of magnetic field induction along the axis of a current carrying coil.

REFERENCE BOOK:
1. S. Balasubramanian, M.N. Srinivasan "A Text book of Practical Physics"- S Chand Publishers,2017.

24X0571:Problem Solving Using C and C++ Laboratory

B.Tech. I Year. I Sem

L	T	P	C
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Course Overview:
The Course Provides good foundation in procedural oriented and object-oriented programming concepts. It provides overview on basic building blocks of procedural oriented concepts like arrays, pointers, structures, strings. It comprises object-oriented concepts such as information hiding, encapsulation, inheritance and polymorphism. C programming is used in operating systems, embedded devices, OS kernels, drivers, IoT applications. C++ is widely used for creating graphics-heavy software, game engines, VR applications, and web browsers.

Prerequisites: Nil

Course Objectives: The students will try to learn
- Using of structured programming approach in solving problems
- How to use arrays, pointers, strings and structures in solving problems
- Defining of structures in C and classes in C++
- Importance of inheritance in object-oriented programming
- Handling of exceptions in programs

Course Outcomes: After successful completion of the course, students should be able to
- Develop programs using Control statements and Repetitive statements
- Modularize the code with functions so that they can be reused
- Learn about Object oriented concepts
- Design programs by using Inheritance concepts
- Implement polymorphism and Exception Handling

Week1: Algorithm and Flowchart

1. You are designing a flowchart and algorithm for a distance and speed calculator. The flowchart should prompt the user to input the distance traveled and the time taken and calculate the speed using the formula: **Speed = Distance / Time**.

2. You are developing an algorithm and flow chart for a circle area calculator. The flowchart should prompt the user to input the radius of a circle and calculate the area using the formula: **Area = πr^2**

3. You are designing an algorithm and flowchart for a fuel efficiency calculator in a car rental app. The flowchart should prompt the user to input the distance traveled and the amount of fuel consumed and calculate the fuel efficiency in miles per gallon (MPG) using the formula MPG = Distance / Fuel Consumption.

4. You are developing an algorithm and flowchart for a discount calculator in an online shopping app. The flowchart should prompt the user to input the original price and the discount percentage and calculate the discounted price using the formula: **Discounted Price = Original Price - (Original Price * Discount Percentage /100).**

5. You are developing a flowchart and algorithm for a monthly budget tracker. The flowchart should prompt the user to input their income and expenses and calculate the total savings using the formula **Total Savings = Income - Total Expenses**.

6. You are designing a flowchart for a loan amortization calculator. The flowchart should prompt the user to input the loan amount, interest rate, and duration, and calculate the monthly payment using the formula Monthly Payment = (Loan Amount * Interest Rate * $(1+ \text{Interest Rate})^{\text{Duration}}$) / ($(1 + \text{Interest Rate})^{\text{Duration-1}}$).

7. You are developing a flowchart and algorithm for a construction materials calculator. The Flow chart should guide the user through the process of inputting the dimensions ofa room, including the length, width, and height. The goal is to calculate the surface area of the room using the provided formula:
   Surface Area=2*(Length*Width+Length *Height+Width* Height).

8. Developaflowchartandanalgorithmtoconvertagiventimeinhoursandminutesto   minutes only. Prompt the user to input the time in hours and minutes and display the converted time in minutes.

   Skill Oriented Exercise

9. Farmer Thimmayya bought some mules at Rs. 50 each, sheep at Rs. 40 each, goats at Rs. 25each,andpigsatRs.10each.TheaveragepriceoftheanimalsperheadworkedtoRs. 30.What is the minimum number of animals of each kind did he buy?

10. **AMatterofRupeesandPaisa:**IhavemoneypouchcontainingRs.700.Thereareequal numberof25 paise coins, 50 paise coins and 1 rupee coins. How manyof each are there.

11. Developanalgorithmandflowchartthatpromptstheusertoinputtheinitialvelocity, acceleration, and time. Calculate and display the final velocity using the formula Final Velocity = Initial Velocity + (Acceleration * Time).

12. Develop an algorithm and flowchart that prompts the user to input the lengths of the three sides of a triangle. Calculate and display the area of the triangle using Heron's formula: Area=√(s*(s -Side1)*(s-Side2)*(s -Side3)),where s=(Side1+Side2+ Side3) / 2.

   Week2: Algorithm and Flowchart

1. ABC Company wants to calculate the monthly salary for its employees based on various components such as basic pay, DA, HRA, and deductions for taxes and provident fund.
                        The company follows the following rules for salary calculation:
   * The basic pay is a fixed amount each employee receives.
   * DAiscalculatedas20 percentage of the basic pay.
   * HRA is calculated as 10percentageofthebasicpay.
   * The gross salary is the sum of the basic pay, DA, and HRA.
   * The net salary is the gross salary minus deductions for taxes and provident fund.
   Develop an algorithm and flow chart to calculate the gross and net salary of the employee. Include the necessary steps to calculate the net salary.

   2. Sarah, a dedicated student, wants to calculate her average grade for a semester. She has received marks in four different subjects and seeks assistance in creating an algorithm to determine her average grade based on these marks. Develop an

algorithm and flowchart to help Sarah calculate her average grade for the semester using the marks obtained in these four subjects. Ensure that the algorithm includes the necessary steps to compute the average grade accurately.

3. John is a programmer who wants to convert a given temperature in Celsius to Fahrenheit. Help John in developing an algorithm and flowchart to perform this conversion. Design an algorithm for John to convert a given temperature in Celsius to Fahrenheit. Provide step-by-step instructions for performing the conversion.

4. **The Tall Men Next Door:** Next door to me live four brothers of different heights. Their average height is 74 inches, and the difference in height among the first three men is two inches. The difference between the third and the fourth man is six inches. Can you tell how tall each brother is?

5. **Driving Through the Country:** I decided to travel through the countryleisurely and on the first day I did only 7 miles. On the last day I did 51 miles, increasing my journey by 4 miles per day. How many days did I travel and how far?

6. There is a beautiful pond in a park, filled with clear water. The park management wants to monitor the water level in the pond regularly to ensure it remains at an optimal level. They have asked you to create an algorithm to help them with this task. Develop an algorithm and flow chart to monitor the water level in the pond and notify the park management if it falls below a certain threshold. (Note: You can assume that the input for the current water level and threshold level is obtained from a monitoring device or sensor).

7. If a participant can make one submission every 45 seconds, and a contest lasts for Y minutes, create an algorithm and flowchart to find the maximum number of submissions that the participant can make during the contest? Assume the participant is allowed to make submissions until the last second of the contest.

Skill Oriented Exercise

8. Michael wants to find the largest number among a set of given numbers. Help Michael write an algorithm to determine the largest number from the given inputs. Create an algorithm and flowchart for Michael to find the largest number among a set of given inputs. Provide step-by-step instructions to identify the largest number.

9. A construction worker needs to paint the exterior walls of a rectangular building. The dimensions of the walls are L meters in length, H meters in height, and W meters in width. If the cost of painting is Rs. 20 per square meter, what will be the total cost of painting the walls? Prepare an algorithm and flowchart to calculate the total cost of painting.

10. An ice cream vendor brings 'i' litre of ice cream to a fair. Each cone requires0.25liters of ice cream. If the vendor sells 80 cones, Develop an algorithm and flowchart to find the number of liters of ice cream left with the vendor.

11. Amanda is planning a party and wants to determine the total number of guests attending. Assist Amanda by writing an algorithm to calculate the total number of guests based on the number of adults and children invited. Create an algorithm and flowchart for Amanda to calculate the total number of guests attending her

party, considering the number of adults and children invited. Include the necessary steps to calculate the total number of guests.

Week: 3 Data Types, Console I/O, Operators Storage Classes

1. You are working as a financial analyst at a bank. As part of your job, you need to calculate the maturity amount for fixed deposits (FD) based on the principal amount, interest rate, and duration. For that help me to write a C program that takes the principal amount, interest rate, and duration(in years)as input from the user. Calculate and display the maturity amount using the simple interest formula: Maturity Amount = Principal + (Principal * Interest Rate * Duration).

2. Jenny, a budding mathematician, was studying the concept of area and perimeter. She was given a rectangular garden with a known length and width. Jenny wondered if she could find the area without knowing the width. Can you help Jenny derive a formula to calculate the area of a rectangle using only the length and perimeter?

3. Develop a C program that computes the hypotenuse of a right-angled triangle given the lengths of its two perpendicular sides. Prompt the user to enter the lengths and display the result. (Pythagorean theorem:$Hypotenuse^2 = Side1^2 + Side2^2$)

4. Once upon a time, there was a mathematician named Alex. Alex loved solving mathematical problems and puzzles. One day, Alex came across an ancient scroll that contained a secret formula to calculate the sum of the first n natural numbers. The scroll mentioned that by using the formula, one could find the sum of any given number of natural numbers without having to manually add them up. Alex was intrigued and decided to test the formula. Can you help Alex implement a C program that uses the formula to calculate the sum of the first n natural numbers?

Instructions:

Write a C program that takes an input integer n from the user and calculates the sum of the first n natural numbers using the formula: **sum=(n*(n+1))/2**

5. Once upon a time in a small town, there were two friends, Kavi and Jei, who were fascinated by the concept of slopes in mathematics. They loved exploring the hills and valleys around their town and wondered how they could calculate the slope of any given landscape. One sunny day, while hiking up a hill, Kavi and Jei discovered an ancient map that had the secret to finding the slope of a line between two points. The map indicated that by using the coordinates of two points, they could determine the slope of the line connecting them. Excited about their discovery, Kavi and Jei decided to create a C program that could calculate the slope for any two points. They wanted to share their program with others so that everyone could explore the slopes of various land scapes. Can you help Kavi and Jei bring their idea to life by implementing a C program that calculates the slope of a line?

Instructions:

Write a C program that prompts the user to enter the coordinates of two points:(x1,y1)and (x2, y2). The program should then

Calculate ,the slope of the line connecting these points using the formula: slope=(y2-y1) /(x2- x1)

Finally, the program should display the calculated slope to the user.

6. Ravi and Kavi are on an exciting treasure hunt adventure, following a map with hidden treasures located at different coordinates. They want to calculate the distance between two treasures to determine how far apart they are. Can you help them by writing a C program that performs this calculation?

Instructions:

Write a C program that prompts the user to enter the coordinates of two treasures: Treasure A and Treasure B. The coordinates should be in the form (x, y). Calculate the distance between the treasures using the distance formula:

distance = sqrt ((x2 - x1)^2 + (y2 - y1)^2)

Finally ,output a message indicating how far a part the treasures are.

7. Imagine a scenario where there is a coconut tree with multiple coconuts hanging from it. There is a person standing at a distance of "D" meters away from the tree. The coconuts are positioned at a height of "H" meters from the ground. Could you please help write a C program that calculates the angle at which the person should aim in order to hit the coconuts? (Hint: you can use the inverse tangent function (atan() in C) to determine the angle based on the ratio of the height of the coconuts to the distance from the tree.)

Skill Oriented Exercise

8. In a faraway kingdom, two treasure hunters named Alex and Bella embarked on a daring quest to find valuable treasures. While exploring a mysterious cave, they stumbled upon two treasure chests, each containing a unique gemstone. Curiosity took over, and they decided to swap the gemstones inside the chests. However, a magical enchantment prevented them from directly swapping the gemstones. To fulfill their quest and restore the treasures to their rightful chests, Alex and Bella realized they could use a third variable and arithmetic operations. Can you help them by writing a C program that takes the values of the gemstones as input, and swap their values.

9. Emily, a young architect, was working on designing a cylindrical water tank for a new building. As she was finalizing the plans, she needed to calculate the surface area of the cylinder to determine the amount of material required for its construction. However, she was unsure of the exact formula and the steps involved in the calculation. Can you help Emily by writing a C program that assists her in calculating the surface area of a cylinder?(Surface Area = $2\pi r^2 + 2\pi rh$)

10. Hemanthisanarchitectwhowantstodesignagardenwithabeautifulpolygon-shaped fountain at its center. He needs to calculate the area of the polygon so that he can determine the appropriate size for the fountain. Help Hemanth by writing a C program that calculates the area of a regular polygon when given the number of sides and the length of each side.

Area=(num Sides* side Length*side Length)/ (4 *tan(π/ num Sides))

11. Prathima loves ice cream cones and wants to decorate the surface of her favorite ice cream cone with colorful stickers. To know how many stickers she needs, she wants to calculate the surface area of the cone. Help Prathima by writing a C program that calculates the surface area of a cone when given the radius of the base and the slant height, (SurfaceArea=π*r*(r+l))

12. **RIGHT FOOT FORWARD:** A short man takes three steps to a tall man's two steps. They both start out on the left foot. How many steps do they have to take before they are both stepping out on the right foot together?

Week: 4DataTypes, Console I/O, Operators Storage Classes

PREDICTTHEOUTPUT:

1.   #include<stdio.h> **Output:**
```
int main()
{
inta=5;floatb=3.5;
intresult=a+b;printf("%d\n",result);return0;
}
```

2.   #include<stdio.h> **Output:**
```
intmain(){inta=10;intb=20;
intresult=a*b/4%3;printf("%d\n",result);return0;
}
```

3.   #include<stdio.h> **Output:**
```
intmain(){inta=15;intb= 10;
intresult=(a>b)&&(b!=0);printf("%d\n", result); return0;
}
```

4.   #include<stdio.h> **Output:**
```
intmain(){inta=10;intb= 5;
intresult=(a>b)||(a==10);printf("%d\n",result);
return0;
}
```

5.   #include<stdio.h> **Output:**
```
int main(){
int x=3,y=2;
intresult=x*y-y/x%y;printf("%d\n", result);return 0;
}
```

6.   #include<stdio.h>
                                                          Output:
```
intmain(){intx=5;
 int *ptr1 = &x;
int**ptr2=&ptr1;printf("%d\n",**ptr2);return0;
}
```

7.   #include<stdio.h>
                                                          Output:
```
int main(){intx=5;
int*ptr1,*ptr2;ptr1 =&x;
ptr2=ptr1;printf("%d\n",*ptr2);return0;
}
```

8.   #include<stdio.h>
                                                          Output:
```
int main(){intx=51;
int*ptr=&x; printf("%d\n",*ptr);x=15;
 printf("%d\n",*ptr); return 0;
}
```

9. #include<stdio.h>
Output:

```
intmain(){float*ptr;
printf("Sizeofptr:%lubytes\n",sizeof(ptr));return0;
}
```

10. #include<stdio.h>**Output:**

```
intmain(){doublearr[5];
printf("Sizeofarr:%lubytes\n",sizeof(arr));return0;
}
```

11. #include<stdio.h>**Output:**

```
intmain(){
intx=10;if(x>5){
printf("Hello\n");
}
printf("Goodbye\n");return0;
}
```

Skill Oriented Exercise

Find the syntax error, logical errors if any in the following code snippet:

1. #include<stdio.h>   **Errors:**
```
int main(){
printf("Hello,KLUFamily!\n")return0;
}
```

2. #Include<stdio.h>   **Errors:**
```
intmain(){
int      x      =      5,      y=      0;
intresult=x/y;printf("Theresultis:%d\n",result);
return0;
}
```

3. #include<stdio.h>   **Errors:**
```
intmain(){intx=5;int*ptr;
*ptr=&x;printf("%d\n",*ptr);return0;
}
```

4. #include<stdio.h>   **Errors:**
```
intmain(){intx=-5;if(x){
printf("xisnotzero\n");
}else
{
printf("xiszero\n";)
}
return0;
}
```

Week5:If else and Ternary Operator

1. Chef and Chefina are playing with dice. In one turn, both of them roll their dice at

once. They consider a turn to be good if the sum of the numbers on their dice is greater than
6. Given that in a particular turn Chef and Chefina got X and Y on their respective dice, find whether the turn was good.

2. Chef has been working hard to compete in MasterChef. He is ranked X out of all contestants. However, only 10 contestants would be selected for the finals. Check whether Chef made it to the top 10 or not?

3. Apple considers any I Phone with a battery health of 80% or above, to be in *optimal* condition. Given that your iPhone has X% battery health, find whether it is in *optimal* condition.

4. In a classic chase, Tom is running after Jerry as Jerry has eaten Tom's favorite food. Jerry is running at a speed of X metres per second while Tom is chasing him at a speed of Y metres per second. Determine whether Tom will be able to catch Jerry.
Note that initially Jerry is not at the same position as Tom.

5. Chef has started studying for the upcoming test. The textbook has N pages in total. Chef wants to read at most X pages a day for Y days. Find out whether it is possible for Chef to complete the whole book.

6. Chef has finally got the chance of his lifetime to drive in the F1 tournament. But, there is one problem. Chef did not know about the 107% rule and now he is worried whether he will be allowed to race in the main event or not.
Given the fastest finish time as X seconds and Chef's finish time as Y seconds, determine whether Chef will be allowed to race in the main event or not.
Note that, Chef will only be allowed to race if his finish time is within **107%** of the fastest finish time.

Skill Oriented Exercise

7. Chef wants to host a party with a total of N people. However, the party hall has a capacity of X people. Find whether Chef can host the party.

8. Chef has to attend an exam that starts in X minutes, but of course, watching shows takes priority. Every episode of the show that Chef is watching, is 24 minutes long. If he starts watching a new episode now, will he finish watching it **strictly before** the exam starts?

9. Chef has to travel to another place. For this, he can avail any one of two cab services.
   • The first cab service charges X rupees.
   • The second cab service charges Y rupees.
   Chef wants to spend the **minimum** amount of money. Which cab service should Chef take?

10. Chef categorizes an Instagram account as *spam*, if, the *following* count of the account is more than 10 times the count of *followers*.
Given the *following* and *follower* count of an account as X and Y respectively, find whether it is a *spam* account.

11. Chef is watching TV. The current volume of the TV is X. Pressing the volume up button of the

TVremoteincreasesthevolumeby11whilepressingthevolumedownbuttondecreasesthe volumeby11.Chefwantstochangethevolumefrom X to Y .Findtheminimumnumberof button presses required to do so.

12. Cities on a map are connected by a number of roads. The number of roads between each cityisinanarrayandcity0isthestartinglocation.Thenumberofroadsfromcity0tocity1 isthefirstvalueinthearray,fromcity1tocity2inthesecond,andsoon.Howmanypaths aretherefromcity0tothelastcityinthelist,modulo1234567?

13. Square within Square
WriteaCprogramtodeterminethenumberofsquaresinthegivenillustration below
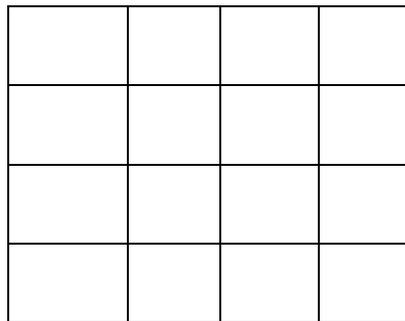
Week6: Loops, Increment and Decrement operator

1. Sum of digits of five digit number.
Given the five digit number print the sum of its digits.
 Input
 10564
 Output
 16

2. Write a program that takes two integers as input, start and end. The program should use for loop to iterate from start to end (both inclusive).

3. WriteaCprogramthattakestheinputformultipletestcases.Foreachtestcase,the program should receive two integers, E and K, representing the energyat the lowest trophiclevelandtheenergyreductionfactor,respectively.Theprogramshouldcalculate and output the maximum length of the food chain for each test case.

4. Write a program in C that takes an integer, n, as input, representing the number of multiplicationtablestobegenerated.Theprogramshouldoutputthemultiplicationtable for each number from 1 to n, up to a multiple of 10.

5. Alice,Bob,andCharliehavedifferentpreferencesfornumbers.Alicelikesnumbersthat are even and multiples of 7, while Bob prefers numbers that are odd and multiples of 9. They have found a number, A, and the task is to determine who takes it home.
Write a program that takes an integer, A, as input and outputs the person who takes the number home based on their preferences. If A is an even multiple of 7, Alice takes it home. If A is an odd multiple of 9, Bob takes it home. If neither Alice nor Bob likes the number, Charlie takes it home.

6. Chef owns a car that can run 15 kilometers using 1 litre of petrol. He wants to attend a programmingcampatDAIICT,whichisadistanceofYkilometersfromhishouse.Chef

currently has X litres of petrol in his car. The task is to determine whether Chef can attend the event at DAIICT and return to his home with the given amount of petrol. Write a program that takes two integers, X and Y, as input and outputs whether Chef can complete the round trip with the available petrol.

Skill Oriented Exercise

7. Listen to this story: a boy and his father, a computer programmer, are playing with wooden blocks. They are building a pyramid. Their pyramid is a bit weird, as it is actually a pyramid- shaped wall - it's flat. The pyramid is stacked according to one simple principle: each lower layer contains one block more than the layer above. The figure illustrates the rule used by the builders:

Note: the height is measured by the number of fully completed layers –if the builders don't have a sufficient number of blocks and cannot complete the next layer, they finish their work immediately.

Sample input: 6
Expected output: The height of the pyramid: 3 Sample input:1000

height: 3

blocks: 6
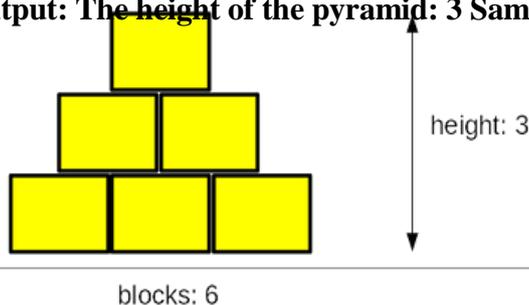
Expected output: The height of the pyramid:44

8. **The Special Number**
There is a number whose double is greater than its half by45.Can you find this number?

9. Chef is a student at a university, and the university has a requirement that students must be present foratleast75%oftheworkingdaysinasemestertopass.Thesemesterhasa total of 120 working days. Chef has been taking a lot of holidays and is worried about meeting the attendance requirement. The information about the days Chef has attended or been absent is given as a sequence of N bits: B1, B2,..., BN. If B_i =0, it means Chef was absent on the ith day, and if B_i=1,itmeans Chef was present on that day. The task is to determine if Chef can pass the attendance requirement by the end of the semester. Write a program that takes an integer N as input, followed by a sequence of Nbits, and out puts whether Chef can hope to pass the attendance requirement or not.

10. There are N piles where the ith pile consists of A_i stones. Chef and Chef in a are playing a game taking alternate turns with Chef starting first. In his/her turn, a player can choose any non-empty pile and remove exactly 1 stone from it. The game ends when exactly1 pile becomes empty. The player who made the last move wins. Determine the winner if both players play optimally.

11. Write the c program for following pattern
12. Write a program to obtain a number N and increment itsvalueby1ift he number is divisible

```
1 2 3 4 5
1 2 3 4
1 2 3
1 2
1
```

by4 otherwise decrement its value by 1.

Week7: Arrays

1. Given a large integer represented as an integer array digits, where each digits[i]is the i-th digit of the integer, ordered from most significant to least significant in left-to-right order (without any leading zeros), implement a program to increment the large integer by one and return the resulting array of digits.

2. Chef has set a target to solve at least 10 problems every week for a duration of 4 weeks. The input consists of four integers representing the number of problems Chef solved in each week (P1, P2, P3, and P4). The task is to determine the number of weeks in which Chefmet his target. The output should be a single integer indicating the count of weeks where Chef solved at least 10 problems.

3. Code Chef recently revamped its practice page to make it easier for users to identify the next problems they should solve by introducing some new features: Recent Contest Problems - contains only problems from the last 2 contests Separate Un-Attempted, Attempted, and All tabs.

Problem Difficulty Rating-there commended drop down menu has various difficulty ranges so

that you canattempttheproblemsmostsuitedtoyourexperiencePopularTopicsandTags. Like most users, Chef didn't know that he could add problems to a personal to-do list by clickingonthemagic'+'symbolonthetop-rightofeachproblempage.Butoncehefound out about it ,he went crazy and added loads of problems to his to-do list without looking at their difficulty rating.

Chef is a beginner and should ideally try and solve only problems with difficulty rating strictly lessthan1000.GivenalistofdifficultyratingsforproblemsintheChef'sto-dolist,please helphimidentifyhowmanyofthoseproblemsChefshouldremovefromhisto-dolist,sothat he is only left with problems of difficultyratinglessthan1000.

4. You are given an array price where prices[i] is the price of a given stock on the ith day. You want to maximize your profit by choosing a single day to buy one stock and choosing a different day in the future to sell that stock. Return the maximum profit you can achieve from this transaction. If you cannot achieve any profit, return 0.

5. Given a non-empty array of integer's nums, every element appears twice except for one. Find that single one. You must implement a solution with a linear runtime complexity and use only constant extra space.

6. Given an array nums of size n, return the majority element. The majority element is the element that appears more than $\lfloor n / 2 \rfloor$ times. You may assume that the majority element always exists in the array.

7. Write a C program to calculate the factorial of small positive integers. The input consists of an integer 't' representing the number of test cases, followed by 't' lines containing a single

integer 'n' (1 <= n <= 100) for each test case. The output should display the factorial of 'n' on a separate line for each input value of 'n'.

8. (Puzzle)On the Way to Market One morning.
    I was on my way to the marketandmetamanwhohad4wives.Eachofthewiveshad4 bags ,containing 4 dogsandeachdoghad4puppies.Taking all things into consideration how many were going to the market?

9. Vasyalikesthenumber239.Therefore,he considers a number pretty if its last digit 2,3 or 9.Vasya wants to watch the numbers between Land R(both inclusive),so he asked you to determine how many pretty numbers are in this range. Can you help him?

10. You are participating in a contest which has 11 problems (numbered 1 through 11). The first eight problems (i.e. problems 1,2,…,8) are scorable, while the last three problems (9,10 and 11) are non-scorable ― this means that any submissions you make on any of these problems do not affect your total score.
    Your totals core is the sum of your best scores for all scorable problems. That is, for each scorable problem, you look at the score so fall submissions you made on that problem and take the maximum of these scores(or0if you didn't make any submissions on that problem); the total score is the sum of the maximum scores you took. You know the results of all submissions you made. Calculate your total score.

Skill Oriented Exercise

11. WriteaCprogramtohelpJoeandLillymultiplytwomatrices,AandB.Theprogram should take input for multiple test cases. For each test case, the program should read the dimensions and values of matrices A and B. If the multiplication is possible, the program should print the output matrix values. If the multiplication is not possible, the program should print "IMPOSSIBLE".

12. You are given an m x n integer matrix with the following two properties:
    Each row is sorted in non-decreasing order. The first integer of each row is greater than the last integer of the previous row. Given an integer target, return true if target is in matrix or false other wise.

1	3	5	7
10	11	16	20
23	30	34	60

Input :matrix=[[1,3,5,7],[10,11,16,20],[23,30,34,60]],target=3
Output: true

13.   You are given an m x n integer grid accounts where accounts[i][j] is the amount of money the ith customer has in the jth bank. Return the wealth that the richest customer has A customer's wealth is the amount of money they have in all their bank accounts. The richest customer is the customer that has the maximum wealth.

14. Given a square matrix mat, return the sum of the matrix diagonals. Only include the sum of all the elements on the primary diagonal and all the elements on the secondary diagonal that are not part of the primary diagonal.
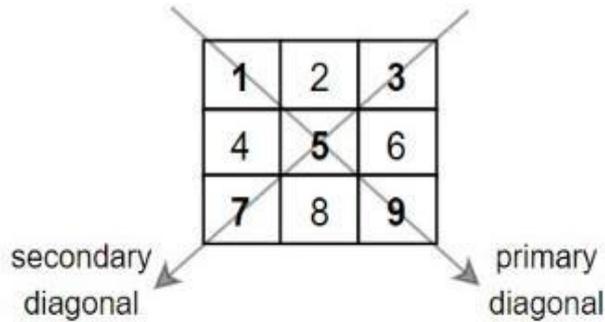

```
Input: mat = [[1,2,3],
              [4,5,6],
              [7,8,9]]
Output: 25
Explanation: Diagonals sum: 1 + 5 + 9 + 3 + 7 = 25
Notice that element mat[1][1] = 5 is counted only once.
```

15. Write a program to perform matrix multiplication. If Multiplication cannot be done for a given matrices then print "NOT POSSIBLE"

$$A = \begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix} \quad B = \begin{pmatrix} 5 & 6 & 7 \\ 8 & 9 & 10 \end{pmatrix}$$

Multiplication of two matrixes:

$$A * B = \begin{pmatrix} 1*5 + 2*8 & 1*6 + 2*9 & 1*7 + 2*10 \\ 3*5 + 4*8 & 3*6 + 4*9 & 3*7 + 4*10 \end{pmatrix}$$

$$A * B = \begin{pmatrix} 21 & 24 & 27 \\ 47 & 54 & 61 \end{pmatrix}$$

Input:
1) Read the row & column size of matrix1
2) Read the matrix1
3) Read the row & column size of matrix2
4) Read the matrix2

Output:
Resultant Matrix.

Sample Input	Sample Output
22	710
12	1522
34	
22	
12	
34	

16. Given two sorted arrays num s1and num s2ofsizemandnrespectively,return the median of the two sorted arrays.
Input: nums1 = [1,3], nums2 = [2] Output: 2.00000
Explanation: merged array=[1,2,3] and median is 2.

17. Given a m x n grid filled with non-negative numbers, find a path from top left to bottom right, which minimizes the sum of all numbers along its path.
Note: You can only move either down or right at any point in time.

1	3	1
1	5	1
4	2	1

Input: grid=[[1,3,1],[1,5,1],[4,2,1]]
Output:7
Explanation: Because the path1→3→ 1→1→1 minimizes the um.

18. Given an array nums of size n, return the majority element. The majority element is the element that appears more than ⌊n/2⌋ times. You may assume that the majority element always exists in the array.
Input: nums=[3,2,3]Output:3

19.Given a sorted array of distinct integers and a target value, return the index if the target is found. If not, return the index where it would be if it were inserted in order.

Input: nums=[1,3,5,6],target=5Output:2

20. Givenamxnmatrixgridwhichissortedinnon-increasingorderbothrow-wise and column-wise, return the number of negative numbers in grid.

```
Input: grid = [[4,3,2,-1],[3,2,1,-1],[1,1,-1,-2],[-1,-1,-2,-3]]
Output: 8
Explanation: There are 8 negatives number in the matrix.
```

Example 2:

```
Input: grid = [[3,2],[1,0]]
Output: 0
```

Week8: String Handling

1. Louise joined a social networking site to stay in touch with her friends. The signup page required her to input a *name* and a *password*. However, the password must be *strong*. The website considers a password to be *strong* if it satisfies the following criteria:

- Its length is at least 6.
- It contains at least one digit.
- It contains at least one lower case English character.
- It contains at least one upper case English character.
- It contains at least one special character. The special

characters are: @#$%^&*()-+!

2.   As pace explorer's ship crashed on Mars! They send a series of SOS messages to Earth for help.

Letters in some of the SOS messages are altered by cosmic radiation during transmission. Given the signal received by Earth as a string, determine how many letters of the SOS message have been changed by radiation.
s='SOSTOT'

Example
The original message was SOSSOS. Two of the message's characters were changed in transit.

Function Description
CompletethemarsExplorationfunctionintheeditorbelow.marsExplorationhasthefollowing parameter(s):
strings: the string as received on Earth

Returns
int: the number of letters changed during transmission

3. ChefhasastringSwithhim.Chefishappyifthestringcontainsacontiguoussubstring   of length strictly greater than 2 in which all its characters are vowels.
   Determine whether Chef is happy or not.
   Note that, in english alphabet, vowels are a, e, i, o, and u.
4. Given two strings needle and haystack, return the index of the first occurrence of needle in haystack, or -1 if needle is not part of haystack.
5. Givenastringsconsistingofwordsandspaces,returnthelengthofthelast word in the string. A word is a maximal substring consisting of non-space characters only.

6. Given a string S, reverse only all the vowels in the string and return it. The vowelsare'a','e','i','o',and'u',andtheycanappearinbothlowerandupper cases, more than once.

7. You have been given a String S. You need to find and print whether this string is a palindrome or not. If yes, print "YES" (without quotes), else print "NO" (without quotes).

Skill Oriented Exercise

8. Jeff, Chef's younger brother, is learning to read and knows a subset of the Latin alphabet. Chef gave Jeff a book with N words to practice. Jeff can only   read wordsthatconsistofthelettersheknows.Thetaskistodeterminewhichwords Jeff can read based on the given letters and output "Yes" or "No"

accordingly.

9. Timur loves code forces. That's why he has a string S having length 10 made containing only lower case Latin letters. Timur wants to know how many indices string s differs from the string "codeforces".

For example strings="coolforsez" differs from "codeforces" in 4 indices, shown in bold.

Up the Ladder
A man wants to reach window which is 40ft above from the ground. And the distance between the foot of the ladder and wall is 9 feet. How long should the ladder be?

10. Given two strings s and t, return true if t is an anagram of s, and false otherwise. An Anagram is a word or phrase formed by rearranging the letters of a different word or phrase, typically using all the original letters exactly once. Given strings, find the first non-repeating character in it and return its index. If it does not exist, return -1.

11. A robot starts at the origin (0, 0) on a 2D plane. It is given a sequence of moves represented by the string "moves". Each move is represented by 'R' (right), 'L' (left), 'U' (up), or 'D' (down). The task is to determine if the robot returns to the origin after completing all the moves. The robot's direction is irrelevant, and all moves have the same magnitude. Return true if the robot ends up at the origin, and false otherwise.

12. Chandu is a bad student. Once his teacher asked him to print the reverse of a given string. He took three hours to solve it. The teacher got agitated at Chandu and asked you the same question. Can you solve it?

13. There is a string s of lowercase English letters that is repeated infinitely many times. Given an integer n find and print the number of letter a's in the first n letters of the infinite string.

Week9: Recursion

1. Given an integer n, return true if it is a power of three. Otherwise, return false. An integer n is a power of three, if there exists an integer x such that $n == 3^x$.
2. You are climbing a stair case. It takes n steps to reach the top. Each time you can either climb 1 or 2 steps. In how many distinct ways can you climb to the top?

3. Given an integer n, return true if it is a power of four. Otherwise, return false. An integer n is a power of four, if there exists an integer x such that $n == 4^x$.

4. You are given an integer N. You need to print N! –the factorial of N.

Input The first line of the input contains a single integer *T* denoting the number of test cases. The description of *T* test cases follows. The first and only line of each test case contains a single integer *N*.

Output For each test case print a single line containing a single integer *N*!

5. The Fibonacci numbers, commonly denoted F(n) form a sequence, called the Fibonacci sequence, such that each number is the sum of the two preceding ones, starting from 0 and 1

6. Kristen loves playing with and comparing numbers. She thinks that if she takes two different positive numbers, the one whose digits sum to a larger number is *better* than the other.

If the sum of digits is equal for both numbers, then she thinks the smaller number is *better*. For example, Kristen thinks that 13is better than 31and that12is better than 11 .Given an integer, n ,can you find the divisor of n that Kristin will consider to be the best?

7. A perfect number is a positive integer that is equal to the sum of its positive divisors, excluding the number itself. A divisor of an integer x is an integer that can divide x evenly. Given a n integer n, return true if n is a perfect number, other wise return false.

8. Given an integer num, repeatedly add ll its digits until the result has only one digit, and return it.

9. **Something for Profit:** A friend of mine bought a used pressure cooker for Rs. 60. She somehow did not find it useful and so when a friend of hers offered her Rs. 70 she sold it to her. However, she felt bad after selling it and decided to buy it back from her friend' by offering her Rs. 80. After having bought it once again she felt that she did not really need the cooker. So, she sold it at the auction forRs.90.Howmuchprofitdidshemake? Did she a tall make any profit?

10. Given a signed 32-bit integer x, return x with its digits reversed. If reversing x causes the value to go outside the signed 32-bit integer range $[-2^{31}, 2^{31} - 1]$, then return 0.

11. Given an integer array num s, move all 0's to the end of it while maintaining the relative order of the non-zero elements.

12. Writeafunctionthattakesthebinaryrepresentationofanunsignedinteger and returns the number of '1' bits it has (also known as the Hamming weight).

13. Martha is interviewing at Subway. One of the rounds of the interview requires her to cut a bread of size l X b into smaller identical pieces such that each piece is a square having maximum possible side length with no leftover piece of bread.

14. Given N two-dimensional points in space, determine whether they lie on some vertical or horizontal line.

If yes, print YES; otherwise, print NO.

PREDICTTHEOUTPUT

```
#include<stdio.h>voidfoo(intn){
if(n>0){printf("%d",n);foo(n-1);printf("%d",n);
}
}
intmain(){
foo(3);return0;
}
```

1. **What is the output of the above program?**
- 321123
- 321
- 123
- 123321

```c
#include<stdio.h>intbar(intn){ if (n
<= 0) { return 0;
}else{
returnn+bar(n-2);
}
}
int main(){
intresult=bar(7); printf("%d",result);return0;
}
```

2.   What is the output of the above program?
- 20
- 16
- 14
- 12

```c
#include<stdio.h>voidbaz(intn){ if (n >
0) {
baz(n/2);printf("%d",n%2);
}
}
intmain(){
baz(10);return0;
}
```

3.   What is the output of the above program?
- 1010
- 0101
- 00101
- 1101

```c
#include<stdio.h> intfactorial(intn){ if (n
== 0) { return 1;
}else{
returnn*factorial(n-1);
}
intmain(){
intresult=factorial(5); printf("%d",result);return0;
}
```

4.   What is the output of the above program?
- 120
- 24
- 25
- 20

```c
#include<stdio.h>
intpower(intbase,intexponent){if(exponent==0){return1;
}else{
returnbase*power(base,exponent-1);
}
}
```

```
intmain(){
intresult=power(2,4);printf("%d",result); return0;
}
```

5. **What is the output of the above program?**

- 16
- 8
- 32
- 64

Week10: Structures

1. You are building a pay roll system for accompany with multiple departments. Designa programusingstructuresthatstoresemployeedetailssuchasname,employeeID,and salary. Implement an array of structures to store employee records for each department. Calculate the total salary expenditure for each department and display it. Additionally, identify the department with the highest salary expenditure and acknowledge it as the top-performing department

2. VGP logistics is a premium Cargo service for Sending/receiving parcels from Vijayawada to Singapore. You are appointed as Manager in delivery department and need to maintain the arrival and delivery of the consignments sent/received. Create a structure consignment with the following Members Consignment_id, name, from, to, DOS (Date of Shipment), net weight, Address.
   For Example:
   Consignment_id:1008Name:HaierSteamerFrom:Vijayawada   To:
   Singapore
   DOS(Date of Shipment):30-may-2023net_weight:28.8kg Address:
   Mint Street Chennai

3. You have been assigned the task of developing a student grading system for a prestigious college. Design a program using structures that stores student details, such as name, roll number, and marks in various subjects. Implement an array of structures to store multiple student records and calculate the overall percentage for each student. Additionally, provide a functionality to generate a grade for each student based on their percentage and display it alongside their record.

4. You are developing a soldier management system for an army unit. Each soldier's record consists of the following information: name, rank, and years of service. Implement an array of structures to store the records of multiple soldiers. Write a C program to calculate and display the average years of service for all soldiers in the unit.

5. You are working on a ship management system for a naval fleet. Each ship's record contains the following details: name, type (e.g., aircraft carrier, destroyer), and year of commissioning. Implement an array of structures to store the ship records. Write a C program to search for a specific type of ship within the fleet and display the names of all ships belonging to that type.

6. You have been assigned the task of developing a pilot roster system for an air force squadron. Each pilot's record includes the following information: name, rank, and flight hours. Implement an array of structures to store the pilot records. Write a C program to find and display the pilot with the highest number of flight hours in the squadron.

7. You are working on a reservation system for a luxurious hotel. Create a program using structures that stores guest details, including name, room number, and check-in

date. Implement an array of structures to store multiple guest records and allow the hotel staff to search for guests by either their room number or name. Provide an additional feature that calculates the duration of each guest's stay and generates the total revenue earned by

the hotel.

Skill Oriented Exercise

8.   You have been tasked with developing a library management system for a renowned library. Create a program using structures that stores book information, including title, author, and publication year. Implement an array of structures to store multiple book records and allow the librarian to search for books by either title or author's name. Enhance the system by enabling the librarian to borrow and return books, updating the book status accordingly.

9.   You have been assigned the task of creating a customer billing system using an array of structures. Each structure should store the customer's name, account number, and total amount due. Implement functions to add customer records, display all records, and find the customer with the highest amount due.

10.   You are working on a car inventory management system using an array of structures. Each structure should hold the details of a car, including the make, model, and year of manufacture. Implement functions to add car records, display all records, and find the newest car in the inventory.

11.   You are developing a product inventory management system for a retail store. Each product has a unique identifier, name, price, and quantity in stock. Implement an array of structures to store the product records. Create functions to add new products, update product details, display all products, and search for products based on their identifier or name.

Week11: Classand Objects:
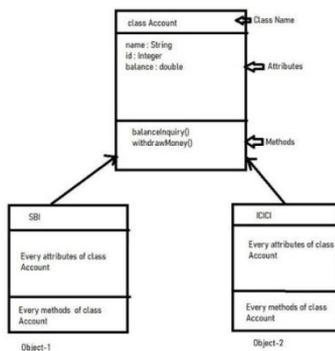
1. Create a class and the object code for the above scenario.
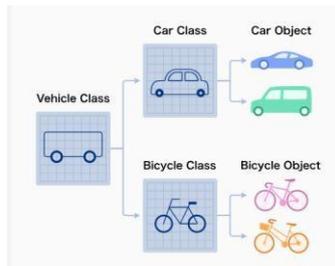
2.   Develop code for Class and Object.

Week12: Data Abstraction

Developing a banking application that handles various types of accounts such as savings, checking, and loans.

- **Abstraction Use:** Create abstract classes or interfaces like Account with common methods (e.g., deposit(), withdraw(), get Balance()). Concrete classes (e.g., Savings Account, Checking Account) implement these methods. The user interacts with Account objects without needing to know the specific type of account or its internal workings.

Inheritance

Developing a graphical user interface (GUI)library with various types of buttons.

- **Inheritance Use:** Create a base class Button with common properties like label, size, and methods like click(). Derive subclasses like Image Button, Toggle Button, and RadioButtonthatinheritfromButtonandaddspecificpropertiesormethodsuniqueto each type of button.

Building a ne-commerce plat form with different types of products.

- **Inheritance Use:** Define a base class Product with common attributes like name, price, and methods like apply Discount(). Create subclasses like Electronics, Clothing, and Books, each adding specific attributes (e.g., Electronics might have warrantyPeriod, Clothing might have size and color).

Skill Oriented Exercise

Building educational software that manages different types of learning resources.

- **Inheritance Use:** Establish a base class Learning Resource with common properties like title, subject, and methods like display(). Derive subclasses such as Book, Video Lecture, and Quiz, each adding specific attributes and methods (e.g., Quizmight have questions and a method evaluate()).

Designing a system to classify and manage information about different animals.

- **Inheritance Use:** Define a base class Animal with common attributes like name, habitat, and methods like eat(), sleep(). Create subclasses such as Mammal, Bird, and Reptile, each with specific characteristics and methods(e.g., Bird might have methods fly()).

An application that can draw various shapes such as circles, rectangles, and triangles.

- **Polymorphism Use:** Define an abstract class Shape with a method draw(). Implement subclasses Circle, Rectangle, and Triangle, each providing its specific draw() implementation. The application can then handle any shape object through the Shape interface

A program that simulates sounds of different animals.

- **Polymorphism Use:** Create a base class Animal with an abstract method make Sound(). Implement subclasses Dog, Cat, and Cow that override make Sound(). The simulator can then invoke make Sound() on any animal object

Managing different types of transportation such as cars, buses, and bicycles.

Skill Oriented Exercise

- **Polymorphism Use:** Define a base class Vehicle with an abstract method move(). Implement subclasses Car, Bus, and Bicycle, each with its own implementation of move(). The system can then manage different vehicles uniformly

A system sending notifications via email, SMS, and push notifications.

- **Polymorphism Use:** Define an abstract class Notification with a method send(). Implement subclasses Email Notification, SMS Notification, and Push Notification, each with its own send() method. The system can send notifications through any medium using the same interface

Week14: Virtual functions

A document edit or that supports different types of documents such as text documents, spreadsheets, and presentations.

- **Virtual Function Use:** Define a base class Document with a virtual function save(). Subclasses Text Document, Spreadsheet, and Presentation override save() to handle specific saving mechanisms.

Anaudioprocessinglibrarythathandlesvariousaudioeffectssuchasreverb,echo,and distortion.

Skill Oriented Exercise

- **Virtual Function Use:** Define a base class Audio Effect with a virtual function apply().SubclassesReverbEffect,EchoEffect,andDistortionEffectoverrideapply() to implement specific effects.

An AI strategy game that involves different types of game characters such as warriors, mages, and archers.

- **Virtual Function Use:** Define a base class Character with a virtual function attack(). Subclasses Warrior, Mage, and Archer override attack() to provide specific attack behaviors.

Week15: Exception handling

1) File Operations Scenario: An application needs to read data from a file. Exception Handling Use: Implement code to handle scenarios where the file might not exist, the

application lacks permissions, or the file is corrupted. Use try-catch blocks to manage these exceptions:

2)   E-Commerce Checkout Process

Scenario:Ane-commerceapplicationprocessesuserordersduringcheckout.

• Exception Handling Use: Handle errors such as invalid payment details, out-of-stock items, or delivery address issues.

Skill Oriented Exercise

3)An application processes images for various operations like resizing, filtering, and saving.

- Exception Handling Use: Handle errors such as unsupported file formats, corrupted files, or out-of-memory issues.

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24X0073: ENGLISH LANGUAGE AND COMMUNICATION SKILLS LABORATORY

B.Tech. I Year. II Sem.

L	T	P	C
0	0	2	1

The **English Language and Communication Skills (ELCS) Lab** focuses on the production and practice of sounds of language and the students with the use of English in everyday situations both in formal and informal contexts.

Course Objective

- ✓ To facilitate computer-assisted multi-media instruction enablingindividualized and independent language learning

- ✓ To sensitize the students to the nuances of English speech sounds, wordaccent, intonation and rhythm

- ✓ To bring about a consistent accent and intelligibility in students' pronunciation of English by providing an opportunity for practice in speaking

- ✓ To improve the fluency of students in spoken English and neutralize theimpact of dialects.

- ✓ To train students to use language appropriately for public speaking,group discussions and interviews

Course Outcomes: Students will be able to:

- ✓ Understand the nuances of the English language through audio-visual experienceand group activities

- ✓ Neutralize their accent for intelligibility

- ✓ Speak with clarity and confidence which in turn enhances their employability skills

Syllabus: English Language and Communication Skills Lab (ELCS) shall have two parts:
a. **Computer Assisted Language Learning (CALL) Lab**

b. **Interactive Communication Skills (ICS) Lab**

Listening Skills:

Objectives

1. To enable students to develop their listening skills so that they may appreciate therole in the LSRW skills approach to language and improve their pronunciation

2. To equip students with necessary training in listening, so that they can comprehend the speech of people of different backgrounds and regions

Students should be given practice in listening to the sounds of the language, to be able to recognize them and find the distinction between different sounds, to be able to mark stress and to recognize and use the right intonation in sentences.

- Listening to general content
- Listening to fill up information
- Intensive listening
- Listening to specific information

Speaking Skills:

Objectives

1. To involve students in speaking activities in various contexts
2. To enable students to express themselves fluently and appropriately in social andprofessional contexts

- Oral practice
- Describing objects/situations/people
- Role play – Individual/Group activities
- Just A Minute (JAM) Sessions

The following course content is prescribed for the **English Language and Communication Skills Lab**.

Exercise – ICALL Lab:

Understand Listening Skill- Its importance – Purpose- Process- Types- Barriers- Effective Listening. *Practice*: Introduction to Phonetics – Speech Sounds – Vowels and Consonants

– Minimal Pairs- Consonant Clusters- Past Tense Marker and Plural Marker- *TestingExercises*

ICS Lab:

Understand: Spoken vs. Written Language- Formal and Informal English.

Practice: Ice-Breaking Activity and JAM Session- Situational Dialogues – Greetings – Taking Leave

– Introducing Oneself and Others.

Exercise –

IICALL

Lab:

Understand: Structure of Syllables – Word Stress– Weak Forms and Strong Forms – Stress

pattern insentences – Intonation.

Practice: Basic Rules of Word Accent - Stress Shift - Weak Forms and Strong Forms- Stresspattern in sentences – Intonation - *Testing Exercises*

ICS Lab:

Understand: Features of Good Conversation – Strategies for Effective Communication. *Practice:* Situational Dialogues – Role Play- Expressions in Various Situations –MakingRequests and Seeking Permissions - Telephone Etiquette.

Exercise -
IIICALL
Lab:

Understand: Errors in Pronunciation-Neutralising Mother Tongue Interference (MTI).

Practice: Common Indian Variants in Pronunciation – Differences between British and American Pronunciation -*Testing Exercises*

ICS Lab:

Understand: Descriptions- Narrations- Giving Directions and Guidelines – Blog Writing

Practice: Giving Instructions – Seeking Clarifications – Asking for and Giving Directions – Thanking and Responding – Agreeing and Disagreeing – Seeking and Giving Advice – Making Suggestions.

Exercise – IVCALL Lab:

Understand: Listening for General Details.

Practice: Listening Comprehension Tests - *Testing Exercises*

ICS Lab:

Understand: Public Speaking – Exposure to Structured Talks - Non-verbalCommunication- Presentation Skills.

Practice: Making a Short Speech – Extempore- Making a Presentation.

Exercise –
VCALL
Lab:

Understand: Listening for Specific Details.

Practice: Listening Comprehension Tests -*Testing Exercises*

ICS Lab:

Understand: Group Discussion

Practice: Group Discussion

Minimum Requirement of infrastructural facilities for ELCS Lab:

1. Computer Assisted Language Learning (CALL) Lab:

The Computer Assisted Language Learning Lab has to accommodate 40 students with 40 systems, with one Master Console, LAN facility and English language learning software for self-study by students.

System Requirement (Hardware component):

Computer network with LAN facility (minimum 40 systems with multimedia)
with the following specifications:

    i)   Computers with Suitable Configuration

    ii)   High-Fidelity Headphones

2. Interactive Communication Skills (ICS) Lab :

The Interactive Communication Skills Lab: A Spacious room with movable chairs and audio-visual aids with a Public Address System, a T.V. or LCD, a digital stereo –audio & video system and camcorder etc.

Source of Material (Master Copy):

- *Exercises in Spoken English. Part 1,2,3*. CIEFL and Oxford University Press

Note: Teachers are requested to make use of the master copy and get it tailor-made to suit thecontents of the syllabus.

Suggested Software:

- Cambridge Advanced Learners' English Dictionary with CD.
- Grammar Made Easy by Darling Kindersley.
- Punctuation Made Easy by Darling Kindersley.
- Oxford Advanced Learner's Compass, 10th Edition.
- English in Mind (Series 1-4), Herbert Puchta and Jeff Stranks with Meredith Levy, Cambridge.
- English Pronunciation in Use (Elementary, Intermediate, Advanced) CambridgeUniversity Press.
- English Vocabulary in Use (Elementary, Intermediate, Advanced) CambridgeUniversity Press.

- TOEFL & GRE (KAPLAN, AARCO & BARRONS, USA, Cracking GRE by CLIFFS).
- Digital All
- Orell Digital Language Lab (Licensed Version)

REFERENCE BOOKS:

1. (2022). *English Language Communication Skills – Lab Manual cum Workbook.* Cengage Learning India Pvt. Ltd.

2. Shobha, KN & Rayen, J. Lourdes. (2019). *Communicative English – A workbook.* Cambridge University Press

3. Kumar, Sanjay & Lata, Pushp. (2019). *Communication Skills: A Workbook.* OxfordUniversity Press

4. Board of Editors. (2016). *ELCS Lab Manual: A Workbook for CALL and ICS Lab Activities.* Orient Black Swan Pvt. Ltd.

5. Mishra, Veerendra et al. (2020). *English Language Skills: A Practical Approach.* Cambridge University Press.

2410596: WEB APPLICATION DEVELOPMENT

B.Tech. I Year. I Sem

L	T	P	C
0	0	2	1

COURSE OBJECTIVES: The students will try to learn
- HTML tags
- CSS
- Development of static web site
- Concepts of Java script
- Development of dynamic web site

0   0   2   1

COURSE OUTCOMES: After successful completion of the course, students should be able to
- Learn HTML tags and CSS
- Develop static web pages using HTML
- Use CSS in web pages
- Understand basic concepts of Javascript
- Develop dynamic web pages

PART-A

1. Write a HTML program to create a webpage about the different art forms of India, with appropriate title on the title bar. Use different heading tags for the headings, and list them using ordered list.
2. Write a HTML program to create sections in the document using appropriate tags and apply different color as background to them. Use internal hyperlinks to move to differentpoints within the page.
3. Write a HTML program to insert a picture on the webpage, giving description for the picture in a paragraph. Use properties of height, width, hspace, vspace and align, with different values.
4. Write a HTML Program, to create a profile of 2 pages, the First page containing the applicant's picture with personal details using unordered lists, and the second containingEducational details using tables. Use hyperlinks to move to the next page.
5. Using Frames create an Indian Flag and insert the image of chakra in the center.
6. Create a frame like structure based on the given diagram, such that When the first link is clicked, the contents of the first frame is filled with the corresponding information and when the second link is clicked the second frame is filled.

	Networks……..
● <u>Networks</u> ● <u>Simulation</u>	Simulation

7. Write a program in HTML to demonstrate the concept of Image map, for India map.Map for areas rectangle, Circle and polygon.

PART-B

1. Write a program using Javascript to do the multiplication table for a number entered bythe user in the textbox.
2. Create a sparse array using the values entered by the user in the five textboxes, and useArray methods such as sort(),pop(),push(), reverse() and join().
3. Create a Math object and use methods ceil(),floor(), round() for rounding off thenumber, also use methods such as cos(), sin(),sqrt().
4. Write a Program using Javascript to print a bill for 5 items purchased by the user.
5. Write a program Using Date object, to display appropriate greeting message "Good Morning" or "Good Afternoon" or "Good Night", in an alert box with the user's name, after receiving the same in the prompt box.
6. To demonstrate the concept of styles, Write a program applying internal style for paragraph tag, and override the same by applying inline style. Also create an external CSS file applying styles for the headings.
7. Create a registration form for creating an email account, having the input type elements like checkbox, radio button, select option, text area and submit button, and validate the textboxes for verifying the password.
8. Create a web page using two image files, which switch between one another as the mouse pointer moves over the image. Use on Mouse Out and on Mouse Over event handlers.
9. Using filters apply opacity feature to blur the image and using Transition apply hover feature, so the image will be transparent again when the mouse pointer is placed on the image.

I-II

2420002: DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS
(CSE, CSD, CSM, ECE, EEE, MECH, CIVIL)

I Year B.Tech. II Sem.   **L T P C**

                                                                 3 1 0 4

Course Overview:

This course plays a crucial role in engineering, serving as the foundation upon which engineers build and apply their knowledge to solve real world applications. It presents a systematic and comprehensive introduction to ordinary differential equations and vector calculus for engineering students .Mathematical concepts and various techniques are presented in a clear logical and concise manner. A linear differential equation is used to regulate the flow of electricity in various electrical circuits like LR, LCR and CR circuits. Vector calculus is extensively used in the description of electromagnetic fields, gravitational fields and fluid flow.

Pre-requisites: Mathematics courses of 10+2 year of study.

Course Objectives: The student will try to learn
- Methods of solving the differential equations of first order and first degree.
- Concept of higher order liner differential equations.
- Concept, properties of Laplace transforms, solving ordinary differential equations by using Laplace transforms techniques.
- The physical quantities involved in engineering field related to vector valued functions.
- The basic properties of vector valued functions and their applications to line, surface and volume integrals.

Course outcomes: After successful completion of the course, students should be able to
    CO1: Identify whether the given first order differential equation is exact or not.
    CO2: Solve higher differential equation and apply the concept of differential equation to real world problems.
    CO3: Usethe Laplace transforms techniques for solving ODE's.
    CO4: Apply the Del operator to scalar and vector point functions.
    CO5: Evaluate the line, surface and volume integrals and converting them from one to another.

UNIT-I: First Order ODE 10L
Exact differential equations, equations reducible to exact differential equations, linear and Bernoulli's equations, Orthogonal Trajectories (only in Cartesian Coordinates). Applications: Newton's law of cooling, Law of natural growth and decay.

UNIT-II: Ordinary Differential Equations of Higher Order 10 L
Second order linear differential equations with constant coefficients: Non-Homogeneous

terms of the type e^{ax}, sin ax, cos ax, polynomials in x, $e^{ax}V(x)$ and x V(x), method of variation of parameters, Equations reducible to linear ODE with constant coefficients: Legendre's equation, Cauchy-Euler equation.

UNIT-III: Laplace transforms 10 L

Laplace Transforms: Laplace Transform of standard functions, First shifting theorem, Second shifting theorem, Unit step function, Dirac delta function, Laplace transforms of functions when they are multiplied and divided by 't', Laplace transforms of derivatives and integrals of function (All without proof), Evaluation of integrals by Laplace transforms, Laplace transform of periodic functions, Inverse Laplace transform by different methods, convolution theorem (without proof). Applications: solving Initial value problems by Laplace Transform method.

UNIT-IV: Vector Differentiation 8 L

Vectorpointfunctionsandscalarpointfunctions,Gradient,DivergenceandCurl,Directionalderiv atives, Vector Identities, Scalar potential functions, Solenoidal and Irrotational vectors.

UNIT-V:Vector Integration 10 L

Line, Surface and Volume Integrals, Theorems of Green's, Gauss and Stokes's (without proof) and their applications.

TEXT BOOKS:
1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition,2010.
2. R.K. Jain and S.R.K. Iyengar, Advanced Engineering Mathematics, Narosa Publications, 5th Edition,2016.

REFERENCE BOOKS:
1. Erwin Kreyszig, Advanced Engineering Mathematics, 9thEdition, John Wiley & Sons, 2006.
2. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
3. H. K. Dass and Er. RajnishVerma, Higher Engineering Mathematics, S Chand and Company Limited, New Delhi.

B.Tech I Year II Sem   **L T P C**

                                                                                   3 1 0 4

Course overview:

1.   **Importance of course**- It helps engineers understand the nature of different materials. It also helps engineers learn how to work with different types of matter without causing pollution or waste.

2. **Brief about course-** To impart knowledge on the fundamental concepts of chemistry

    Involved in application of several important engineering materials that are used in Industry/day to day life**.**

3.   **Applications of course:** Engineering chemistry graduates use raw materials and chemicals to design, manufacture, and test new products, systems and machinery which are used in numerous industries.

Prerequisites: chemistry knowledge at Pre- University level

Course Objectives: The students will try to learn

1.   Knowledge about desalination of brackish water and treatment of municipal water.

2.   Fundamental aspects of battery chemistry, significance of corrosion its control to protect the structures.

3.   Knowledge of polymers, conducting polymers, bio-degradable polymers and fiber reinforced plastics.

4.   Basic concepts of petroleum and its products.

5.   Knowledge about engineering materials like cement, smart materials and Lubricants.

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

1.   Apply softness of water by ion exchange process.

2.   Analyze the various types Factors affecting of corrosion.

3.   Understand the fundamental concepts of polymers

4.   Analyze the various type of Gaseous Fuels.

5.   Evaluate the smart materials and their Applications.

Course articulation matrix

PO/PSO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	4	2	1	-	-	1	-	-	-	-	1	1	-
CO2	2	4	3	4	2	1	1	1	-	-	-	1	1	-
CO3	1	2	1	2	1	2	1	-	-	-	-	1	1	-
CO4	1	4	4	5	1	2	1	-	-	-	-	1	1	-
CO5	1	4	4	5	1	2	1	-	-	-	-	1	1	-

UNIT - I: Water and its treatment: [8]

Introduction to hardness of water – Estimation of hardness of water by complex ometric method and related numerical problems. Potable water and its specifications - Steps involved in the treatment of potable water-Disinfection of potable water by chlorination and break-point chlorination.

Boiler troubles: Sludges, Scales and Caustic embrittlement. Internal treatment of Boiler feed water - Calgon conditioning - Phosphate conditioning - Colloidal conditioning, External treatment methods - Softening of water by ion- exchange processes. Desalination of Brackish water – Reverse osmosis.

UNIT – II Battery Chemistry & Corrosion [8]

Introduction-Classification of batteries-primary, secondary and reserve batteries with examples. Basic requirements for commercial batteries. Construction, working and applications of: Lithium ion battery, Applications of Li-ion battery to electrical vehicles. Fuel Cells- Differences between battery and a fuel cell.

Construction and applications of Hydrogen Oxygen fuel cell. Solar cells - Introduction and applications of Solar cells.

Corrosion: Causes and effects of corrosion – theories of chemical and electrochemical corrosion mechanism of electrochemical corrosion,

Types of corrosion: Galvanic, water-line and pitting corrosion. Factors affecting rate of corrosion, Corrosion control methods- Cathodic protection – Sacrificial anode and impressed current methods. Surface coatings-Metallic coatings-Hot dipping- Galvanisation, Tinning

UNIT - III: Polymeric materials: [8]

Definition – Classification of polymers with examples – Types of polymerization–addition (Mechanism of free radical addition) and condensation polymerization with examples – Nylon 6:6.

Plastics: Definition and characteristics- thermoplastic and thermosetting plastics, Preparation, Properties and engineering applications of PVC ,Teflon, Fiber reinforced plastics (FRP).

Rubbers: Natural rubber and its vulcanization.

Elastomers: Characteristics –preparation – properties and applications of Buna-S,Thiokol rubber.

Conducting polymers: Characteristic, Classification and applications of conducting polymers.

Biodegradable polymers: Concept and advantages - Poly vinyl alcohol and their applications.

UNIT - IV: Energy Sources: [8]

Introduction, Calorific value of fuel – HCV, LCV- Dulongs formula. Classification- solid fuels: coal – analysis of coal – proximate and ultimate analysis and their significance. Liquid fuels – petroleum and its refining,. Knocking – octane and cetane rating, synthetic petrol - Fischer-Tropsch's process; Gaseous fuels – composition and uses of natural gas, LPG and CNG.Bio-diesel-Transesterification-advantages.

UNIT - V: Engineering Materials: [8]

Cement: Portland cement, its composition, setting and hardening, special cements-white cement, waterproof cement, high alumina cement.

Smart materials and their applications:-

Classification-(piezoelectric materials-quartz, Shape memory material (SMA-Nitinol), Thermoresponsive materials, magneto rheological materials-Examples.

 Lubricants: Classification of lubricants with examples-characteristics of a good lubricants-

mechanism of lubrication (thick film, thin film and extreme pressure)- properties of lubricants: viscosity, cloud point, pour point, flash point and fire point.

TEXT BOOKS:
1. Engineering Chemistry by P.C. Jain and M. Jain, Dhanpatrai Publishing Company, 2010.

2. Engineering Chemistry by Rama Devi, and Rath, Cengage learning, Second edition 2022.

3. Textbook of Engineering Chemistry by Jaya Shree Anjireddy, Wiley Publications,2022.

4. A text book of Engineering Chemistry by M. Thirumala Chary, E. Laxminarayana and K. Shashikala, Pearson Publications, 2021.

5.

REFERENCE BOOKS:
4. Engineering Chemistry by Shikha Agarwal, Cambridge University Press, Delhi (2015)

5. Engineering Chemistry by Shashi Chawla, Dhanpatrai and Company (P) Ltd. Delhi(2011)

24X0321: APPLIED MECHANICS
(Common to Mechanical & Civil)

B.Tech.I Year II Semester

L	T	P	C
3	0	0	3

Course Overview:

Engineering mechanics is the basic course which is useful for the engineering students, studying of the subject helps to develop the thinking, analytical ability and imagination, skills of the student .This course covers a essential topics such as equilibrium system of forces, friction, centroids and centre of gravity, moment of inertia, trusses and work energy. This course principles apply for manufacturing of various products and projects such as automobiles, railways, bridges, dam, power transmission towers, etc.

Prerequisite: Nil

Course Objective: The students will be able

- To solve resultant of any force system.
- To analyze the types of friction for moving bodies and problems related to friction.
- To determine the centroid of an area and centre of gravity of a body.
- To understand the concept of trusses and virtual works.
- Understand the work energy principle.

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

- Determine the resultant forces acting on a body and analyze equilibrium of a body subjected to a system of forces.
- Solve problem of bodies subjected to friction.
- Find the location of centroid and calculate moment of inertia of given section.
- Determine the forces in the member of the trusses.
- Solve the problem using work energy equations for translation, fixed axis rotation and plane motion of rigid bodies.

Module-I: Introduction to Engineering Mechanics
[10]

Basic Concepts, system of Forces Coplanar Concurrent Forces -Components in Space - Resultant -Moment of Forces and its Application - Couples and Resultant of Force Systems. Equilibrium of system of Forces: Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems.

Module-II: Friction, Centroid and center of Gravity
[08]

Types of friction -Limiting friction -Laws of Friction -static and Dynamic Frictions – Types of friction – Dry friction – Ladder friction – Wedge friction – Screw friction – Centroid and centre of gravity- Centroid of lines, Areas and volumes from First principle, Centroids of composite sections; Centre of gravity and its implications.

Module -III: Area of Moment of Inertia and Mass Moment of Inertia.
            [10]
Introduction – Definition of Moment of Inertia of plane sections from first principle, Theorems of moment of inertia – Moments of inertia of standard sections and Moments of Inertia of Composite sections; Product of Inertia. Parallel axis theorem, Perpendicular axis theorem, Mass moment of Inertia, Inertia of masses- Mass moment of inertia of composite bodies.

Module -IV: Analysis of trusses and Virtual work
            [10]
Introduction, Classification of trusses, Assumptions made in the analysis of perfect truss, methods of Trusses-Methods of   Joint and Methods of sections. Principle of virtual work: Equilibrium of ideal systems, efficiency of simple machines, stable and unstable equilibriums

Module –V: Review of partical dynamics:
            [10]
Rectilinear motion, Plane curvilinear motion(rectangular, path and polar coordinates). 3-D curvilinear motion, relative and constrained motion; Newton's 2nd law (rectangular, path and polar coordinates), D'Alemberts Principle, Work-Kinetic energy, power, potential energy. Impulse-momentum (linear, angular) Impact (Direct and oblique)

Text Books:
1. Reddy Vijay Kumar K. and J.Suresh Kumar (2010),Singer's Engineering Mechanics -Statics & Dynamics.
2. A.Nelson, "Engineering Mechanics: Statics & Dynamics", Tata McGraw-Hill Education, 2009.

Reference Books:
1. Timoshenko S.P & Young D.H "Engineering Mechanics" McGraw-Hill international Edition,1983
2. A.K Thayal, Engineering Mechanics Uma Publications 14th edition,2013
3. R.k. Bansal Engineeing Mechanics , laxmi Publications 8th edition.2013

24X0502: Essentials of Problem Solving Using Python

B.Tech. I Year II Sem.

L	T	P	C
3	0	0	3

Course Overview:
This course gives acquaintance to Python Programming and Graph Theory. The course deals with Python programming concepts and concepts in graph theory like properties of standard graphs, Eulerian graphs, Hamiltonian graphs, Chordal graphs, Distances in graphs, Planar graphs, graph connectivity and Colouring of graphs.
 Graph theory is used in Network Topologies and Routing Algorithms, Algorithm Design, Social Network Design, Logistics.

Prerequisites:
- A course on "Problem solving using C and C++".

Course Objectives: The students will try to learn
- Basic building blocks of python
- Using of Functions and Modules
- Importance of Multithreading in problem solving
- The fundamental concepts of graph theory
- Graph coloring and traversal algorithms for solving real-world problems

Course Outcomes: After successful completion of the course, students should be able to
- Construct Python data structures programs using tuples sets and dictionaries
- Design Programs using Functions and Modules
- Implement Multithread concept in solving problems
- Understand graph terminology
- Build efficient graph routing algorithms for various optimization problems on graphs.

Module-I   **[10]**
Python Basics: Python Objects, Operators, Python Numbers, Operators, Built-in Functions. Conditionals and Loops-if, else, elif, for, while, break, continue, pass**.**
Sequences: Strings, Lists, and Tuples- Built-in Functions, Special features.
Mapping and Set Types: Dictionaries, Sets.

Module –II   **[9]**
Functions and Functional Programming –Calling Functions , Creating Functions, Passing Functions , Formal Arguments, Variable-Length Arguments, Functional Programming.
Modules–Modules and Files, Namespaces, Importing Modules, Module Built-in Functions, Packages, Related modules.

Module –III [8]

Files and Input / Output: File Objects, File Built-in Functions, File Built-in Methods, File Built-in Attributes, Standard Files, Command-line Arguments.
Multithreaded Programming: Introduction, Threads and Processes, Python Threads, the Global Interpreter Lock, Thread Module, Threading Module.

Module -IV [8]

Graph terminology, Digraphs, Weighted graphs, Complete graphs, Graph complements, Bipartite graphs, Graph combinations, Isomorphism's, Matrix representations of graphs, incidence and adjacency matrices, Degree Sequence, Eulerian circuit: Konigsberg bridge problem, Touring a graph; Eulerian graphs, Hamiltonian cycles

Module – V [7]

Shortest paths: Dijkstra's algorithm, Walks using matrices.
Graph Coloring And Graph Algorithms: Four color theorem, Vertex Coloring, Edge Coloring, Coloring Variations.
Graph traversal: Depth-First Search, Breadth-First Search and its applications; The traveling salesman problem, Minimum Spanning Trees: Kruskal's and Prim's algorithm

TEXTBOOKS:

1. Core Python Programming, Wesley J. Chun, Third Edition, Prentice Hall PTR

2. Karin R Saoub, Graph Theory: An Introduction to Proofs, Algorithms, and Applications, 1 st edition, Chapman and Hall, 2021.

REFERENCES:

1. Think Python, Allen Downey, Green Tea Press

2. Introduction to Python, Kenneth A. Lambert, Cengage

3. Python Programming: A Modern Approach, VamsiKurama, Pearson

4. Learning Python, Mark Lutz, O'Really

5. R Balakrishnan, K Ranganathan, A Textbook of Graph Theory,Springer Exclusive, 2 nd edition, 2019.

24X0371: COMPUTER AIDED ENGINEERING GRAPHICS
(Common to All Branches)

B.Tech I Year II Semester   **L T P C**
                                                           1 0 4 3

Course Overview:

Engineering Graphics is a foundational course designed to introduce first-year engineering students to the principles and practices of technical drawing and computer-aided design (CAD). This course covers essential topics such as geometric construction, orthographic projection, isometric drawing, lettering and dimensioning. Students will develop skills to create and interpret engineering drawings and gain proficiency in using CAD software for engineering applications.

Prerequisite: NIL

Course Objective: The students will be able

1. To understand the importance of engineering graphics in the engineering design process.
2. To apply principles of dimensioning and lettering in engineering drawings
3. To develop the ability to create and interpret technical drawings.
4. To master geometric constructions and projections.
5. To gain proficiency in computer-aided design (CAD) software.

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

1. Explain the role of engineering graphics in the engineering design and manufacturing process.
2. Understand the fundamental concepts of AutoCAD.
3. Perform basic geometric constructions and create accurate technical drawings.
4. Develop skills to create 2D and 3D drawings.
5. Use CAD software to create, modify, and manage engineering drawings.

Module-I: **Introduction to Engineering Graphics:**   [12]

The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line, The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.

Module-II: Conic Sections and Engineering Curves
[10]

Construction of Ellipse, Parabola, Hyperbola (General Method Only)
Engineering Curves: Cycloids, Epicycloid and Hypocycloid

Module -III: Orthographic Projections
[12]

Introduction to Projections: Assumptions, Principles and Different angles of projections.
Projections of Points: Located in all Quadrants
Projections of Lines: Parallel, Perpendicular, Inclined to one plane.

Module -IV: Projections of Planes and Projection of Solids [10]

Projections of Planes: Introduction to planes, Regular lamina- Orientations- Surface parallel to HP, Surface parallel to VP, Inclined to HP, Inclined to VP.

Projections of Solids: Introduction to solids, Right Regular Solids- Orientations- Axis perpendicular to HP, Axis perpendicular to VP, Axis inclined to HP, Axis inclined to VP.

Module –V: Isometric Drawing and Conversions
[14]

Principles of Isometric projections, Isometric View and Isometric Scale, Isometric view of: Planes and Solids, Conversion: Isometric to Orthographic and Vice Versa

Text Books:

1. **"Engineering Drawing",** N.D. Bhatt,Charotar Publishing House Pvt. Ltd, 53rd Edition, 2014, ISBN: 978-9380358173
2. **"Textbook of Engineering Drawing",** K. Venkata Reddy, BS Publications, Revised Edition, 2013, ISBN: 978-9381075994
3. **"Engineering Graphics**", K.R. Gopalakrishna, Subhas Stores, 32nd Edition, 2014, ISBN: 978-9353460206
4. "**Engineering Drawing and Computer Graphics",** M B Shah & C. Rana, Pearson Edition 2010.

Reference Books:

1. "**A Textbook of Engineering Drawing**", R.K. Dhawan, S. Chand Publishing, Revised Edition, 2012, ISBN: 978-8121914311
2. "**AutoCAD 2024: A Problem-Solving Approach, Basic and Intermediate**", Sham Tickoo, CADCIM Technologies, 1st Edition, 2023, ISBN: 978-1640571577
3. "**Engineering Drawing and Graphics Using AutoCAD**", T. Jeyapoovan, Vikas Publishing House 2nd Edition, 2015, ISBN: 978-9325982417

24X0072: ENGINEERING CHEMISTRY LAB

B.Tech. I Year. II Sem   **L T P C**

                                                                     0 0 2 1

Course Objectives: The course consists of experiments related to the principles of chemistry required for engineering student. The student will learn:
- Estimation of hardness of water to check its suitability for drinking purpose.
- Students are able to perform estimations of acids and bases using conductometry, potentiometry methods.
- Students will learn to prepare polymers such as Bakelite and Thiokol rubber in the laboratory.
- Students will learn skills related to the lubricant properties such as saponification value, surface tension and viscosity of oils.

Course Outcomes: The experiments will make the student gain skills on:
- Determination of parameters like hardness of water
- Able to perform methods such as conductometry, potentiometry and in order to find out the concentrations or equivalence points of acids and bases.
- Students are able to prepare polymers like bakelite and Thiokol rubber.
- Estimations saponification value, surface tension and viscosity of lubricant oils.

List of Experiments:
I. Volumetric Analysis: Estimation of Hardness of water by EDTA Complexometry method.
II. Conductometry: 1.Estimation of the concentration of an strong acid by Conductometry.
III. Potentiometry: Estimation of the amount of Fe^{+2} by Potentiomentry.
IV. Dichrometry: Determination of Ferrous ion by Dichrometry
V. Preparations:
  1. Preparation of Thiokol rubber
VI. Lubricants:
  1. Estimation of acid value of given lubricant oil.
  2. Estimation of Viscosity of lubricant oil using Ostwald's Viscometer.
VII. Preparation of Hand sanitizer(Iso propyl alcohol)
VIII. Virtual lab experiments
  1. Construction of Fuel cell and its working.
  2. Smart materials for Biomedical applications
  3. Batteries for electrical vehicles.
  4. Functioning of solar cell and its applications.

REFERENCE BOOKS:
1. Lab manual for Engineering chemistry by B. Ramadevi and P. Aparna, S Chand Publications, New Delhi (2022)
2. Vogel's text book of practical organic chemistry 5th edition
3. Inorganic Quantitative analysis by A.I. Vogel, ELBS Publications.
4. College Practical Chemistry by V.K. Ahluwalia, Narosa Publications Ltd. New Delhi (2007).

FUELS AND LUBRICTION LAB

B.Tech. I Year II Sem   **L   T   P   C**
                                                              0   0   2   1

Pre-Requisites: Engineering Physics & Chemistry

Course Objectives: The students will try to learn
1. To understand the fuels and lubricants Properties

2. To understand the knowledge of automobile fuels and lubricants.

3. To understand the viscosity of lubricants and its variation with temperature

4. To understand the distillation characteristics of petroleum products

Course Outcomes: After completion of the course the student is able to

1. Find the kinematic viscosity of lubricants and its variation with temperature

2. Determine the flash point, fire point, cloud point and pour point of liquid fuels

3. Determine the calorific value of solid, liquid and gaseous fuels

4. Determination of the dropping point of lubricating grease

5. Determination of distillation characteristics of petroleum products

List Of Experiments

1. Determination of Flash and Fire points of Liquid fuels/Lubricants using: Abels Apparatus.

2. Determination of Flash and Fire points of Liquid fuels/Lubricants using: Pensky Martens Apparatus.

3. Determination of Carbon residue test: Liquid fuels.

4. Determination of Viscosity of Liquid lubricants and Fuels using: Saybolt Viscometer.

5. Determination of Viscosity of Liquid lubricants and Fuels using: Redwood Viscometer –I.

6. Determination of Viscosity of Liquid lubricants and Fuels using: Redwood Viscometer – II.

7. Determination of Viscosity of Liquid lubricants and Fuels using: Engler Viscometer.

8. Determination of Calorific value of Gaseous fuels using: Junkers Gas Calorimeter.

9. Determination of Calorific value: Solid/Liquid/ fuels using: Bomb Calorimeter.

10. Drop point and Penetration Apparatus for Grease.

11. ASTM Distillation Test Apparatus.

12. Cloud and Pour point Apparatus.

24X0572:Essentials Of Problem Solving Using Python Laboratory

B.Tech. I Year II Sem.   **L   T   P   C**

                                                              0   0   2   1

Course Overview:
This course gives acquaintance to Python Programming and Graph Theory. It deals with Python programming concepts and concepts in graph theory like properties of standard graphs, Eulerian graphs, Hamiltonian graphs, Chordal graphs, Distances in graphs, Planar graphs, graph connectivity and Colouring of graphs. Python programming is used developing machine learning and data science applications. Graph theory is used in Network Topologies and Routing Algorithms, Algorithm Design, Social Network Design, Logistics.

Prerequisites:
- A course on "Problem solving using C and C++".

Co-Requisites: Essentials of problem solving

Course Objectives: The students will try to learn
- Basic building blocks of python
- Using of Functions and Modules
- Importance of Multithreading in problem solving
- The fundamental concepts of graph theory
- Graph coloring and traversal algorithms for solving real-world problems

Course Outcomes: After successful completion of the course, students should be able to
- Construct Python data structures programs using tuples sets and dictionaries
- Design Programs using Functions and Modules
- Implement Multithread concept in solving problems
- Understand graph terminology
- Build efficient graph routing algorithms for various optimization problems ongraphs.

Week 1: Python Numbers

a) You are developing a program to determine whether a given year is a leap year, usingthe following formula: a leap year is one that is divisible by four, but not by one hundred, unless it is also divisible by four hundred. For example, 1992, 1996, and 2000 are leap years, but 1967 and 1900 are not. The next leap year falling on a century is 2400.

b) You are developing a program to determine the greatest common divisor and least common multiple of a pair of integers.

c) You are developing a program to create a calculator application. Write code that will take two numbers and an operator in the format: N1 OP N2, where N1 and N2 are floating point or integer values, and OP is one of the following: +, -, *, /, %, **, representing addition, subtraction, multiplication, division, modulus/remainder, and exponentiation, respectively, and displays the result of carrying out that operation on the input operands.

Hint: You may use the string split() method, but you cannot use the exal () built-in function.

Skill Oriented Exercise

1. The cricket World Cup has started in Chefland. There are many teams participating in the group stage matches. Any team that scores 12 or more points in the group stage matches qualifies for the next stage.

2. The elections in Chefland have concluded, and the results are conducted. Chef received X votes, and his rival Chefu received Y. Chef thinks he dominated the election if and only if he received at least double the number of votes Chefu received. Did Chef dominate the election?

3. Bob has an account in the Bobby Bank. His current account balance is W rupees. Each month, the office in which Bob works deposits a fixed amount of X rupees to his account. Y rupees is deducted from Bob's account each month as bank charges. Find his final account balance after Z months. Note that the account balance can be negative as well.

   4. You're a bit all over the place as a college student. You used to eat out at expensive restaurants almost every day until your parents gave you a talking-to about being irresponsible. Now, you've got to control your eating and spending habits. So, here's the plan: you'll stick to the college mess for your meals every day, except Sundays. On Sundays, you're treating yourself to those fancy restaurant meals. The cost is Rs.X for the mess food each day, and Rs. Y for the restaurant splurges. Now, what's the cost of food per week? Note that you don't have to pay for the mess on Sundays. (A week has seven days, as usual.)

Week 2: **Control Flow**

  a) Write a Program for checking whether the given number is a prime number ornot.
  b) Write a program to print Fibonacci series upto given n value.
  c) Write a program to calculate factorial of given integer number.
  d) Write a program to calculate value of the following series $1+x-x^2+x^3-x^4+ x^n$.
  e) Write a program to print Pascal triangle.

Skill Oriented Exercise

1. Charlie is 17 years old and is eager to vote. Write a Python program to check if he meetsthe legal voting age of 18.

2. Your friend given a list of numbers to you and asked to find out the largest numberamong them. Write a python program to find the largest number.

3. Daemon don't like the multiples of 7 so help him to write a Python program that printsnumbers from 1 to 30 but skip the number if it encounters multiple of a 7.

4. Bob has an account in the Bobby Bank. His current account balance is W rupees. Each month, the office in which Bob works deposits a fixed amount of X rupees to his account. Y rupees is deducted from Bob's account each month as bank charges. Find his final account balance after Z months. Note that the account balance can be negative as well.

Week-3 Python Sequences

a) Write a program to sort the numbers in ascending order and strings in reverse alphabetical order.

b) Given an integer value, return a string with the equivalent English text of each digit. For example, an input of 89 results in "eight-nine" being returned. Write a program to implement it.

c) Write a program to create a function that will return another string similar to the input string, but with its case inverted. For example, input of "Mr. Ed" will result in "mR.eD" as the output string.

d) Write a program to take a string and append a backward copy of that string, making a palindrome.

Skill Oriented Exercise

1. Alice loves quotes. Write a Python program to count the number of characters in her favorite quote: "To be or not to be, that is the question.".

2. Emily wants to know if her friends name is a palindrome. Write a Python program to check for a name is a palindrome.

3. Charlie just read a new book and wants to add it to his set of favorite books {"The Hobbit", "Harry Potter"}. Write a Python program to add "The Great Gatsby" to Charlie's set and print the updated set.

4. You have a list of friends' ages: [25, 22, 29, 24]. Write a Python program to sort this listin ascending order.

Week-4 Python Dictionaries

a) Write a program to create a dictionary and display its keys alphabetically.

b) Write a program to take a dictionary as input and return one asoutput, but the values are now the keys and vice versa.

c) Given a List, extract all elements whose frequency is greater than K.Ex: Input test_list = [4,6,4,3,3,4,3,4,3,8], k=3

Output =[4,3]

Skill Oriented Exercise

1. You have a dictionary of your friends' favorite fruits: {"Alice": "Apple", "Bob": "Banana", "Charlie": "Cherry"}. Write a Python program to print Bob's favorite fruit.

2. John manages a small store and needs a program to track his product inventory. Write a Python program that will help John Creating the dictionary which contains the name and

price of the product and print the maximum product name along with its price.

Week-5 Files

a) Write a program to compare two text files. If they are different, give the line andcolumn numbers in the files where the first difference occurs.

b) Write a program to compute the number of characters, words and lines in a file.

1. Alice wants to list all files in her current directory. Write a Python program to import theos module and use it to print the names of all files in the current directory.
2. Charlie wants to read the contents of books.txt line by line and print each book name.Write a Python program to open the file and use the readline method to print each line.
3. Write a Python program greet.py that takes a name as a command-line argument andprints "Hello, [name]!". Demonstrate how to run it with the argument "Alice".

Week- 6&7 Functions

a) Write a function ball collide that takes two balls as parameters and computes if they are colliding. Your function should return a Boolean representing whether or not the balls are colliding.

Hint: Represent a ball on a plane as a tuple of (x, y, r), r being the radius

If (distance between two balls centers) <= (sum of their radii) then (they are colliding)

b) Find mean, median, mode for the given set of numbers in a list.
c) Write simple functions max2() and min2() that take two items and return the larger and smaller item, respectively. They should work on arbitrary Python objects. For example, max2 (4, 8) and min2(4, 8) would each return 8 and 4, respectively.

d) Write a function nearly equal to test whether two strings are nearly equal. Two strings a and b are nearly equal when a can be generated by a single mutation on b.

e) Write a function dups to find all duplicates in the list.

f) Write a function unique to find all the unique elements of a list.

g) Write a function cumulative_ product to compute cumulative product of a list of numbers.
h) Write a function reverse to reverse a list. Without using the reverse function.
i) Write function to compute GCD, LCM of two numbers. Each function should n't exceed one line.

Skill Oriented Exercise

1. Alice wants to create a reusable function to greet her friends. Write a Python function greet that takes a friend's name as an argument and prints a greeting. Call the function with the name "Bob."

2. Charlie needs a function that can sum any number of arguments. Write a function sum_numbers that takes a variable number of arguments and returns their sum. Use thisfunction to sum 1, 2, 3, and 4.
3. Alice wants a quick way to increment a number by 1. Write a lambda function that takesa number and adds 1 to it. Use this lambda to increment 7.
4. Bob has written a custom module called mymath.py with a function add(a, b) that returns the sum of a and b. Write a Python program to import this module and use the add function to add 3 and 5.

Week- 8 Multithreading

a) Write a program to create thread using thread module.
b) Write a program to create thread using threading module.
c) Write a Program to use Python's threading module to calculate the square and cube of anumber concurrently.

Skill Oriented Exercise

1. Alice wants to perform two tasks simultaneously: counting numbers and printing messages. Write a Python program to create two threads, one for counting from 1 to 5 and another for printing "Hello" five times.
2. Charlie is learning about the Global Interpreter Lock (GIL). Write a Python program demonstrating how GIL affects multi-threaded CPU-bound tasks by incrementing a counter in two threads.
3. Diana wants to print numbers in a separate thread using the thread module. Write a Python program to print numbers from 1 to 5 in a new thread.
4. Emily needs a background thread to print a heartbeat message every second. Write a Python program to create a daemon thread that prints "Heartbeat" every second.
5. Alice is managing a shared resource. Write a Python program where two threads increment a shared counter using a threading.Lock to avoid race conditions.

Week 9:

a) Write a Python program to implement Euler Circuit.
b) Write a Python program to implement Dijkstra's algorithm.
c) Given a connected graph G with N nodes and M edges (edges are bi-directional). Every node is assigned a value $A[i]$. We define a value of a simple path as :

Value of path = Maximum of (absolute difference between values of adjacent nodes in a path). A path consists of a sequence of nodes starting with start node S and end node E.

$S-u1-u2-....-E$ is a simple path if all nodes on the path are distinct and $S,u1,u2,...,E$ are nodes in G.

Given a start node S and end node E, find the minimum possible **"valueofpath"** which starts with node S and ends with node E.

d) Yatin created an interesting problem for his college juniors. Can you solve it?

Given N rooms, where each room has a one-way door to a room denoted by $room[i]$, where $1 \le i \le N$. Find a positive integer K such that, if a person starts from room i, $(1 <= i <= N)$, and continuously moves to the room it is connected to (i.e. $room[i]$), the person should end up in room i after K steps;

Note: The condition should hold for each room.If there are multiple possible values of K modulo (109+7), find the smallest one.If there is no valid value of K, output −1

Week 10: Implement the following using python
   a) M-coloring
   b) Vertex coloring
   c) Edge coloring

Week 11: Implement the following graph traversal methods.
   a) Depth-First Search
   b) Breadth-First Search
   c) You are presented with a network comprising N computers and M wired connections between them. Your objective is to optimize the network's connectivity using precisely K wires from your inventory. The aim is to **maximize** the number of computers that can be linked together within the given constraints. Your task is to determine and report the size of the largest network that can be formed by establishing these connections.

In the context of this problem, computers are considered connected if they share either a direct or indirect wired connection. It is worth noting that the value of K will always be less than the number of isolated (standalone) networks in the given configuration, and it may even be zero.

   d) A country consists of N cities. These cities are connected with each other using $N-1$ bidirectional roads that are in the form of a tree. Each city is numbered from 1 to N. You want to safeguard all the roads in the country from any danger, and therefore, you decide to place cameras in certain cities. A camera in a city cansafeguard all the roads directly connected to it. Your task is to determine the minimum number of cameras that are required to safeguard the entire country.

Week 12: Travelling Salesman problem.

   a) You are working in a salesmen company as a programmer.

There are *n* towns in your country and *m* directed roads between them. Each road has a cost person should spend on fuel. The company wants to sell goods in all *n* towns. There are infinitely many salesmen in the company. We can choose some positive number of salesmen and give a non-empty list of towns to each of them. Towns from the list are the towns to sell goods in. Each salesman will visit all the towns in his list in this particular order in cycle (after the last town he will return to the first town and so on). Salesman can visit other towns on his way but he will not sell goods in these towns. Two salesmen cannot sell goods in one town because it will attract unnecessary attention to your company. But for every town there must be a salesman who sell goods in this town. If salesman's list of towns consists of exactly one town then he should pay fee to stay in this town each month (each town has its own fee) or he should go for a round trip and spend money on fuel.

Your task is to calculate the minimal amount of money company must spend monthly to achieve its goals. We will assume that every salesman will spend a month to make one cycle.

b) It is the final leg of the most famous amazing race. The top 'n' competitors have made it to the final. The final race has just begun. The race has 'm' checkpoints. Each team can reach any of the 'm' checkpoint but after a team reaches a particular checkpoint that checkpoint gets closed and is not open to any other team. The race ends when 'k' teams finish the race. Each team travel at a constant speed throughout the race which might be different for different teams. Given the coordinates of n teams and m checkpoints and speed of individual team return the value of minimum time needed to end the race.

c) Little Jhool is a very lenient teaching assistant in his college. He doesn't like cutting the marks of students, so obviously, every student in his tutorial loves him. But anyway, the teacher has got to know about the leniency of Jhool while giving marks, so this time in exam, he decides to give a different exam paper to every single student to check how well have the students been taught by Jhool. Now, Little Jhool knows the strong and weak topics of every single student, so he wants to maximize the total marks obtained by students in his tutorial.You are given the number of students in Jhool's tutorial, denoted by **n - n** also being the number of different exam papers - that is, one for every student. Every student will get only one exam paper to solve. You are further given a matrix, *(n x n)* denoting the marks every student will get if he attempts a particular exam paper. You've to help Jhool figure out a way by which he could maximize the total score obtained by his entire class.

Week 13: Construct minimal spanning tree using the following
   a) Prim's Algorithm
   b) Kruskal's Algorithm
   c) There are total N Hacker-cities in a plane. Each city is located on coordinates $(X[i], Y[i])$ and there can be any number of cities on the same coordinates.

You have to make these cities connected by constructing some roads in such a way that it is possible to travel between every pair of cities by traversing the roads. The

cost of constructing one road between any two cities is the minimum of the absolute difference between their X and Y coordinates.

As you want to earn more and more, you decided to do this in the most optimal way possible, such that the total cost of constructing these roads is minimal. You have to return the minimum money you need to spend on connecting all the cities.

d) Tom is visiting the country Hacker land. Hacker land has n cities and m bi-directional roads. There are k types of tokens. Token i costs c_i. The costs of the tokens are such that for all $2 \le i \le k$, $c_i \ge 2c_{i-1}$. For each road, you need to have a particular set of tokens, if you want to travel it. Note that you don't have to give the tokens, you just need to show them. Thus, one token can be used at any number of roads, where it is required. Tom wants to select a set of tokens, such that using them, he can go from any city to any other city. You have to help him minimize the total cost of tokens he buys.

TEXT BOOKS:

1. Core Python Programming, Wesley J. Chun, Third Edition, Pearson.
2. Karin R Saoub, Graph Theory: An Introduction to Proofs, Algorithms, andApplications, 1 st edition, Chapman and Hall, 2021.

REFERENCE BOOKS:
1. Think Python, Allen Downey, Green Tea Press
2. Introduction to Python, Kenneth A. Lambert, Cengage
3. Python Programming: A Modern Approach, VamsiKurama, Pearson
4. Learning Python, Mark Lutz, O'Really.

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INSTITUTE OF TECHNOLOGY AND MANAGEMENT
(AN AUTONOMOUS INSTITUTION)
(Approved by AICTE, New Delhi & Affiliated to JNTUH, Hyderabad)
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EMPOWERING THROUGH INNOVATIONS
MLRS

B.Tech. I/II Year Syllabus   **MLRSR-24**

PUBLIC SPEAKING SKILLS

Subject Code: 24X0027

L T P C

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Course Description:

This course is designed to develop students' public speaking skills, focusing on speech preparation, delivery techniques, and the use of non-verbal communication. Students will learn to present effectively in various contexts, from formal presentations to informal meetings.

Prerequisites: Basic communication skills

Course Objectives: The students will learn:

- Understand the fundamentals and prerequisites of public speaking.
- Develop the ability to convert ideas into structured speeches.
- Enhance performance through verbal and non-verbal communication.
- Master different types of public speaking and professional presentations.
- Learn the etiquette and mannerisms required for effective public speaking.

Course Outcomes: By the end of this course, students will be able to:

1. **Prepare and deliver** speeches confidently by organizing content and overcoming stage fright.
2. **Utilize** verbal and non-verbal communication to engage the audience effectively.
3. **Adapt** to different contexts by tailoring speeches for diverse audiences and settings.
4. **Exhibit** professionalism and creativity using proper etiquette, rhetorical devices, and creative language

Module 1: Fundamentals of Public Speaking (No of hours: 6)

This unit introduces public speaking, covering its importance, course structure, assessment methods, and prerequisites like understanding the audience, research, organizing speech structure, overcoming

stage fright, and practising speech delivery.

Module2: Speech Development and Delivery (No of hours: 6)

This unit focuses on converting ideas into action through brainstorming, outlining, drafting speeches, using storytelling, and practising impromptu speaking. It also emphasizes public speaking as a performative act, covering voice modulation, eye contact, audience engagement, effective pacing, gestures, and techniques for handling questions and interruptions.

Module 3: Non-verbal Communication and Speech Types (No of hours: 5)

This unit explores non-verbal communication's role in public speaking, covering the importance and types of cues like facial expressions and gestures, aligning verbal with non-verbal messages, observing audience feedback, and adapting non-verbal communication to virtual settings. It also addresses various types of public speaking, including informative, persuasive, special occasion, motivational speeches, panel discussions, and debates.

Module 4: Professional and Formal Speaking (No of hours: 6)

This unit covers speeches, including analysis of famous examples, preparing and delivering various types, conducting peer and self-evaluation, and effectively utilizing visual aids and multimedia. Adapting speeches for diverse audiences, and addressing practical skills for interviews, professional communication, conducting meetings, conferences, presentations, and building professional networks.

Module 5: Advanced Techniques and Professionalism (No of hours: 5)

This unit focuses on structuring and delivering professional presentations effectively, using creative language techniques for impactful messaging, and embodying proper etiquette and professionalism in public speaking.

TEXTBOOK:
- **"The Art of Public Speaking"** by Dale Carnegie Prabhat Prakashan Pvt. Ltd.; First Edition (31 December 2020) **ISBN-10:** 8184302614

REFERENCEBOOKS:

- **"The Art of Public Speaking" by Stephen E. Lucas**, ISBN: 978-0073523910, Year of Publication: 2014, Publisher: McGraw-Hill Education
- **Confessions of a Public Speaker" by Scott Berkun**, ISBN: 978-0596801991, Year of Publication: 2010, Publisher: O'Reilly Media ISBN: 978-0596801991, Year of Publication: 2010
- **"Speak Like Churchill, Stand Like Lincoln: 21 Powerful Secrets of History's Greatest Speakers" by James C. Humes,** ISBN: 978-0761563518, Year of Publication: 2002, Publisher: Three Rivers Press
- **"The Quick and Easy Way to Effective Speaking" by Dale Carnegie,** ISBN: 978-0671724009, Year of Publication: 1990, Publisher: Pocket Books

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(AUTONOMOUS)

II - I

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2430322: Mechanics of Solids

II Year I Semester

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Course Overview:

This course explores the fundamental concepts of stress and strain in materials, including axial, shear, and thermal stresses. It examines shear force and bending moment relationships in beams, bending stress, and deflection analysis. The syllabus covers the theory of torsion for circular shafts and helical springs, stresses in thin-walled cylinders, and principal stresses using analytical and graphical methods. Practical applications in structural analysis and material strength are emphasized throughout.

Prerequisite: Engineering Mechanics

Course Objective: The students will be able

1. To develop the understanding of the principle concepts behind stress, strain and deformation of solids for various engineering applications.
2. Analyzing the transverse loading on beams and stresses in beam for various engineering applications.
3. Analyzing the deflection of beams for various engineering applications.
4. Analyzing the torsion principles on shafts and springs for various engineering applications.
5. Analyzing the thin and thick shells and principal stresses in beam for various engineering applications

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

- Quote the stress and strain relationship and also distinguish the determinate and indeterminate structures.
- Determine the shear force and bending moment diagrams for s beams for various engineering applications.
- Analyze the deflection of beams for various engineering applications.
- Estimate the torsional load and stresses on shafts and springs for various engineering applications.
- Illustrate principal stresses, knowledge of calculating deformation in thin cylindrical and spherical shells.

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Module-I:Concepts of Stress and Strain   [9]

Stresses and strains, types; Axial and shear stresses and strains: Elastic limit, Hooke's law, lateral strain, Poisson's ratio, volumetric strain, elastic constants, factor of safety; Stepped bars, Thermal stresses, Stresses due to gradual load, sudden load and impact loads.

Module-II:Shear Force and Bending Moment   [9]

Relationship between load, shear force and bending moment; Shear force and bending moment diagrams: Cantilever, simply supported and overhanging beams under concentrated load, uniformly distributed load, uniformly varying load, concentrated moments, maximum bending moment and point of contraflexure.

Module -III:Bending Stress and Deflection of Determinate Beams   [9]

Theory of simple bending: Assumptions and derivation, section modulus, bending stresses in symmetrical and unsymmetrical sections; Shear stresses in beams; Deflection of beams: Double integration method, Macaulay's method and moment area method; Euler's theory of columns

Module -IV: TORSION   [9]

Theory of torsion: Assumptions and derivation, polar modulus; Stresses in solid and hollow circular shafts, power transmission, design for strength and stiffness; Stresses and deflection in close coiled helical spring, springs in series andparallel.

Module –V: Thin Cylinders, Principal Stresses and Strains   [9]

Stresses in thin cylindrical and spherical shells subjected to internal pressure; State of stress at a point: Normal and tangential stresses on a given plane, principal stresses and their planes, plane of maximum shear stress, analytical method, Mohr's circle method.

TEXT BOOKS:

1. Bansal, R.K., Strength of Materials, Laxmi Publications (P) Ltd., 2007
2. Jindal U.C., Strength of Materials, Asian Books Pvt. Ltd., New Delhi, 2007.

REFERENCES:

1. S S Rattan, "Strength of Materials", McGraw-Hill Education (India) Pvt. Ltd., 3rd edition, 2017.
2. Hibbeler, R.C., Mechanics of Materials, Pearson Education, Low Price Edition, 2007.
3. Subramanian R., Strength of Materials, oxford University Press, Oxford Higher Education Series, 2007.

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2430323: METALLURGY AND MATERIAL SCIENCE

II Year I Sem   L   T   P C

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Course Overview:

This course covers metallurgy and material characterization, focusing on defects, and grain boundaries, and their effects on metal properties. It includes alloy and composite constitution, equilibrium diagrams, and phase transformations, emphasizing the Fe-Fe$_3$C phase diagram. Engineering materials such as cast irons, steels, copper, aluminium, titanium alloys, and ceramics are examined. Heat treatment processes and testing methods like tensile, hardness, impact, creep, and fatigue tests are explored. Material characterization techniques, including optical microscopy, SEM, tribology, and corrosion testing, are detailed. The course combines lectures, labs, and projects to develop practical skills in materials analysis.

 Prerequisite: Basic knowledge in Physics and chemistry

Course Objective : The students will try to learn

1. Understand the different types of imperfections
2. Understand the Structure-property correlation of steel and cast iron
3. Interpret phase Diagrams of different alloy systems.
4. Analysetheeffectofheattreatmentonmechanicalpropertiesofmaterials
5. Explore about the materials testing and characterizations techniques

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

1. Memorize the types of imperfections
2. Demonstratetheimportanceofheattreatmentinachievingrequiredproperties.
3. Apply the knowledge of heat treatment to enhance surface properties.
4. Analyzethepropertiesandmicrostructureofferrousandnon-ferrousalloys.
5. Explaindifferentmechanicaltestsandcharacterizationtechniquesofmaterials.

Module-I: Introduction   [09]

 Crystal Structure: Imperfections in solids: point defects, line defects, surface defects. Grain and grain boundaries, effect of grain boundaries on the properties of metal / alloys, determination of grain size.
 Constitution of alloys and composites: Necessity of alloying, types of solid solutions, Hume Rotherys rules, definition of composite, rule of mixtures, classifications of composite materials.

Module-II: Equilibrium Diagrams   [09]

 Equilibrium diagrams: Experimental methods of construction of equilibrium diagrams, Isomorphous alloysystems,equilibriumcoolingandheatingofalloys,Leverrule,coringmiscibilitygaps,eutectic

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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 Fe-Fe3C, equilibrium phase diagram, TTT diagram.

Module-III: Engineering materials   [09]

Cast irons and steels: Structure and properties of White Cast iron, Malleable Cast iron, grey cast iron, Spheroidal graphite cast iron. Classification of steels, structure and properties of plain carbon steels, tool steels.

Non-ferrous metals and alloys: Structure and properties of copper and its alloys, Aluminium and its alloys. Titanium and its alloy.

Ceramic materials: Definition, properties of ceramic materials

Module-IV: Heat treatment of alloys   [09]

Annealing ,normalizing, Hardening, tempering, Harden ability, surface hardening methods, Age hardening treatment, Cryogenic treatment of alloys. Special metals and alloys- Super alloys managing steels.

Module–V: Material testing and characterization   [09]
Material testing: Tensile testing, Hardness–Brinell, Rockwell test and micro hardness. Impact test - Charpy and izod, Creep – creep test, creep curve, Mechanism of creep. Fatigue – fatigue test, S-N curve. **Material Characterization**: Working principle and applications of Optical microscopy (OM), Scanning electron microscopy (SEM), tribology (pin on disc) and bio corrosion

Text Books:

1. IntroductiontoPhysicalMetallurgy:Avner,2nded.,TataMcGraw-HillEducation,2010.
2. MaterialsScienceandMetallurgy:KodgireV.D.25thed.,EverestPublishingHouse,2009
3. WilliamD.Callister,Jr,MaterialsScienceandEngineering –Anintroduction,sixthedition,John Wiley & Sons, Inc. 2004.

ReferenceBooks:

1. PhysicalMetallurgy:RaghavanV.,2nded.,PHI,2006
2. MaterialsScienceandMetallurgy:KhannaO.P.5thed.,DhanpatRaiandSons,2009
3. LawrenceH.VanVlack,ElementsofMaterialsScienceandEngineering,sixthedition,Addison Wesley Longman, Inc. New York, 1998

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(AUTONOMOUS)

2430324: THERMODYNAMICS

II Year I Sem   L T P C
                                                                           3 0 0 3

Course Overview:

Thermodynamics is one of the most basic of physical sciences and almost defines the field of Mechanical Engineering. Certainly there are many areas of study that make up the full gamut of an Engineer's education. However, the subject of thermodynamics brings to the fore front some of the most basic of nature's physical laws: the First, Second, Third and even the Zeroth Laws of Thermodynamics. A truly educated individual should consider the understanding of the essence of these basic laws to be necessary if one is to be truly considered educated. However, the need to understand the essence and the application of these laws in engineering practice becomes an absolute necessity for the well-educated engineer.

Prerequisite: Basic knowledge in Physics and chemistry

Course Objective: The students will try to learn

1. Understanding the basics and application of zeroth and first law of thermodynamics.
2. Analyzing the second law of thermodynamics for performance of thermal systems.
3. Imparting the knowledge on availability and applications of second law of thermodynamics
4. Interpreting the various properties of steam
5. Help the students learn the properties of gas mixtures and power cycles

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

1. Apply zeroth and first lawsto thermodynamic systems.
2. Relate the second law of thermodynamics towards analyzing the performance of thermal systems.
3. Adopt the concept of entropy and availability in thermal systems.
4. Evaluate the various properties of steam using thermodynamic relations.
5. Compute the macroscopic properties of gas mixtures and power cycles.

Module-I: Introduction   **[9]**

Introduction, system, boundary, surrounding, control volume, universe, types of system, Macroscopic and Microscopic View Point, concept of Continuum, control volume, control space, Thermodynamic Equilibrium, State, property, process, cycle, Reversibility, Quasi static process, irreversible process, causes of irreversibility energy in state and energy in transition, types of work and heat, point and path function. Zeroth law of Thermodynamics- Concept of temperature principles of thermometry, reference points, constant volume gas thermometer, Scales of temperature, ideal gas scale.

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Module-II :First law of thermodynamics   **[9]**

Joule's Experiment- First law of thermodynamics, PMM-I, Corollaries- First law applied to a Process, applied to a system, Steady Flow Energy Equation, throttling and free expansion processes. Energy Balance, deviations from perfect gas model, Vander walls equation of state, compressibility charts, variable specific heats, gas tables.

Module-III : Second law of thermodynamics   **[9]**
Limitations of first law of thermodynamics, thermal reservoir, heat engine, heat pump, parameters of performance, second law of thermodynamics, Kelvin Planck and Clausius statements and their equivalence collieries, PMM-II, Carnot Principle, Carnot cycle and its specialties. 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.

Module-IV: Properties of Pure Substances& mixture of gases   **[9]**

Pure substance, P-V-T surfaces, T-S & h-s diagrams, Mollier charts, phase transformations, triple point, at critical state properties during the change of phase, dryness fraction, Clausius - Clapeyron equation property tables. Various thermodynamic processes, energy transfer, steam calorimetry.

Mixture of perfect gases, mole fraction, mass fraction, gravimetric & volumetric analysis, Dalton's law of partial pressure, Avogadro's law of additive volumes, equivalent gas constant, molecular internal energy, enthalpy of specific heats and entropy of mixture of perfect gasses, vapour and atmospheric air.

Module –V : Air Standard Cycles& Refrigeration cycles   **[9]**

Carnot Cycle, Otto Cycle, Diesel & Dual Cycle. Mean Effective Pressures on Air standard basis – Comparison of Cycles, Sterling Cycle, Atkinson Cycle, Ericson Cycle, Lenoir Cycle. Carnot cycle, Bell Coleman cycle, Vapor Refrigeration cycles Description and representation on P–V and T-S diagram, Thermal Efficiency.

Text Books:

1. Engineering Thermodynamics, P.K. Nag, Tata McGraw Hill Publishers, 5th Edition, 2014
2. Heat Engineering, V.P.Vasandhani & D.S Kumar, Metropolitan Book Depot, 2011 Edition.

Reference Books:

1. Thermodynamics: An Engineering Approach Y.A. Cengel and M.A. Boles, Tata Mc-Graw Hill .
2. Engineering Thermodynamics, Mayhew and Rogers, Longman Green & Co Ltd., London, E.L.B.S, 8thEdition.
3. Fundamentals of Classical Thermodynamics (SI Version), Van Wylen. G.J. and Sonntag. R.E, 2ndEdition.

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2430507: Data Structures

L T P C
3 0 0 3

Prerequisites: A course on "Essentials of Problem Solving using python".

Course Overview:
Data structures are the fundamental building blocks of computer programming. They define how data is organized, stored, and manipulated within a program. Understanding data structures is very important for developing efficient and effective algorithms. In this Course, student will explore the most commonly used data structures, including linked lists, stacks, queues, trees, and Hashing.

Course Objectives: The students will try to learn
   • Various linear and non-linear data structures.
   • How to perform operations on data structures.
   • Priority Queues and Heaps
   • Various searching and sorting techniques.
   • Different hashing techniques

Course Outcomes: After successful completion of the course, students should be able to
   • Develop solutions by using different types of linked lists
   • Solve problems using stack and queue
   • Learn different types of trees and their applications
   • Implement and know the application of algorithms for searching and sorting.
   • Design Programs using Hashing

Module–I: Linked Lists [9]
Introduction to Data Structures, Linear list – singly linked list, Doubly linked list, Circular linked list - operations and its applications.

Module-II: Stack and Queue [8]
Stacks - Introduction, Operations, array and linked representations of stacks, stack applications (Infix to postfix conversion and postfix evaluation),
Queues - Introduction, operations, array and linked representations of queues and its applications.

Module–III: Trees [10]
Trees: General Trees, Binary Trees, Implementing Trees, Tree traversals
Search Trees: Binary Search Trees, Balanced search trees- AVL trees, B- trees

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Priority Queue and Heaps: Priority queue ADT, Priority queue, Applications, Heap Trees, implementing a priority queue with a Heap, Heap Sort.

Module–IV: Searching and Sorting   **[9]**
Searching: Linear Search and Binary Search and its applications.
Sorting: Bubble sort, Selection sort, Insertion sort, Merge sort, Quick sort and its applications.

Module – V: Hashing   **[8]**
Introduction, Hash Functions-Modulo, Middle of Square, Folding, Collision Resolution Techniques-Separate Chaining, Open addressing,- Linear Probing, Quadratic Probing, Double Hashing.

TEXTBOOKS:

1. Fundamentals of data structures in C, E.Horowitz, S.Sahni and Susan Anderson Freed, 2nd Edition, Universities Press.
2. Data structures using C, A.S.Tanenbaum, Y. Langsam, and M.J. Augenstein, PHI/pearson education.

REFERENCES:

1. Data structures: A Pseudocode Approach with C, R.F.Gilberg And B.A.Forouzan, 2nd Edition, Cengage Learning.
2. Introduction to data structures in C, Ashok Kamthane, 1st Edition, PEARSON.

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2430007: Probability Statistics and Numerical Methods

II BTech I Sem (Mech)   **L   T   P   C**

                                                       3   1   0   4

Course Overview: Probability statistics are useful tools for both social and natural sciences, and they help to represent complicated data in any easy and understandable way. This course provides an elementary introduction to probability and statistics with applications. Topics include basic combinatorics, random variables, probability distributions, Bayesian inference, hypothesis testing, confidence intervals. Statistics is a crucial process behind how we make discoveries in science, make decisions based on data and make predictions. Numerical methods are paramount in modern product engineering and scientific research.

Course Objectives:

The students will try to learn:

1. The Concept of Random variables.
2. Probability distributions of single random variables.
3. The sampling theory and the concept of Estimation.
4. Testing of hypothesis and making statistical inferences.
5. Various numerical methods to find roots of polynomial and transcendental equations.

CO No	Course Outcomes	Knowledge Level (Bloom's Taxonomy)
CO1	Formulate and solve real world problems involving Random variables	Understand
CO2	**Apply and** Identify probability distributions to various case studies	Analyze
CO3	Understand the concept of sampling and apply concept of Estimation	Analyze
CO4	**Apply** the concept of testing a hypothesis to case studies	Apply
CO5	**Identify** the root of a given Algebraic and transcendental equations	Analyze

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Unit-I: Probability and Random Variables: Probability of an Event, Additive Rules, Conditional Probability, Product Rule and the Baye's Rule (All rule without proof). Random variables: Discrete and continuous random variables and their properties, Expectation of Random Variables, Variance of random variables.

Unit-II: Probability Distributions: Discrete Probability distributions: Binomial and Poisson distributions, statistical parameters for these distributions (without proof). Continuous probability distributions: Normal and Uniform distributions, statistical parameters for these distributions (without proof).

Unit-III: Sampling Distribution & Estimation: Sampling Distributions: Random Sampling, Parameters and Statistics, Sampling Distribution of Means and the Central Limit Theorem, t - Distribution, F-Distribution.

Estimation: Estimating the Mean, Standard Error of a Point Estimate, Confidence Intervals for single sample and two Samples.

Unit-IV: Test of Hypothesis: Statistical Hypothesis: General Concepts, testing a Statistical Hypothesis, Tests Concerning Large samples - Single Mean, Two Means, Single Proportion and two Proportions. Small samples- T-test for Single Mean and Two Means.

Unit-V: Numerical Methods: Solution of polynomial and transcendental equations: Bisection method, Iteration Method, Newton-Raphson method and Regula-Falsi method. Methods for solving linear systems of equations: Gauss Jacobi method and Gauss Seidel Iteration Method.

TEXT BOOKS:

1. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers, Keying Ye, Probability & Statistics for Engineers & Scientists, 9th Ed. Pearson Publishers.
2. S. C. Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, Khanna Publications.
3. S. S. Sastry, Introductory Methods of Numerical Analysis, PHI, 4th Edition, 2005.

REFERENCE BOOKS:

1. T.T. Soong, Fundamentals of Probability and Statistics for Engineers, John Wiley & Sons, Ltd, 2004.
2. Sheldon M Ross, Probability and Statistics for Engineers and Scientists, Academic press.
3. M. K. Jain, S.R.K. Iyengar, R.K. Jain, Numerical Methods for Scientific and Engineering Computations, New Age International Publishers.

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2430374: Material Science & Mechanics of Solids Laboratory

II Year I Sem   **L   T   P   C**

                                                                     0   0   2   1

PRE-REQUISITES: Basic knowledge in Physics
 Course overview

The course is to learn the fundamental concepts of stress, strain, and deformation of solids with applications to bars, beams, and columns. Detailed study of properties of materials and also of interest. Fundamentals of applying equilibrium, compatibility, and force- deformation relationships to structural elements are emphasized. The students are introduced to advanced concepts of flexibility and stiffness methods of structural analysis. The course builds on the fundamental concepts of engineering mechanics course.

COURSE OBJECTIVES:
1. Determination of mechanical properties of different materials.
2. Establish the constitutive relations in metals using destructive methods.
3. Understand the behaviour of members during twisting and transverse loading.
4. Familiarize with standard test specimens
5. Prepare samples for investigating microstructure of different materials.

COURSE OUTCOMES:
1. Understand the microstructures of pure metals, steels, cast irons, non-ferrous alloys and heat-treated steels
2. Estimate the hardenability of steels by the Jominy End Quench test.
3. Analyse the hardness of various treated and untreated steels by using the Brinells hardness test   & Rockwell hardness test.
4. Practice different tests such as direct tension test, torsion test, and impact test and punch shear test on metal rod.
5. Illustrate the bending test on a simply supported and cantilever beam.
6. Analyze the mechanical properties of different materials.

LIST OF EXPERIMENTS :
1. Preparation and study of crystal models for simple cubic, body centered cubic, face centered cubic and close packed structures.
2. Preparation and study of the Microstructure of pure metals like Iron, Cu and Al.
3. Preparation and study of the Microstructure of Mild steels, low carbon steels, high – C steels.
4. Study of the Microstructures of Cast Irons.
5. Hardenability of steels by Jominy End Quench Test.
6. Direct Tension Test
7. Bending test on Simple supported beam.
8. Bending test on Cantilever beam
9. Torsion test
10. Brinell hardness test / Rockwell hardness test
11. Test on springs
12. Izod Impact test / Charpy Impact test.

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2430375: COMPUTER AIDED MACHINE DRAWING PRACTICE

B.Tech. II – Year. I – Sem   **L   T   P   C**
                                                                     0   0   2   1

Overview:
The purpose of computer aided machine drawing practice course is to communicate the technical data needed for the production and assembly of machine parts. Students practice using industry-leading mechanical design software to generate drawings of machine components in accordance with the Bureau of Indian Standards (BIS) and assembly. It is employedin develop a whole variety of products, encompassing economic, sociological, safety, and manufacturing factors. These products vary from single parts to assemblies with thousands of precise-fit components.

Prerequisite: Engineering Graphics

Course Objective: The students will try to learn

1. Purpose of BIS-recommended drawing code for mechanical elements created using AutoCAD.
2. The sectional views of joints, couplings, bearings and keys drawn using 2D.
3. The preparation of component drawings, assembly drawings and bill of materials for selected assemblies and their applications.
4. Selected part drawings showing how different machines and engine parts are assembled.
5. About limits, tolerance and fits and indicate that information on machine drawings.

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

1. Interpret machine drawings by recognizing the various kinds of materials, machine elements, and parts.
2. Sort various sectional views of machine elements to prepare part drawings for design process.
3. Draw selected bearings, keys and cotter joints drawings for assembly of machine parts.
4. Categorize the riveted joints and couplings to secure the parts that need to be assembled frequently.
5. Create assembly drawings for the machine vice, safety valves, tail stock and engine parts to make manufacturing easier.

WeekI: Conventional Representation & Sectional Views   **[3]**

Conventional representation of materials, common machine elements and parts such as screws, nuts, bolts, keys, gears.
Types of sections, selection of section planes and drawing of sections and auxiliary sectional views, parts not usually sectioned.

WeekII: Working Drawings   **[3]**
Types of drawings–Working drawings for machine parts

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WeekIII: Machine Elements   **[3]**

Drawing of machine elements and simple parts; Selection of orthogonal views and additional views for thefollowing machine elements and parts with drawing proportion, popular forms of screw threads& fasteners.

Week IV:Keys and Cotter Joints   **[3]**

Keys: Parallel Key, Taper Key, Feather Key, Gib-Head Key, Woodruff Key

Joints: Cotter joints, Knuckle joint (pin joint) for two rods.

Week V: Riveted Joints[3]

Riveted Joint for Plates

Week VI: Couplings

Split Muff Coupling, Flange Coupling, Flexible Coupling, & Universal Coupling**[3]**

Week VI: Bearings   **[3]**

Journal, Pivot, and Collar bearing

Week VII: Assembly Drawings – Engine Parts   **[3]**

Assembly drawings Assembly drawings for the following, using conventions and drawing proportions: Engineparts–stuffing box

Week VIII: Connecting Rod and Eccentric   **[3]**

Eccentrics, I.C. engine connecting rod

Week IX: Screw Jack   **[3]**

Screw Jack

Week X: Tail Stock   **[3]**

Tail Stock

Week XI: Machine Vice   **[3]**

Machine Vice

Week XII: Safety Valve   **[3]**

Safety Valve

TEXT BOOKS:

1. K.L. Narayana, P. Kannaiah, K. Venkata Reddy, "Machine Drawing", New Age Publishers, 3rd edition, 2021.

2. K.C. John, "Text book of Machine Drawing", PHI Eastern Economy, 6th edition, 2020.

3. P.S Gill, "Machine Drawing", S.K Kataria & Sons, 1st edition, 2021.

REFERENCE BOOKS:

1. N. D. Bhatt, V. M Pancahal, "Machine Drawing", Charotar, 53rd edition, 2019.

2. R. K. Dhavan, "A Text book of Machine drawing", S.Chand Publication & Co, New Delhi, 2nd edition, 2008.

ELECTRONIC RESOURCES:

1. https://nptel.ac.in/courses/10234286.

2. https://akanksha.iare.ac.in/index?route=course/details&course_id=03.

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2430575: DATA STRUCTURES LABORATORY USING PYTHON

B.Tech. II – Year. I – Sem   **L   T   P   C**
                                                                 0   0   2   1

Prerequisites: Data Structures
Course Objectives:
The Data Structures Lab using Python aims to:
- To implement fundamental data structures in Python.
- To perform basic operations on linear and non-linear data structures.
- To apply Python programming concepts for efficient data handling.
- To analyze the performance of data structure operations.
- To enhance problem-solving skills using appropriate data structures.

Course Outcomes:
After completing the Data Structures Lab using Python, students will be able to
- Implement various data structures using Python.
- Perform stack, queue, and linked list operations effectively.
- Work with trees, heaps, and graphs for applications.
- Select suitable data structures based on complexity.
- Develop efficient Python programs using optimized structures.

List of Experiments:

1. Write a program that uses functions to perform the following operations on singly linked list.: i) Creation ii) Insertion iii) Deletion iv) Traversal
2. Write a program that uses functions to perform the following operations on doubly linked list.: i) Creation ii) Insertion iii) Deletion
3. Write a program that uses functions to perform the following operations on circular linked list: i) Creation ii) Insertion iii) Deletion
4. Write a program that implement stack operations using i) Arrays ii) Pointers
5. Write a program to implement infix to postfix conversion using stack.
6. Write a program to implement postfix evaluation.
7. Write a program that implement Queue operations using i) Arrays ii) Pointers
8. Write a program to implement the tree traversal methods using both recursive and non recursive.
9. Write a program to implement tree operations on i) AVL Trees ii) B Trees iii) Heap
10. Write a program that implements the following sorting methods to sort a given list of integers in ascending order i) Bubble sort ii) Selection sort iii) Insertion sort
11. Write a program that implements the following sorting methods to sort a given list of integers in ascending order i) Merge sort ii) Quick sort iii) Heap Sort
12. Write a program that use both recursive and non-recursive functions to perform the following searching operations for a Key value in a given list of integers: i) Linear search ii) Binary search
13. Write a program to implement hashing.

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2430395: Automotive Design Course – I

B.Tech. II – Year. I – Sem   **L T P C**

                                                                        0 0 2 1

Prerequisites: Auto cad

Course Objectives:

The students will try to learn:

- The fundamentals of parametric and feature-based modelling using CATIA.

- The creating and editing 2D sketches using geometric constraints and sketch tools.

- The designing 2D components through material addition and removal operations.

- The creating and managing 3D part models using advanced commands.

- The drafting and detailing techniques including dimensioning, tolerancing, and annotations using GD&T standards.

Course Outcomes:

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

CO1	Identify the key features, interface elements, and user operations in CATIA used for parametric modelling.
CO2	Construct detailed 2D drawings with proper dimensions and tolerances.
CO3	Apply material addition and removal operations to model mechanical components.
CO4	Develop part models using draw and modify commands by applying appropriate constraints.
CO5	Generate complete drafting documentation including balloon annotations, and standard symbols.

MODULE 1:   **(5)**

Introduction: Concept of Parametric Modelling, Feature Based Modelling, User Interface, Mouse operations, File types and Management, drawing profiles. Major user industries of Catia.

MODULE 2:   **(5)**

Sketcher: Profile toolbar, operation (corner, chamfer, relimitations, transformations, project 3D element), constraints, types of constraints, workbench. sketch tools, tools (Sketch solving status,

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sketch analysis, output feature), visualization toolbar, user selection filter.

MODULE 3:   **(5)**

Modelling: Modelling of Machined component, Material Addition and Removal (Pad, Pocket, Shaft, Groove), Sketch and Positioned Sketch, Types of Fillets, Types of Chamfers, Types of Holes. Pattern (Rectangular, Circular, User), Thread/Tap, Datum Features (Plane, Axes, Points) Simple Draft. Frequently used commands for Machined components in Catia. Types of draft, Shell, Stiffener, rib slot, Multi section solid, removed multi section solid, Apply Material, Measure, Render

MODULE 4:   **(5)**

Part Modelling: Assigning Properties To The Product, Tools Used For Creating Product Structure, Creating Volume In Linear Direction, Creating A Cavity In Volume In Linear Direction, Limitations Of Pad And Pocket Command, Restrictions For Pad/Pocket Profile Sketches, Creating A New Volume Using Two Different Sketches (Solid Combine), Volume Creation Using Multiple Sketches With Multiple Options, Creating Cavity Using Multiple Sketches

MODULE 5:   **(5)**

Introduction To Drafting & Detailing Theory: - (types Generative – Interactive), Initial Drafting setting, Sheet Background, Views (ortho, ISO), Dimensions (Types-Generate Dimension & Create Dimension).

TEXTBOOKS:

1. CATIA V5, Sham Tickoo, 13th edition, CAD Soft Technologies.

ELECTRONIC RESOURCES:

1. https://www.3ds.com/support/documentation

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243IKS2: Fundamentals and Applications of Vedic Mathematics

B.Tech. II – Year. I – Sem   **L T P C**

                                                                 0 0 2 1

Course Objectives:

By the end of this course, students will be able to:

- Understand the origin, structure, and purpose of the Sutras and Upsutras in Vedic Mathematics.
- Compare Urdhva Tiryak multiplication with conventional methods for evaluation and simplicity.
- Solve square root problems using the Dwandwa Yoga method.
- Formulate linear equations in two variables.
- Recognize contributions of modern Indian mathematicians like Srinivasa Ramanujan, especially in trigonometric functions.

Course Outcomes

- **CO1**: Interpret the Sutras and Upsutras of Vedic Mathematics
- **CO2**: Apply the Urdhva Tiryak Sutra for Vertical and Crosswise Multiplication
- **CO3**: Illustrate square roots using the Dwandwa Yoga method
- **CO4**: Develop Logical Thinking and Algebraic Reasoning
- **CO5**: Understand the Contributions of Ancient and Modern Indian Mathematicians on Trigonometry

Unit I: High Speed Addition and Subtraction   (5 Hours)

History of Vedic Mathematics and its features, including the foundational formulae known as Sutras and Upsutras. It introduces addition techniques in Vedic Mathematics that avoid carrying, such as the Dot Method, and subtraction methods like Nikhilam Navatashcaramam Dashatah

Unit II: Miracle Multiplication and Excellent Division   (5 Hours)

Multiplication in Vedic Maths: Base Method (any two numbers up to three digits), Multiplication by Urdhva Tiryak Sutra, Miracle Multiplication: Three-digit number using a series of 1's and 9's, and Division by Urdhva Tiryak Sutra (Vinculum method)

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Unit III Vedic Maths - lightening squares and rapid cubes   (6Hours)

Squares of any two-digit numbers: Base method, Square of numbers ending in 5: Ekadhikena Purvena Sutra, Easy square roots: Dwandwa Yoga (duplex) Sutra, Square root of 2: Baudhayana Shulbasutra, Cubing: Yavadunam Sutra

Unit IV: Easy Solution of Linear Equations   (4 Hours)

Introduction of simple equation, Solutions of simple equations, Solutions of linear equations in two variables, Practical application of linear equations in two variables

Unit V: Contribution of Indian Mathematicians - Trigonometry and its applications (8 Hours)

Varahmihir, Brahmagupta, Srinivasa Ramanujan, Neelkanth Somayya, Bharti Krishna, Tirtha, Baudhayana, Apastamba, Aryabhata, Bhaskara and Lilavati Introduction of Trigonometric ratios Application of Trigonometry-Height and Distance Inverse Trigonometric Function

References:

1.   Vedic Mathematics, Motilal Banarsji Das, New Delhi.
2.   Vedic Ganita: Vihangama Drishti-1, Siksha Sanskriti Uthana Nyasa, New Delhi.
3.   Vedic Ganita Praneta, Siksha Sanskriti Uthana Nyasa, New Delhi.
4.   Vedic Mathematics: Past, Present and Future, Siksha Sanskriti Uthana Nyasa, New Delhi.

Useful Video links:

1.   https://www.youtube.com/results?search_query=vedic+mathematics+multiplication
2.   https://www.youtube.com/watch?v=yic5xmqPonMhttps://www.youtube.com/watch?v=yic5xmqPonM
3.   https://www.youtube.com/watch?v=yic5xmqPonM&list=PLrpYUF9DFVUNoBTtT5QnJkK3pqCL_7i&index=2
4.   https://www.youtube.com/watch?v=LiLGBMX6dBA
5.   https://www.youtube.com/watch?v=hkmAkhCLfEQ

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II - II

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2430202 - BASIC ELECTRICAL AND ELECTRONICS ENGINEERING
(Common for Civil & Mechanical)

B.TECH II YEAR II SEM	**L**	**T**	**P**
C			
	2	0	0	2

COURSE OVERVIEW:

Basic Electrical and Electronics Engineering serves as a fundamental cornerstone across various engineering disciplines. Civil engineers benefit from understanding basic electrical principles to grasp the intricate electrical systems present within buildings. This knowledge encompasses wiring layouts, lighting setups, power distribution mechanisms, and safety protocols, enhancing their ability to design and manage infrastructural projects effectively. Moreover, collaboration between mechanical and electrical engineers is pivotal in addressing common challenges and innovating new products, technologies, or structures. This synergy harnesses the expertise of both fields to develop comprehensive solutions that often transcend the boundaries of individual disciplines.

Prerequisite: NIL

COURSE OBJECTIVE: The students will be able

- To understand the concepts of electrical circuits and its fundamental elements.
- To study and understand the different types of DC machines and Transformers.
- To import the knowledge of electrical installations and methods for power factor improvement.
- To introduce the concepts of basic semiconductor devices and their characteristics.
- To understand the digital circuits to perform Boolean operations.

COURSE OUTCOMES: After successful completion of the course, students should be able

- To analyze and solve electrical circuits using network laws.
- To design, analyze, and optimize electrical systems for a wide range of applications
- To introduce components of Low Voltage Electrical Installations.
- To identify and characterize diodes and various types of transistors.
- To design and analyze electronic circuits.

MODULE-I: ELECTRICAL CIRCUITS   [L=10]

DC Circuits: Basic Circuit elements, Classification, Ohm's Law, KVL & KCL, Series, Parallel, Star-Delta Connections, Mesh and Nodal Analysis (Simple Problems).

AC Circuits: Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor, Analysis of single-phase ac circuits. Three-phase balanced circuits, voltage and current relations in star and delta connections.

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MODULE -II: ELECTRICAL MACHINES   12L

Transformers: Working principle of Single-phase transformer, equivalent circuit, losses in transformers, efficiency.

Dc Machines: Construction and working principle of DC generators, EMF equation, Working Principle of DC motor, Torque Equation, Speed Control methods of DC Motors.

MODULE –III: ELECTRICAL INSTALLATIONS   8L

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing.

Batteries: Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.

MODULE –IV: DIODES & TRANSISTORS   10L

Diodes: Classification of solids based on energy band theory- Instrinsic Semi Conductors- Extrinsic Semiconductors- P-type and N-type- PN junction- Zener effect- Zener diode characteristics- Half wave and full wave rectifiers.

Bipolar Junction Transistor (BJT): CB, CE, CC configuration and characteristics- Biasing circuits – Class A, B and C amplifiers.

MODULE –V: DIGITAL LOGIC DESIGN   10L

Binary number system, Boolean algebra, Logic Gates**:** AND, OR, NOT, NAND, NOR, Exclusive OR and NOR gates, Flip flops, half and full adders, Registers, Counters, A/D and D/A conversion.

Text Books:
1. "Basic Electrical and electronics Engineering" –M S Sukija, TK Nagasarkar Oxford University 2005.
2. "Basic Electrical and electronics Engineering" - D P Kothari, I J Nagarath, McGraw Hill Education, 3rd edition, 2010.
3. "Modern Digital Electronics" - R. P. Jain, Tata McGraw-Hill, 3rd Edition, 2007.

Reference Books:
1. "Circuit Theory: Analysis and Synthesis" – A.Chakrabarti, Dhanpath Rai & Co., 7th Edition, 2018.
2. "Electrical Machines (Vol. 1)" - J.B. Gupta, S K Kataria and Sons, 2012.
3. "Electronic Devices and Circuits" – R. L. Boylestad and Louis Nashelsky, PEI/PHI, 9th Ed, 2006.
4. "Millman's Electronic Devices and Circuits" – J. Millman and C. C. Halkias, SatyabrataJit, TMH, 2/e,1998.
5. "Fundamentals of Electrical Engineering and Electronics" - BL Theraja, S. Chand Publishing, 2006.
6. "Electrical and Electronics Technology" - E. Hughes, Pearson, 2010.

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(AUTONOMOUS)

2440325: MANUFACTURING PROCESS

II B TECH II SEMESTER

II Year II Semester   **L   T   P   C**

                                                                         3   0   0   3

Course Overview:

The Manufacturing Processes course offers a comprehensive introduction to the various techniques and methodologies used in converting raw materials into finished products. This course covers essential manufacturing processes including casting, forming, machining, welding, and extrusion. Students will engage in both theoretical learning and practical applications through lectures, laboratory sessions, and project work. The course is designed to develop a foundational understanding and skill set necessary for analyzing and optimizing manufacturing processes to enhance quality and efficiency in production.

Prerequisite: Engineering Workshop, Engineering Drawing and Engineering Materials

Course Objective: The students will be able

- Understand the fundamental principles and practices of a wide range of manufacturing processes.
- Identify and select suitable manufacturing processes for different materials and product designs.
- Analyze the advantages, limitations, and applications of various manufacturing techniques.
- Exposed to fundamentals of casting and will be provided with an insight into sand casting process.
- Understand the fundamentals of welding and advanced welding process along with their application.
- Understand various sheet metal forming process, extrusion and forging.

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

- Demonstrate a comprehensive understanding of different casting processes and their applications.
- Analyze and select appropriate welding methods for specific engineering problems.
- Understand the principles and process of Forging, Rolling, Extrusion, machining and their applications in real time.
- Explain the working principle of hot and cold extrusion processes and their application in industries formaking of pipes and tubes.
- Categorize various defects and shortcomings during and after various forging operations.

Module-I:Introduction to manufacturing and casting: [9]

Overview of Manufacturing process, Classification of Manufacturing Process, Materials and their properties.

Casting: Fundamentals of casting,Sand casting: Types of sand, Sand Properties, Sand casting tools, Gating procedure, Steps involved in sand Casting, Die Casting and Investment Casting. Pattern: Materials, Types and allowances. Casting Defects Melting: Crucible and cupola.

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Module-II:Welding   [9]

Welding: Principle, Joint types and Classification of welding processes.

Welding Type, process, advantages and Limitations: Gas welding: Different types of flames, Arc Welding, Sub merged arc welding, Inert Gas welding- TIG & MIG welding,Spot Welding, Soldering & Brazing,Welding defects – causes and remedies

Advanced Welding techniques: Electron beam, Laser welding and hyperbaric welding(under water)

Module -III:Sheet Metal Forming   [9]

Introduction to Sheet Metal Forming

Overview of sheet metal forming processes: Applications of sheet metal parts in various industries, Material properties relevant to sheet metal forming Sheet Metal Forming Process: Bending, Deep Drawing, Stretch Forming, Shearing, Spinning, Rolling, Stamping and Coining.

Tooling and Equipment: Types of presses and their selection criteria, Die design for sheet metal forming and Tool materials.

Module -IV: Extrusion and Processing of Plastics[9]

Fundamentals of Extrusion: Overview, Principle, Materials, Equipment and tooling, and Applications in various industries.

Types of Extrusion: Direct extrusion, Indirect, Hydrostatic and Impact extrusion- Principle, Process description, Advantages and limitations

Processing of Plastics: Types of Plastics, Properties, Applications and their processing methods, Blow and Injection molding.

Module –V: Unconventional Machining Process   [9]

Introduction to Unconventional Machining; Definition and importance of unconventional machining processes, Comparison with conventional machining, Classification of Unconventional Machining Processes, Applications in modern manufacturing industries

Mechanical Unconventional Machining: Ultrasonic Machining (USM) - Principles and working mechanism, Equipment and tool design, Applications and advantages, Abrasive Jet Machining (AJM)- Process parameters and control, Applications and limitations, Water Jet and Abrasive Water Jet Machining (WJM/AWJM) : Operating principles, Nozzle design and material considerations, Industrial applications

Text Books:
1. Manufacturing Technology /P.N.RaoVol.1&2/Mc Graw Hill/3rdEdition.
2. Manufacturing Engineering & Technology / Serope Kalpakjian / Steven R. Schmid /Pearson/5thEdition.

Reference Books:
1. Production Technology/P.C Sharma/S. Chand/3rd Edition.
2. AmitabhGhosh&Mallick,"ManufacturingScience",Assoc.EastwestPressPvt.Ltd/4thEditn.
3. Workshop Technology (vol.1)/Hajra Chowdary/Asia Publishing House/5thEdition.

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2440326: THEORY OF MACHINES

II Year II Semester

	L	T	P	C
	3	0	0	3

Course Overview:

This course delves into the kinematics and dynamics of mechanical systems. It covers the analysis and design of mechanisms like four-bar linkages, gears, and gear trains, incorporating principles such as Grubler's criterion and Grashoff's law. The curriculum includes gyroscopic effects, force analysis, governors, brakes, dynamometers, and balancing of mechanical systems. Additionally, it explores vibrations, including natural, damped, and forced vibrations, and their implications on mechanical stability and performance. Practical applications in engineering are emphasized throughout.

Prerequisite: Engineering mechanics

Course Objective: The students will be able

- Applying the basic components of mechanisms, analyzing the assembly with respect to the displacement, velocity, and acceleration at any point in a link of a mechanism.
- Applying the basic concepts of toothed gearing and kinematics of gear trains
- Analyzing the force-motion relationship in components subjected to external forces and analyzing of standard mechanisms.
- To Impart the knowledge of Various Governors, Brakes and operation of Dynamometers.
- Analyzing the undesirable effects of unbalances resulting from prescribed motions in mechanism and the effect of dynamics of undesirable vibrations.

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

- Apply the basic components of mechanisms, analyze the assembly with respect to the displacement, velocity, and acceleration at any point in a link of a mechanism.
- Apply the basic concepts of toothed gearing and kinematics of gear trains.
- Analyze the force-motion relationship in components subjected to external forces and analyze of standard mechanisms.
- Illustrate various Governors, Brakes and operation of Dynamometers.
- Analyze the undesirable effects of unbalances resulting from prescribed motions in mechanism and the effect of dynamics of undesirable vibrations.

Module-I:Kinematics of Mechanisms   [9]

Mechanisms: Terminology and definitions, Grubler's criterion, Grashoffs law, kinematics inversions of 4 bar, slider crank chain, double slider crank. kinematics analysis in simple mechanisms, velocity and acceleration (graphical method), Mechanical Advantage. Coriolis component of acceleration. Davis Steering gear, Ackerman's steering gear.Classification of Cam and follower.

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Module-II:Gears and Gear Trains   [9]

Friction wheels and toothed gears, types, law of gearing, condition for constant velocity ratio for transmission of motion, velocity of sliding Forms of teeth, Methods of interference. Condition for minimum number of teeth to avoid interference, expressions for arc of contact and path of contact.

Gear Trains: Simple, compound, reverted and planetary gear trains; sun and planet gear train (Tabular method only).

Module -III:Gyroscopes and Force Analysis: [9]

Gyroscopes:Introduction,Precision,angular motion, Gyroscopic couple,effect of gyroscopic couple on an aeroplane,effect of gyroscopic couple on a naval ship during steering, stability of a four-wheeland two-wheel vehicle taking a turn.

Static Force Analysis: Introduction, Static Equilibrium, Equilibrium of Two force and three force members, Memberwith Two force

Dynamic Force Analysis: Introduction, D'Alemberts principle,Dynamic analysis of Four bar and Single slidermechanisms.

Module -IV: Governors, Brakes and Dynamometers   [9]

Governors: Introduction, types of governors, Watt governor, Porter governor, Proell governor, Hartnell governor, Sensitiveness of governor.

Brakes and Dynamometers: Types of brakes - Simple block brake,band and block brake,internal expanding shoe brakeeffectof braking of a vehicle. Dynamometers-absorption and transmission types. General description and methods ofoperation.

Module –V:Balancing and Vibration   [9]

Static and Dynamic balancing: Balancing of revolving and reciprocating masses, Balancing Machines, free vibrations, Equations of motion, natural Frequency, Damped Vibration, bending critical speed of simple shaft, Torsional vibration, Forced vibration, harmonic Forcing, Vibration isolation.

TEXT BOOKS:
1. Uicker, J.J., Pennock G.R and Shigley, J.E., "Theory of Machines and Mechanisms", Oxford University Press, 2017.
2. Ramamurthi. V, "Mechanics of Machines", Narosa Publishing House, 2002.

REFERENCES:
1. Rattan, S.S, "Theory of Machines", McGraw-Hill Education Pvt. Ltd., 2014.
2. Robert L. Norton, Kinematics and Dynamics of Machinery, Tata McGraw-Hill, 2009.
3. Wilson and Sadler, Kinematics and Dynamics of Machinery, Pearson, 2008.

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2440327: Thermal Engineering - I

II Year II Sem   **L   T   P   C**
                                                                         3   0   0   3

Course Overview:

This course covers the basics of engines and real cycles. It provides a detailed discussion of fuel injection systems and examines SI (spark ignition) and CI (compression ignition) engines along with their combustion mechanisms. The curriculum also includes topics such as engine cooling, lubrication, and performance, as well as advanced IC (internal combustion) engines and their systems components. Additionally, we explore compressors and alternative fuels. Towards the end of the course, we study hybrid electric trains.

Prerequisite: Basic knowledge in Thermodynamics

Course Objective: The students will try to learn

1. Explain the Components of IC Engines and systems.
2. Analyze the stages of combustion to improve the performance of IC engines with respect to fuel economy and control of emissions in global, environmental and social context.
3. Understand and evaluate the performance analysis of the major components and systems of IC engines and their applications
4. Explore to the components and working principles of rotary, reciprocating, dynamic and axial compressors
5. Understand the significance of alternate fuels and hybrid vehicles.

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

1. Elaborate the working principles of IC Engine systems and its classification.
2. Explore the combustion stages of SI and CI engines, and factors influence for better combustion.
3. Evaluate the testing and performance parameters of IC engines.
4. Explain the function and working principles of rotary, reciprocating, dynamic axial compressors.
5. Will be analyze the concept of alternate fuels hybrid vehicles

Module-I: IC ENGINES   **[10]**

Classification, Working principles of Four & Two stroke engine, SI & CI engines, Valve and Port Timing Diagrams, Air, Standard, air-fuel and actual cycles, Engine systems, Carburetor and Fuel Injection Systems for SI engines, Fuel injection systems for CI engines, Ignition, Cooling and Lubrication system, Fuel properties and Combustion Stoichiometry.

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Module-II :Combustion in SI & CI Engines   **[12]**

Normal Combustion and abnormal combustion in SI engines, Importance of flame speed and effect of engine variables, Abnormal combustion, pre-ignition and knocking in SI Engines, Fuel requirements and fuel rating, anti-knock additives, combustion chamber, requirements, types of SI engines. Four stages of combustion in CI engines, Delay period and its importance, Effect of engine variables, Diesel Knock,need for air movement, suction, compression and combustion induced turbulence in Diesel engine, open and divided combustion chambers and fuel injection, Diesel fuel requirements and fuel rating.

Module-III :Testing and Performance of engines and reciprocating compressors   **[12]**

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 Classification of compressors – Fans, blowers and compressors, positive displacement and dynamic types, reciprocating and rotary types.

Reciprocating Compressors: Principle of operation, work required, Isothermal efficiency volumetric efficiency and effect of clearance volume, staged compression, under cooling, saving of work, minimum work condition for staged compression

Module-IV: Rotary Compressor   **[10]**

Rotary Compressor (Positive displacement type): Roots Blower, vane sealed compressor, mechanical details and principle of working – efficiency considerations.

Dynamic Compressors: 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 calaculation.

Axial Flow Compressors: Mechanical details and principle of operation, velocity triangles and energy transfer per stage degree of reaction, work done factor, isentropic efficiency- pressure rise calculations, Polytropic efficiency.

Module –V :Alternative fuels and Hybrid vehicles   **[10]**

Need for alternate fuel: Availability and properties of alternate fuels, LPG, hydrogen, ammonia, CNG and LNG, vegetable oils and biogas, merits and demerits of various alternate fuels,

Electric, Hybrid, Fuel Cell And Solar Cars : Concept of hybrid electric drive train, types, architecture of series and parallel hybrid electric drive train, merits and demerits, high energy and power density batteries, fuel cell vehicles, solar powered vehicles – Working operations

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Text Books:

1. I.C. Engines, V. Ganesan, 4th Edition, Mc Graw Hill, 2012.
2. Thermal Engineering, Mahesh M Rathore, 2nd Edition Tata Mc Graw Hill, 2010.

Reference Books:

1. Applied Thermodynamics for Engineering Technologists, Eastop& McConkey, Pearson 5th edition
2. Fundamentals of Classical Thermodynamics, Vanwylen G.J., Sonntag R.E., Wiley Eastern. 6th edition
3. Internal Combustion Engines Fundamentals, John B. Heywood, McGraw Hill Ed. 9thedition

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2440328: MECHANICS of FLUIDS and HYDRAULIC MACHINERY

II – Year. B. Tech II – Sem

L	T	P	C
3	1	0	4

Course Overview:

Fluid mechanics is a scientific field encompassing the study of fluids (liquids or gases) at rest and in motion. It addresses static, kinematic, and dynamic aspects of fluids. A thorough grasp of fluid mechanics is essential across engineering disciplines. This course focuses on exploring energy transfer in turbo machinery using principles from fluid mechanics and thermodynamics, and examining how different types of fluids behave during operation.

Course Objectives: The students will be able

1. To understand the basic principles of fluid mechanics
2. To identify various types of flows.
3. To understand boundary layer concepts and flow through pipes
4. To evaluate the performance of hydraulic turbines
5. To understand the functioning and characteristic curves of pumps

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

1. Able to explain the effect of fluid properties on a flow system.
2. Able to identify type of fluid flow patterns and describe continuity equation.
3. To analyze a variety of practical fluid flow and measuring devices, utilize Fluid Mechanics principles in design and demonstrate boundary layer concepts.
4. To select and analyze an appropriate turbine with reference to given situation in power plants.
5. To estimate performance parameters of a given Centrifugal and Reciprocating pump.

Module – I: Fluid statics: [10]

Fluid statics: Dimensions and units: physical properties of fluids- specific gravity, viscosity, and surface tension - vapor pressure and their influence on fluid motion- atmospheric, gauge and vacuum pressures – measurement of pressure- Piezometer, U-tube and differential manometers.

Module – II: Fluid kinematics, Fluid dynamics and Measurement of flow   [07]

Fluid kinematics: Stream line, path line and streak lines and stream tube, classification of flows steady & unsteady, uniform & non-uniform, laminar & turbulent, rotational & ir-rotational flows, equation of continuity for one dimensional flow and three-dimensional flows.

Fluid dynamics: Surface and body forces – Euler's and Bernoulli's equations for flow along a stream line.

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Measurement of flow: Pitot tube, venture meter, and orifice meter, Flow nozzle. Momentum equation and its application on force on pipe bend.

Module – III: Closed conduit flow, Boundary Layer Concepts: [12]

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.

Boundary Layer Concepts: Definition, thicknesses, characteristics along thin plate, laminar and turbulent boundary layers (No derivation) boundary layer in transition, separation of boundary layer, submerged objects – drag and lift.

Module – IV: Basics of turbo machinery, Hydraulic Turbines and Performance   [14]

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.

Hydraulic Turbines: Classification of turbines, Heads and efficiencies, 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, Module and specific quantities, characteristic curves, governing of turbines, selection of type of turbine, cavitation, surge tank, water hammer.

Module – V: Centrifugal and Reciprocating pumps: [06]

Centrifugal pumps: Classification, working, work done – barometric head- losses and efficiencies specific speed- performance characteristic curves, NPSH.

Reciprocating pumps: Working, Discharge, slip, indicator diagrams.

TEXT BOOKS:

1. Hydraulics, Fluid mechanics and Hydraulic Machinery - MODI and SETH, 21st Edition, standard Book House.
2. Fluid Mechanics and Hydraulic Machines by Er. R. K. Rajput, S. Chand,2019.

REFERENCE BOOKS:

1. Fluid Mechanics and Fluid Power Engineering by D.S. Kumar, S.K. Kataria & Sons,2018
2. Fluid Mechanics and Machinery by D. Rama Durgaiah, New Age International publishers.
3. Hydraulic Machines by T.R.Banga & S.C. Sharma, 7th Edition, Khanna Publishers

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(AUTONOMOUS)

2440376: Mechanics of Fluids and Hydraulic Machinery Laboratory

II Year II Sem	**L**	**T**	**P**	**C**
	0	**0**	**2**	**1**

Course Overview:

The Mechanics of Fluids and Hydraulic Machinery Laboratory support Mechanical and Electrical Engineering students by reinforcing fundamental principles through practical experiments. It aims to enhance understanding through intuitive demonstrations, introduce experimental techniques, and serve as a hub for teaching and research in fluid mechanics, equipped with comprehensive apparatus for both fundamental and applied studies.

Course Objective: The students will try to learn
- Recognize the various types of fluid flow problems encountered in practice.
- To learn about different measuring devices, working Principles and their performances
- To calculate Cd, Cc, Cv and Coefficient of impact of various hydraulic systems
- To learn about different characteristics of Turbines.
- To understand the importance of various types of flows in pumps and turbines

Course Outcomes: After successful completion of the course, students should be able to
- Understand calibration of flow measuring devices.
- Evaluate the losses in pipe flows.
- Apply the practical aspects of Bernoulli's principle
- Determine the impact of jet on different types of vanes.
- Estimate the efficiencies of various turbines, pumps and draw the characteristic curves.

List of Experiments: (*Any ten of the above experiments are to be covered*_)
1. Calibration of Venturi meter.
2. Calibration of Orifice meter.
3. Determination of friction factor for a given pipe line.
4. Determination of loss of head due to sudden contraction in a pipeline.
5. Verification of Bernoulli's Theorems.
6. Impact of jets on Vanes.
7. Performance Test on Pelt on Wheel.
8. Performance Test on Francis Turbine.
9. Performance Test on Kaplan Turbine.
10. Performance Test on Single Stage Centrifugal Pump.
11. Performance Test on Multi Stage Centrifugal Pump.
12. Performance Test on Reciprocating Pump.

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(AUTONOMOUS)

2440377: Manufacturing Process Laboratory

II Year II Semester   **L T P C**
                                                                     0 0 2 1

Course Overview:

The Manufacturing Process Lab aims to provide hands-on experience with various manufacturing processes covered in the Manufacturing Processes course. The lab sessions are designed to reinforce theoretical knowledge through practical application, enabling students to gain a deeper understanding of manufacturing techniques, tools, and equipment.Prerequisite: Introduction to Mechanical Engineering, Engineering Workshop, Engineering Drawing and Engineering Materials.

Course Objective:

To provide hands-on experience with various manufacturing processes such as casting, forging, machining, welding, and Moulding.

1. To enhance students' understanding of the casting principles by preparation of mould cavity and casting procedures.
2. To develop practical skills in operating Welding equipment and performing various joints.
3. To enable students to select appropriate moulding manufacturing processes and parameters for different plastic materials and product requirements.
4. Design and fabricate a simple product.

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

1. Evaluate and analyze the properties of moulding sand such as, permeability, strength and determine its suitability for various casting processes.
2. Demonstrate the ability to fabricate various types of joints using both gas welding and arc welding techniques, ensuring strong and defect-free welds.
3. Design and create various patterns for casting processes using a wooden lathe machine, adhering to specified dimensions and tolerances.
4. Gain a thorough understanding of various sheet metal operations such as Blanking, piercing, and deep drawing, and apply this knowledge to produce accurate and high-quality sheet metal components.
5. Develop a foundational knowledge of press tools, including their types, applications, and operational principles, to effectively utilize them in manufacturing processes.

Course content:

WEEK 1: Sand Properties Testing

Objective: Prepare green sand using a sand muller and measure its permeability using a permeability meter. Additionally, assess the compatibility of the green sand specimen.

WEEK 2: Testing Sand Strength

Objective: Measure the hardness of green sand specimens using a hardness tester both before and after heating. Determine the shear strength and compression strength of the green sand.

WEEK 3: Preparation of Wooden Pattern

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Objective: Fabricate a wooden pattern of a stepped pulley using a wood-turning lathe machine.

WEEK 4: Making of Mould Cavity

Objective: Create mould cavities using dumbbell and stepped pulley patterns.

WEEK 5: Aluminium Casting

Objective: Melt aluminum and cast it into the prepared mould cavity.

WEEK 6: Preparation of Weld Joints Using Arc Welding

Objective: Join two mild steel (MS) flats using butt and lap joints through the arc welding technique.

WEEK 7: Preparation of Joint Using Spot Welding

Objective: Fabricate a lap joint on galvanized iron (GI) sheets using the spot welding technique.

WEEK 8: Preparation of Joints for Different Materials Using Gas Welding and Brazing

Objective: Create a "T" joint by brazing a copper sheet to a 2mm thick MS sheet in a flat position.

WEEK 9: Preparation of Joints Using TIG and MIG Welding

Objective: Fabricate joints using Tungsten Inert Gas (TIG) and Metal Inert Gas (MIG) welding techniques.

WEEK 10: Use of Progressive Die in Hydraulic Press Operation

Objective: Prepare a blanking component using a fly press, an extruded part using a hydraulic press, and a lever using a power press.

WEEK 11: Injection Molding

Objective: Produce a plastic product using an injection molding machine with high-grade polyethylene material.

WEEK 12: Blow Molding

Objective: Create a plastic product using a blow molding machine with high-grade polyethylene material.

Text Books:

1. Manufacturing Engineering and Technology, SeropeKalpakjian and Steven Schmid, Pearson, 7th Edition, 2016, 978-0133128741.
2. Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, Mikell P. Groover, Wiley, 7th Edition, 2019, ISBN: 978-1119128694.
3. Welding: Principles and Applications, Larry Jeffus, Cengage Learning, 8th Edition, 2016 ISBN: 978-1305494695

Reference Books:

1. Advanced Machining Processes: Nontraditional and Hybrid Machining Processes, Hassan El-Hofy, McGraw-Hill, 1st Edition, 2005, ISBN: 978-0071453349.
2. Handbook of Welding Technology, O.P. Khanna, DhanpatRai Publications, 2013, ISBN: 978-8177000207

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(AUTONOMOUS)

2430272 - BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY
(Common to Civil & Mechanical)

B.TECH II YEAR	**L**	**T**	**P**	**C**
	0	**0**	**2**	**1**

COURSE OVERVIEW:

The course covers a broad range of fundamental concepts in electrical and electronics engineering, which is essential for building a strong foundation in the field. It includes fundamental concepts to know about electrical equipments, panels and operations. By providing a comprehensive understanding of basic principles such as circuit analysis, semiconductor devices, power systems, and electronic components, students can develop the knowledge and skills necessary to tackle more advanced topics and applications in their studies or professional careers.

Pre-requisite: Basic Electrical and Electronics Engineering

COURSE OBJECTIVE: The students will be able to

- ▪ To introduce the concepts of electrical circuits and its components.
- ▪ To understand three phase AC circuits.
- • To examine the performance of Single Phase Transformers (on no-load and on load).
- • To expose the students to the operation of DC Motors.
- • To introduce components such as diodes, BJTs and FETs their switching characteristics.
- • Acquire the knowledge on numerical information in different forms and Boolean Algebra theorems.

COURSE OUTCOMES: After successful completion of the course, students should be able to

- • Analyze and solve electrical circuits using network laws.
- • Understand the concept of three-phase power and the distinction between active (real) power, reactive power, and apparent power.
- • Understand the interrelationship between electric and magnetic circuits, such as in the case of electromagnetic induction and mutual inductance.
- • Analyze the relationships between voltages, current, magnetic flux, and mechanical torque in electrical machines, and their speed-torque characteristics.
- • Exploring the current-voltage (I-V) characteristics of a PN junction diode, understanding the operation and circuit configuration of full-wave rectifiers.
- • Analyze the Boolean functions using various Logic Gates.

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List of experiments / demonstrations:

PART A: ELECTRICAL

1. Verification of KVL and KCL.
2. Determination of Impedance in Series RL, RC and RLC Circuits.
3. Measurement of Active and Reactive Power in a balanced Three-phase circuit.
4. Measurement of Voltage, Current and Real Power in primary and Secondary Circuits of a Single-Phase Transformer.
5. Load Test on Single Phase Transformer (Determination of Characteristics).
6. Performance Characteristics of a Separately Excited DC Shunt Motor.

PART B: ELECTRONICS

1. Study and operation of (i) Multi-meters (ii) Function Generator (iii) Regulated Power Supplies (iv) CRO.
2. PN Junction diode characteristics.
3. Zener diode characteristics and Zener as voltage Regulator.
4. Input & Output characteristics of Transistor in CB / CE configuration.
5. Full Wave Rectifier with & without filters.
6. Realization of Boolean expressions using Logic Gates.

REFERENCE BOOKS:

1. "Circuit Theory: Analysis and Synthesis" – A.Chakrabarti, Dhanpath Rai & Co., 7th Edition, 2018.
2. "Electrical Machines (Vol. 1)" - J.B. Gupta, S K Kataria and Sons, 2012.
3. "Electronic Devices and Circuits" – R. L. Boylestad and Louis Nashelsky, PEI/PHI, 9th Ed, 2006.
4. "Millman's Electronic Devices and Circuits" – J. Millman and C. C. Halkias, SatyabrataJit, TMH, 2/e,1998.
5. "Fundamentals of Electrical Engineering and Electronics" - BL Theraja, S. Chand Publishing, 2006.
6. "Electrical and Electronics Technology" - E. Hughes, Pearson, 2010.

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(AUTONOMOUS)

2440396: SDC – Automotive Design Course - II

II Year II Semester

	L	T	P	C
	0	0	2	1

Course Objectives:

The students will try to learn:

- The fundamentals of parametric and feature-based modelling using CATIA.

- The creating and editing 2D sketches using geometric constraints and sketch tools.

- The designing 2D components through material addition and removal operations.

- The creating and managing 3D part models using advanced commands.

- The drafting and detailing techniques including dimensioning, tolerancing, and annotations using GD&T standards.

Course Outcomes:

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

- Identify the key features, interface elements, and user operations in CATIA used for Advanced part modelling.

- Construct detailed 3D drawings with proper dimensions and tolerances.

- Apply material addition and removal operations to model industrial components.

- Develop assembly models using top and bottom approach by applying appropriate constraints.

- Generate complete drafting documentation including balloon annotations, and standard symbols.

MODULE -I: (5)

Advance Design features: - Axis System, Types of draft, Shell, Stiffener, rib slot, Multi section solid, removed multi section solid, Apply Material, Measure, Render.

MODULE- II: (5)

Introduction To Multibody concept: - Copy Paste, paste special, insert body, Boolean Operations (Add, remove, Intersect), Transformation (Translation, Mirror, Scaling, Affinity).

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MODULE III: (5)

Multibody concept: - Standard example, Negative body concept (Boolean Operations) Advance Features: Parameters, Formula, Relations, Design Table.

MODULE IV: (8)

Introduction to Assembly: - Types of assembly approach, Types of Constrains and DOF, placement of components in the Assembly, Manipulating Components, BOTTOM-UP Approach TOP-DOWN Approach: Part, Product, Component, Space Analysis, Reuse Pattern, Save management.

MODULE V: (5)

Assembly Drafting: - Scene (Exploded View), Bill of material, Ballon creation, Graph Tree Reordering. Annotations: GD & T, Symbols, Note, Leaders, Table, Symbols (Machining, Roughness, Welding, Custom), Dress-up Toolbar. Views:(Aux, Section, Details, Clipping, Broken), View properties, DATUMS & Tolerance

TEXTBOOKS:

1. CATIA V5, Sham Tickoo, 13th edition, CAD Soft Technologies.

ELECTRONIC RESOURCES:

1.   https://www.3ds.com/support/documentation

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2440021: ENVIRONMENTAL SCIENCE

II Year II Semester

	L	T	P	C
	3	0	0	0

Course Objectives:
• Understanding the importance of ecological balance for sustainable development.
• Understanding the impacts of developmental activities and mitigation measures.
• Understanding the environmental policies and regulations
• Understanding the importance of natural resources
• Understanding the different standards of environmental pollution

Course Outcomes: Based on this course, the Engineering graduate will
• Understand the technologies on the basis of ecological principles
• Apply the environmental regulations which in turn helps in sustainable development.
• Understand the various classifications of ecosystems and natural resources.
• Apply environmental regulations to different acts.
• Evaluate the values of social, ethical and aesthetic.

UNIT-I
Ecosystems: Definition, Scope, and Importance of ecosystem. Classification, structure, and function of an ecosystem, Food chains, food webs, and ecological pyramids. Flow of energy, Biogeochemical cycles, Bioaccumulation, Biomagnification, Field visits.

UNIT-II
Natural Resources: Classification of Resources: Living and Non-Living resources, water resources: use and over utilization of surface and ground water, floods and droughts, Dams:benefits and problems. Mineral resources: use and exploitation, environmental effects of extracting and using mineral resources, Land resources: Forest resources, Energy resources: growing energy needs, renewable and non renewable energy sources, use of alternate energy source, case studies.

UNIT-III
Biodiversity And Biotic Resources: Introduction, Definition, genetic, species and ecosystem diversity. Value of biodiversity; consumptive use, productive use, social, ethical, aesthetic and optional values. India as a mega diversity nation, Hot spots of biodiversity. Field visit. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts; conservation of biodiversity: In-Situ and Ex-situ conservation. National Biodiversity act.

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UNIT-IV

EnvironmentalPollution and Control Technologies: EnvironmentalPollution: Classification of pollution, Air Pollution: Primary and secondary pollutants, Automobile and Industrial pollution, Ambient air quality standards. Water pollution: Sources and types of pollution, drinking water quality standards. Soil Pollution: Sources and types, Impacts of modern agriculture, degradation of soil. Noise Pollution: Sources and Health hazards, standards, Solid waste: Municipal Solid Waste management, composition and characteristics of e-Waste and its management. Pollution control technologies: Wastewater Treatment methods: Primary, secondary and Tertiary. Overview of air pollution control technologies, Concepts of bioremediation. Global Environmental Issues and Global Efforts: Climate change and impacts on human environment. Ozone depletion and Ozone depleting substances (ODS). Deforestation and desertification. International conventions / Protocols: Earth summit, Kyoto protocol, and Montréal Protocol. NAPCC-GoI Initiatives.

UNIT-V

Environmental Policy, Legislation & EIA: Environmental Protection act, Legal aspects Air Act-1981, Water Act, Forest Act, Wild life Act, Municipal solid waste management and handling rules, biomedical waste management and handling rules, hazardous waste management and handling rules. EIA: EIA structure, methods of baseline data acquisition. Overview on Impacts of air, water, biological and Socio-economical aspects. Concepts of Environmental Management Plan (EMP). Towards Sustainable Future: Concept of Sustainable Development Goals, Population and its explosion, Crazy Consumerism, Environmental Education, Urban Sprawl, Human health, Environmental Ethics, Concept of Green Building.

TEXT BOOKS:
1   Textbook of Environmental Studies for Undergraduate Courses by Erach Bharucha for University Grants Commission.
2   Environmental Studies by R. Rajagopalan, Oxford University Press.

REFERENCE BOOKS:
1.   Environmental Science: towards a sustainable future by Richard T. Wright. 2008 PHL Learning Private Ltd. New Delhi.
2.   Environmental Engineering and science by Gilbert M. Masters and Wendell P. Ela. 2008 PHI Learning Pvt. Ltd.
3.   Environmental Studies by Anubha Kaushik, 4th Edition, New age international publishers.

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III - I

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2450329: Design of Machine Elements

III YEAR I SEM   **L   T   P   C**
                                                         3   0   0   3

Course Overview:

The course on Machine Design provides a comprehensive understanding of fundamental concepts and design processes essential in engineering applications. It begins with the design process, emphasizing material selection, loading conditions, and failure theories. Students explore the design of temporary and permanent joints like riveted, welded, cotter, and knuckle joints, with a focus on modeling components. The course covers energy-storing elements, such as springs and flywheels, analyzing their design parameters. Lastly, students learn to design shafts and couplings under various loads, ensuring strength and rigidity. Through this course, students develop practical skills to apply design theories in engineering software.

Prerequisite: Engineering mechanics and Theory of machines.

Course Objective: The students will try to learn

➢ Designing machine members subjected to static and variable loads.

➢ Designing shafts and couplings for various applications.

➢ Analyzing bolted and welded joints for various kinds of loads.

➢ Designing helical and leaf springs for various applications.

➢ Analyzing Riveted and cotter joints for various kinds of loads.

Course Outcomes:

After successful completion of the course, students should be able to

➢ Understand and apply the design process, material selection, and failure theories in mechanical components.

➢ Design and evaluate riveted, welded joints, and power screws under various loading conditions.

➢ Analyze the stresses in keys, cotter, and knuckle joints, applying design principles effectively.

➢ Design springs and flywheels, addressing energy fluctuations and stress analysis in practical mechanical systems.

➢ Design solid and hollow shafts, couplings, and axles, ensuring strength, rigidity, and

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performance under critical loading conditions.

Module-I: Simple and Variable stresses   [12]
Simple stress in machine parts: Introduction to the design process - factors influencing machine design, selection of materials based on mechanical properties - Preferred numbers-Direct, Bending and torsional loading - Factor of safety – Combined loads – Principal stresses – Eccentric loading –theories of failure – **Variable stress in Machine parts:** Design based on strength and stiffness – stress concentration – Fluctuating stresses – Endurance limit- Gerber's curve– Goodman's line– Soderberg's line. –Design for finite and infinite life under variable loading.

Module-II: Temporary joints -I   [09]
Riveted Joints: Riveted joints- methods of failure of riveted joints-strength equations-efficiency of riveted joints-eccentrically loaded riveted joints.
Welded joints-Design of fillet welds-axial loads-circular fillet welds under bending, torsion. Welded joints under eccentric loading.

Module-III: Temporary joints -II   [09]
Keys, Cotters and Knuckle Joints: Design of keys-stresses in keys-cottered joints-spigot and socket, sleeve and cotter, Gib and cotter joints-Knuckle joints.

Module-IV: Energy Storage Elements   [10]
Springs: Types of springs, design of helical and concentric springs–surge in springs, Design of laminated springs.
Flywheel: coefficient of fluctuation of speed – Fluctuation of Energy – Maximum Fluctuation energy - coefficient of Fluctuation energy – energy stored in a flywheel - Flywheels considering stresses in rims and arms.

Module–V:Shafts and Couplings   [09]
Shafts: Shafts and Axles - Design of solid and hollow shafts based on strength, rigidity and critical speed.
Coupling: Rigid coupling- Muff, Clamp and Flange couplings and flexible couplings -Bushed

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Pin.

TEXTBOOKS:

1.   P. Kannaiah, "Machine Design", 2nd Edition, Scitech Publications India Pvt. Ltd, New Delhi, 2012 .
2.   V.B. Bandari, "A Text Book of Design of Machine Elements", 3rd edition, Tata McGraw Hill, 2011

REFERENCE BOOKS:

1.   Richard G. Budynas, J. Keith Nisbett, "Shiegly's Mechanical Engineering Design", 10th Edition, 2014.
2.   R.L. Norton, "Machine Design An Integrated approach", Person Publisher, 2nd Edition, 2006.
3.   U.C. Jindal, "Machine Design", Pearson, 1st Edition, 2010.
4.   R.S. Khurmi, A. K. Gupta,"Machine Design", S. Chand & Co, New Delhi, 1st Edition, 2014.

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2450330: Metrology and Machine Tools

III Year I Sem   **L   T   P   C**
                                                                          3   0   0   3

Course Overview:

This course offers an in-depth exploration of metal cutting and machining processes, covering chip formation, tool geometry, and material selection with analytical tools like Mohr's and Merchant's circles. It examines the principles and operations of key machine tools such as lathes, milling, and shaping machines, along with their attachments. The curriculum also includes advanced machining and finishing methods like grinding, honing, and gear manufacturing. Metrology is addressed through the study of limits, fits, tolerances, gauges, and modern surface and alignment measurement techniques.

Prerequisite: Production Technology

Course Objective: The students will try to learn

➤ The fundamentals of metal cutting processes, tool geometry, chip formation, cutting tool materials, and lathe operations including capstan, turret, and automatic lathes

➤ The working principles, classifications, specifications, and industrial applications of drilling, boring, shaping, slotting, and planning machines.

➤ Milling and abrasive machining techniques, covering machine types, cutter configurations, operations, surface finishing, and gear manufacturing processes.

➤ The concepts of limits, fits, and tolerances, along with precision measurement techniques and gauge design principles.

➤ To comprehend the significance and practical applications of engineering metrology in modern industrial practices

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

➤ Understand the cutting tool geometry, mechanism of chip formation and mechanics of orthogonal cutting (L1)

➤ Identify basic parts and operations of machine tools including shaper, planer, drilling, boring,(L3)

➤ The student will be able to analyze milling, grinding, and gear manufacturing processes to select suitable machines and techniques based on tool geometry, operations, and industrial requirements(L4)

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➢ Apply the concepts of linear and angular measurement using conventional and optical measuring instruments(L3)

➢ Apply methods for surface roughness, screw thread, and gear measurements, and interpret machine tool alignment.(L3)

Module-I: **[10]**

Metal cutting: Introduction, elements of cutting process – Geometry of single point tools. Chip formation and types of chips. Mohr's circle, Merchant circle, cutting tool materials, tool wear, tool life, surface finish, cutting fluids and Mach inability.

Engine lathe – Principle of working, types of lathe, specifications. Taper turning– Lathe attachments. Capstan and Turret lathe – Single spindle and multi-spindle automatic lathes – tool layouts

Module-II: **[09]**

Drilling and Boring Machines – Principles of working, specifications, types, operations performed; twist drill. Types of Boring machines and applications. Shaping, slotting and planning machines - Principles of working.

Module-III: **[11]**

Milling machines – Principles of working – Types of milling machines – Geometry of milling cutters – methods of indexing. Operations on milling machine.

Abrasive Machining and Finishing Operations :Grinding – theory of grinding – classification of grinding machines. Types of abrasives, bonds. Selection of a grinding wheel. Lapping, honing and broaching machines, comparison and Constructional features, - Gear cutting, gear hobbling and gear shaping – gear finishing methods.

Module-IV: **[09]**

Limits, fits and tolerances: Unilateral and bilateral tolerance system, hole and shaft basis system. Interchangeability and selective assembly.

Limit Gauges: Taylor's principle, Design of GO and NO GO gauges

Linear and Angular Measurements slip gauges, dial test indicators, spirit levels, Bevel protractor , sine bar, surface plates, optical flat and auto collimator.

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Module–V::   **[09]**

Surface Roughness Measurement: Roughness, Waviness. CLA, RMS, Rz Values. Methods of measurement of surface finish, Talysurf.

Screw thread measurement: Elements of measurement, errors in screw threads, measurement of thread angle and thread pitch.

Machine Tool Alignment Tests on lathe, milling and drilling machines.

Lasers in metrology - Advantages of lasers – Laser scan micrometers;

Laser interferometers – Applications Straightness, Alignment; Ball bar tests.

Text Books:

1.Production Technology by R.K. Jain and S.C. Gupta /17th Edition

2. Engineering Metrology by I C Gupta., Dan path Rai/5th Edition

Reference Books:

1.Production Technology by H.M.T. (Hindustan Machine Tools)/1st Edition

2. Metrology and measurements by Anand k bewoor, Tata mc grawhill Publishers/1stEdition

3. Production technology by O.P. khanna, Danpath Rai publications/1st Edition

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2450331: THERMAL ENGINEERING-II

III YEAR I SEM   **L T P C**
                                                                  3 0 0 3

Course Overview:

This course introduces the principles, systems, and applications of steam and gas power plants, along with jet propulsion and rocket engines. Students will study the Rankine cycle, methods of improving cycle performance, and the working principles of boilers, steam nozzles, and turbines. The course also covers steam condensers, gas turbine cycles, and combined power plants with emphasis on regeneration, reheating, and intercooling. Advanced topics include jet propulsion systems, turbojet engines, and rocket propulsion with different propellant types. Emphasis is placed on thermodynamic analysis, performance evaluation, energy efficiency, and design aspects relevant to modern power generation and propulsion engineering.

Prerequisite: Thermodynamics

Course Objective: The students will try to learn

1. Understand the working principles and performance improvement methods of steam power plants.
2. Learn the fundamentals of boilers, steam nozzles, steam turbines, and their applications.
3. Analyze thermodynamic cycles related to steam and gas turbines for efficiency enhancement.
4. Develop knowledge of condensers, cooling systems, and auxiliary equipment in power plants.
5. Gain insight into advanced propulsion systems like jet engines and rockets with their thermodynamic principles.

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

1. Analyze the Rankine cycle and suggest methods like regeneration and reheating to improve cycle performance.

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2. Calculate nozzle flow parameters, including critical pressure ratio and velocity at exit, under ideal and actual conditions.

3. Differentiate between impulse and reaction turbines, draw velocity diagrams, and evaluate turbine efficiency.

4. Evaluate the performance of steam condensers and gas turbine cycles with regeneration, intercooling and reheating.

5. Explain the working principles of jet propulsion and rocket engines, and determine thrust, propulsive efficiency, and specific impulse.

Module-I: **[12]**

Steam Power Plant: Rankine cycle - Schematic layout, Thermodynamic Analysis, Concept of Mean Temperature of Heat addition, Methods to improve cycle performance – Regeneration & reheating.

Boilers – Classification – Working principles with sketches including H.P. Boilers – 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..

Module-II: **[09]**

Steam Nozzles: Stagnation Properties- Function of nozzle – Applications and Types- Flow through nozzles- Thermodynamic analysis – Assumptions -Velocity of nozzle at exit-Ideal and actual expansion in 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.

Module-III: **[10]**

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 - its features- Methods to reduce rotor speed-Velocity compounding and Pressure compounding- Velocity and Pressure variation along the flow – Combined velocity diagram for a velocity compounded impulse turbine.

Reaction Turbine: Mechanical details – Principle of operation, Thermodynamic analysis of a

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stage, Degree of reaction –Velocity diagram – Parson's reaction turbine – Condition for maximum efficiency.

Module-IV: **[09]**

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.

Gas Turbines: Simple gas turbine plant – Ideal cycle, essential components – Parameters of performance – Regeneration, Inter cooling and Reheating –Closed and Semi-closed cycles – Merits and Demerits- Combustion chambers and turbines of Gas Turbine Plant- Brief Concepts, combined cycle.

Module–V: **[09]**

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 Thrust Augmentation – Methods.

Rockets: Application – Working Principle – Classification – Propellant Type – Thrust, Propulsive Efficiency – Specific Impulse – Solid and Liquid propellant Rocket Engines.

Text Books:
1.   Thermal Engineering / Mahesh M Rathore/ Tata McGraw Hill /4th Edition
2.   Gas Turbines – V. Ganesan /Tata McGraw Hill /3rd Edition.

Reference Books:
1.   Gas Turbine Theory/ Saravanamuttoo, Cohen, Rogers, Straznicky, Nix / Pearson /3rd Edition
2.   Fundamentals of Engineering Thermodynamics / Rathakrishnan/ PHI/2nd Edition
3.   Thermal Engineering/ R.K. Rajput/ Lakshmi Publications/2nd Edition

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2450301: Elements of Mechanical Engineering
(Open elective - I)

III Year I Sem

	L	T	P	C
	3	0	0	3

Course Overview:

This course is designed to review the fundamentals and practices of Basic Mechanical engineering within the Engineering curriculum. course deals with topics such as Energy resources, basic concepts of thermodynamics, Steam generators, Prime movers, Power plant, Basic concept of ref. And air conditioning. After completing this course, student will have fundamental understanding of the law of thermodynamics, pressure and temperature measurement, thermal machines, source of energy, power transmitting element and Selection of Material.

Prerequisite: Nil

Course Objective: The students will try to learn
➢ Basic machine elements.
➢ Sources of Energy and Power Generation.
➢ Various manufacturing processes.
➢ Power transmission elements, material handling equipment.
➢ The content of this course shall provide the student the basic concepts of various mechanical systems and exposes the student to a wide range of equipment and their utility in a practical situation.
➢ It shall provide the fundamental principles of materials, fuels, Steam, I.C. Engines, and transmission systems that usually exist in any process plant.

Course Outcomes: After successful completion of the course, students should be able to
➢ Understand basics Concepts and usage of various engineering Materials. (L1)
➢ Apply cam terminologies for design of cam profiles. (L3)
➢ Explain the fundamental definitions used in thermodynamics. (L2)
➢ To Gain Knowledge about IC Engines, general principles and requirement for refrigeration,

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manufacturing. (L1)

➤ Apply the knowledge of various manufacturing processes; identify various processes like welding, Brazing and soldering. (L4)

➤ Use the knowledge gained by the study of Metal Removal process, using Lathe Drilling Milling Robotics and Automation. (L5)

Module-I: **[09]**
Introduction to engineering materials: Metals, ceramics, composites-Heat treatment of metals. Riveted joints- methods of failure of riveted joints-strength equations-efficiency of riveted joints - eccentrically loaded riveted joints.

Machine Elements: Cams: Types of cams and followers.

Construction and applications of Couplings (Box; Flange; Pin type flexible; Universal and Oldham), Clutches (Disc and Centrifugal)

LEARNING OUTCOME:
1. Knowledge of physical properties of materials. (L1)
2. Apply cam terminologies for design of cam profiles. (L3)

Module-II: **[10]**
Power Transmission Elements: Gears terminology of spur, helical and bevel gears, gear trains. Belt drives (types). Chain drives. Shaft and axle, Chain drive, Friction drive, Gear drive

Material Handling equipment: Introduction to Belt conveyors, cranes, industrial trucks, bull dozers Thermodynamics: Statements of zeroth law, 1st, 2nd and 3rd Laws of thermodynamics with their applications.

LEARNING OUTCOME:
1. Apply first law of thermodynamics for closed systems and construct conservation of mass and energy equations (L3)

2. Understand the standard geometry, application, failures of Spur and Helical Gear and Design and Developed effectively Gears for different loading conditions. (L4)

Module-III: **[09]**
Energy: Power Generation: External and internal combustion engines (layouts,

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element/component description, advantages, disadvantages, applications).Classification, Engine details, four-stroke/ two-stroke cycle Petrol/Diesel engines, Indicated power, Brake Power, Efficiencies

Refrigeration: Mechanical Refrigeration and types – units of refrigeration – Air Refrigeration system, details and principle of operation –calculation of COP.Vapor compression refrigeration system, vapor absorption refrigeration system, Domestic Refrigerator, Window and split air conditioners, Modes and mechanisms of heat transfer – Basic laws of heat transfer –General discussion about applications of heat transfer.

LEARNING OUTCOME:

1. To acquire knowledge of thermal efficiency and coefficient of performance for heat engine, refrigerators. (L2)

2. Students will demonstrate an understanding of the basic concepts of conduction, radiation, and convection heat transfer. (L3)

Module-IV: **[09]**

Manufacturing Processes: Sheet Metal Work: Introduction – Equipments – Tools and accessories – Various processes (applications, advantages / disadvantages).

Welding: Types – Equipments –Techniques employed –welding positions-defects-applications, advantages / disadvantages – Gas cutting – Brazing and soldering.

LEARNING OUTCOME:

1.   Understand different tools used in sheet metal work process based on industrial applications. (L3).

2.   Apply knowledge to select appropriate welding process based on the type of industrial application. (L3)

Module–V: **[09]**

Casting: Types, equipments, applications.

Machine Tools: Introduction to lathe, drilling machine, milling machine, grinding machine-Operations performed.

Introduction, components of CNC, advantages and applications of CNC, CNC Machining centres and Turning Centers.

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LEARNING OUTCOME:

1.   Analyze the use of casting processes in manufacturing. (L4)

2.   Knowledge gained by the study of Metal Removal process, using Lathe Drilling and Milling. (L5)

Text Books:

1. Kumar, T., Leenus Jesu Martin and Murali, G., Basic Mechanical Engineering, Suma Publications, Chennai /Ist Edition 2007.

2. K.R, Gopalakrishna Sudhir, Gopalakrishna S.C, Sharma, Elements of Mechanical Engineering /9th Edition 2005.

3.Elements of Workshop Technology (Vol. 1 and 2), Hazra Choudhry and Nirzar Roy, Median Promoters and Publishers Pvt. Ltd., 2010.

Reference Books:

1. Prabhu, T. J., Jai Ganesh, V. and Jebaraj, S., Basic Mechanical Engineering, SciTech Publications, Chennai/ 7th Edition 2000.

2. Hajra Choudhary, S.K. and Hajra Choudhary, A. K., Elements of Workshop Technology Vols. I & II, Indian Book Distributing Company Calcutta/ 12th Edition 2007.

3. Nag, P.K., Power Plant Engineering, Tata McGraw-Hill, New Delhi, 2008. 4. Rattan, S.S., Theory of Machines, Tata McGraw-Hill, New Delhi/4th Edition 2010.

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2450302: INTRODUCTION TO ENGINEERING MATERIALS

(Open elective - I)

IIIYEAR I SEM

	L	T	P	C
	3	0	0	3

Course Overview:

This course introduces the classification, properties, processing, and applications of various engineering materials. Students will gain a thorough understanding of ferrous and non-ferrous materials, polymers, ceramics, composites, and advanced materials. The course equips learners with essential knowledge for material selection in engineering design and manufacturing processes.

Prerequisite: None

Course Objective: The students will try to learn

1. Describe the classification of engineering materials and their key mechanical properties.
2. Explain the classifications, structures, and mechanical characteristics of plain carbon steels, alloy steels, stainless steels, and cast irons.
3. Investigate the classifications and properties of non-ferrous metals and their alloying systems.
4. Demonstrate the properties and advanced applications of ceramic materials in various industries.
5. Distinguish the characteristics and performance of composite materials, semiconductors, nano materials, smart materials, and shape memory alloys.

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

1. Summarize the classification of engineering materials and their mechanical properties. (L2 - Understanding)
2. Compare the applications of plain carbon steels, alloy steels, stainless steels, and cast irons.

3. Differentiate the industrial applications of copper, aluminium, nickel, zinc, titanium, and magnesium alloys.

4. Illustrate the properties and applications of advanced ceramics and polymeric materials.

5. Classify composites, nano materials, smart materials, and shape memory alloys based on their structure and function.

Module-I: **[09]**

Classification of Engineering Materials, Mechanical Properties of Metals and their testing equipment / procedures, ASTM standards for testing, Stress–Strain Behaviour of various materials

Module-II: **[11]**

Ferrous Materials

Plain carbon steels – classifications of steels, properties and applications of steels. Alloy steels– effect of alloying elements, functions and uses. High strength low alloy steels. Stainless steels – physical properties, mechanical properties. Cast Irons – White cast iron, grey cast iron, ductile iron, malleable cast iron–properties and applications.

Module-III: **[09]**

Non– Ferrous Materials: Copper and its alloys – properties & applications – brasses, bronzes, copper–nickel alloys. Aluminium and its alloys – properties and applications. Classification of alloys and applications – Nickel, zinc, titanium, magnesium.

Module-IV: **[10]**

Plastics and Polymers: Structure of polymers, classification of polymers, chain formation by addition mechanism, chain formation by condensation mechanism, degree of polymerisation.

Ceramic Materials: Properties & applications of clay, cement & concrete, glasses, refractories. Advanced ceramic materials – alumina, boron carbide, silicon carbide, sialon, zirconia.

Module–V: **[09]**

Advanced materials: Composites: Definitions, Reinforcements and matrices, Types of reinforcements, Types of matrices, Classification of composites, Properties of composites in

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comparisonwithstandardmaterials.Semiconductors,Nanomaterials,smartmaterialsand   shaper memory alloys.

Text Books:

1.   Introduction toPhysicalMetallurgy:Avner,2nded.,TataMcGraw-HillEducation,2010.
2.   MaterialsScienceandMetallurgy:KodgireV.D.25thed.,EverestPublishingHouse,2009

Reference Books:

1. Physical Metallurgy: Raghavan V., 2nd ed., PHI, 2006.
2. Materials Science and Metallurgy: Khanna O. P., 5th ed., Dhanpat Rai and Sons, 2009.

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2450301: Mechatronics
(Professional Elective I)

III   Year I Sem   **L   T   P   C**
                                                             3   0   0   3

Course Overview:

Mechatronics is an interdisciplinary field that integrates mechanical, electrical, computer, and control engineering to design and develop intelligent systems and products. It focuses on the synergy between these disciplines to create sophisticated, automated systems. A Mechatronics course typically covers topics like robotics, automation, control systems, embedded systems, mechanical design, electronics, and computer programming.

Course Objective: The students will try to learn

1. To explain the concept of Mechatronics.

2. Understand & Elements of sensors, transducers & displacement of characteristics.

3. To analyse the PN junction diode, BIT, FET, DIA and TRIAC and its significance.

4. To gain the Knowledge about Hydraulic and Pneumatic acting system in industrial application.

5. Understand the concept of PLC system and significance of PLC control.

6. Detailed study of system and in its facing data.

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

1. Develop a simulation model for simple physical systems and explain mechatronics design process. (L4)

2. Knowledge of working principle of various energy systems Outline appropriate sensors and actuators for an engineering application. (L1)

3. Time and Frequency domain analysis of system model (for control application). (L4)

4. Implement Mechatronic System/Process which is Environment Friendly with appropriate Consideration for Public Health and Safety. (L3)

5. Explain linearization of nonlinear systems and elements of data acquisition. (L2)

6. Development of PLC ladder programming and implementation of real life system. (L5)

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Module-I: **[11]**
Introduction to Mechatronics: Definition of Mechatronics products, Design Considerations and Tradeoffs. Overview of Mechatronics products. Intelligent Machine vs Automatic. Machine, advantages and disadvantages of mechatronics systems, Sensors and transducers, types, displacement, position, proximity, velocity, motion, force, acceleration, torque, fluid pressure, liquid flow, liquid level, temperature and light sensors.

LEARNING OUTCOME:
1. Identification of key elements of mechatronics system and its representation in terms of block diagram. (L2)
2. Develop a simulation model for simple physical systems and explain mechatronics design process. (L5)

Module-II: **[09]**
Solid-State Devices and Analog Signal Processing with MEMS Overview:

Solid state electronic devices, PN junction diode, BJT, FET, DIA and TRIAC. Analog signal conditioning amplifiers, filtering. Introduction to MEMS & typical applications.

LEARNING OUTCOME:
1. Describe the principle and analyze the operation of p-n diodes, BJTs. (L2)
2. Interfacing of Sensors, Actuators using appropriate DAQ micro-controller. (L1)

Module-III: **[10]**
Fundamentals of Fluid and Electromechanical Actuating Systems:
Hydraulic and pneumatic actuating systems, Fluid systems, Hydraulic and pneumatic systems, components, control valves, electro – pneumatic, hydro – pneumatic, electro – hydraulic servo systems: Mechanical actuating systems and electrical actuating systems.

LEARNING OUTCOME:
1. Outline appropriate sensors and actuators for an engineering application. (L3)
2. Development of PLC ladder programming and implementation of real life system. (L4)

Module-IV: **[09]**
Microcontrollers and PLCs in Automation and Process Control:
Digital electronics and systems, digital logic control, micro processors and micro controllers, programming, process controllers, PLCs versus computers, application of PLCs for controllers.

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LEARNING OUTCOME:

1. PLC implementation on real time systems. (L4)

2. Explain various applications of design of mechatronic systems. (L2)

Module–V: **[09]**

Advanced Mechatronics: DAQ Systems, SCADA, and Dynamic System Design:

System and interfacing and data acquisition, DAQS, SCADA, A to D to A conversions; Dynamic models and analogies, System response. Design of mechatronics systems & future trends.

LEARNING OUTCOME:

1. Exhibit Effective Project Management Skills to Conceive and Develop a Project Plan. (L4)

2.   Apply Knowledge of Math, Science, and Mechatronic Engineering disciplines to Solve Real Life Industrial Problems. (L5)

Text Books:

1. MECHATRONICS Integrated Mechanical Electronics Systems/KP Ramachandran & GK Vijaya Raghavan/WILEY India 1st Edition/2008.

2. Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering? W Bolton/ Pearson Education Press/3rd edition, 2005.

Reference Books:

1. Mechatronics Source Book by Newton C Braga, Thomson Publications, Chennai. 3rd edition.

2. Mechatronics N. Shanmugani /Anuradha Agencies Publishers. 1st edition

3. Mechatronics System Design I Devdas shey/Richard Thomson, 2nd edition

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(AUTONOMOUS)**

2450342: NON-DESTRUCTIVE TESTING
(Professional Elective I)

III Year I Sem   **L T P C**
                                                                       3 0 0 3

Course Overview:

Non-Destructive Testing (NDT) introduces students to advanced techniques for assessing material integrity without causing damage. The course covers essential methods such as visual inspection, liquid penetrant testing, magnetic particle testing, thermography, eddy current testing, ultrasonic testing, acoustic emission testing, and radiography. Students will learn the principles, procedures, equipment, advantages, and limitations of each method. Emphasis is placed on the selection of appropriate NDT techniques for various applications, including in-situ evaluations. Through this course, students will develop the skills to identify defects, interpret inspection results, and ensure the quality and safety of engineering components across diverse industries.

Prerequisite: None

Course Objective: The students will try to learn

1. Explain the fundamentals, need, and applications of NDT with a focus on visual inspection techniques and tools.

2. Analyze the principles and procedures of Liquid Penetrant Testing (LPT) and Magnetic Particle Testing (MPT) for defect detection.

3. Examine advanced NDT techniques like Thermography and Eddy Current Testing with emphasis on their working principles and applications.

4. Explore ultrasonic and acoustic emission testing techniques and their application in defect identification and evaluation.

5. Describe radiographic inspection methods including advancements like computed radiography, tomography, and other modern NDT techniques.

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

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1. Compare the differences between the various visual inspection techniques and apply the same to the components to be inspected.
2. Recognise the importance of Penetrant testing in NDT with the understanding of the procedures involved in the Penetration methods
3. Interpret the images and the results obtained from the Thermographic technique and the Eddy current testing
4. Evaluate and interpret the results obtained in the Ultrasonic inspection and Acoustic Emission technique
5. Explain the techniques involved in the Radiographic testing and the various advancements in Radiography.

Module-I: **[09]**

Introduction & Visual Inspection Methods: NDT versus Mechanical testing, Need for NDT, Relative merits and limitations, various physical characteristics of materials andtheir applicationsinNDT.Visual Inspection -Unaided,Aided-Borescopes -Videoscopes, Optical sensors, Microscopes & replication Microscopy Technique and applications.

Module-II: **[11]**

Liquid Penetrant Testing & Magnetic Particle Testing: LPT-Principle,Procedures, Penetrants and their characteristics, Developers- properties and their forms, Advantages and limitations, Inspection and Interpretation, Applications and case study. MPT-Principle, Magnetisation methods, Magnetic particles, Procedure, Interpretation, Relevant and Non-relevant indications, Residual magnetism, Demagnetisation – need, methods, Advantages and Limitations, Applications, Magnetic Rubber Inspection, Magnetic Printing, Magnetic Painting.

Module-III: **[09]**

Thermography & Eddy Current Testing: Thermography – Introduction, Principle, Contact & Non-Contact inspection methods, Active & Passive methods, Liquid Crystal – Concept, example, advantages & limitations. Eddy current Testing – Principle, properties of eddy currents, Eddy current sensing elements, probes, Instrumentation, Advantages & Limitations, Interpretation of Results& applications.

Module-IV: **[09]**

Ultrasonic Testing & Acoustic Emission Testing: Ultrasonic Testing-Principle, Basic

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Equipment, Transducers, couplants, Transmission and Pulse-echo method, Straight beamand anglebeam, A-Scan, B-Scan& C-Scan,Phased Array Ultrasound & Time of Flight Diffraction, Advantages & Limitations, Interpretation of Results& Applications.

Acoustic Emission Technique – Introduction, Types of AE signal, AE wave propagation, Source location, Kaiser effect, AE transducers, Principle, AE parameters, AE instrumentation, Advantages & Limitations, Interpretation of Results, Applications.

Module–V: **[09]**

Radiography: Introduction, Principle, X-ray Production, Gamma ray sources, tubing materials,X-raytubingcharacteristics,InteractionofX-raywithmatter, Digital Radiography – Film Digitisation, Direct Radiography & Computed Radiography, Computed Tomography.

Other techniques: Microwave inspection and Optical holography.

Text Books:

1.   1.Paul E Mix, "Introduction to Non-destructive testing: a training guide", Wiley/2nd edition New Jersey, 2005

2.   Baldev Raj, T.Jayakumar, M.Thavasimuthu "Practical Non-Destructive Testing", Narosa Publishing House, 2009.

Reference Books:

1.   Ravi Prakash, "Non-Destructive Testing Techniques", New Age International Publishers/1st revised edition,2010.

2.   ASM Metals Handbook, "Non-Destructive Evaluation and Quality Control", American Society ofMetals, Metals Park, Ohio, USA, 200/Volume-17.

3.   ASNT, American Society for Non Destructive Testing, Columbus, Ohio, NDT Handbook,Vol. 1,LeakTesting, Vol. 2, Liquid Penetrant Testing, Vol. 3, Infrared and Thermal Testing Vol. 4, Radiographic Testing, Vol. 5, Electromagnetic Testing, Vol.6, Acoustic Emission Testing, Vol. 7, Ultrasonic Testing

MARRI LAXMAN REDDY INSTITUTE OF TECHNOLOGY AND MANAGEMENT
(AUTONOMOUS)

2450343: Automation in Manufacturing
(Professional Elective I)

III Year I Sem   **L   T   P   C**
                                                            3   0   0   3

Course Overview: The *Automation in Manufacturing* course introduces undergraduate Mechanical Engineering students to the principles, technologies, and systems that form the backbone of modern automated manufacturing processes. With a focus on practical applications and industry-relevant strategies, the course aims to develop a foundational understanding of various automation techniques, material handling systems, control systems, and their integration into manufacturing environments.

Prerequisite: Basic Manufacturing Processes, Fluid Mechanics and Hydraulic Machines, Engineering Mechanics and Kinematics, Computer Programming Fundamentals

Course Objective: The students will try to learn

1. Understand the fundamentals, strategies, and classifications of automation in modern manufacturing environments.
2. Analyze and design automated flow lines and assess the role of buffer storage and transfer mechanisms.
3. Learn methods of assembly line design and balancing to optimize manufacturing productivity.
4. Explore the principles and components of automated material handling and storage systems.
5. Understand the basics of industrial control systems, sensors, actuators, data communication, and their integration with business process tools like ERP and BPE.

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

1. Recall types and strategies of automation and control circuits.
2. Describe automated flow lines and buffer storage functions.
3. Use line balancing techniques in flexible assembly lines.
4. Analyze automated material handling and storage systems.
5. Evaluate control systems, ERP, and BPE in manufacturing.

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(AUTONOMOUS)**

Module-I: **[10]**
Introduction: Types and strategies of automation, pneumatic and hydraulic components circuits, Automation in machine tools. Mechanical feeding and too changing and machine tool control transfer the automaton.

Module-II: **[09]**
Automated flow lines: Methods or work part transport transfer Mechanical buffer storage control

function, design and fabrication consideration.
Analysis of Automated flow lines: General terminology and analysis of transfer lines without and withbuffer storage, partial automation, implementation of automated flow lines.

Module-III: **[09]**
Assembly system and line balancing: Assembly process and systems assembly line, line balancing methods, ways of improving line balance, flexible assembly lines.

Module-IV: **[10]**

Automated material handling: Types of equipment, functions, analysis and design of material handling systems conveyor systems, automated guided vehicle systems. Automated storage systems, Automated storage and retrieval systems; work in process storage, interfacing handling and storage with manufacturing

Module–V: **[09]**

Fundamentals of Industrial controls: Review of control theory, logic controls, sensors and actuators, Data communication and LAN in Manufacturing. Business process Re-engineering: Introduction to BPE logistics, ERP, Software configuration of BPE.

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(AUTONOMOUS)**

Text Books:

1. M.P. Groover,Automation, Production Systems and Computer Integrated Manufacturing: 3e./PE/PHI, 2009.
2. Tien-Chien Chang, Richard A. Wysk and Hsu-Pin Wang, "Computer Aided Manufacturing" , Pearson, 2009.
3. Frank Lamb - Industrial Automation, Mc Graw Hill,2013
4. W. Buekinsham – Automation

Reference Books:

1. Tien-Chien Chang, Richard A. Wysk and Hsu-Pin Wang, Computer Aided Manufacturing, Pearson, 2009.
2. Nick Dawkins - Automation and Controls
3. Peter G. Martin and Gregory Hale - Automation Made Easy

MARRI LAXMAN REDDY INSTITUTE OF TECHNOLOGY AND MANAGEMENT
(AUTONOMOUS)

2450344: Microprocessors in Automation
(Professional Elective I)

III Year I Sem   **L T P C**
                                                                                   3 0 0 3

Course Overview: This course introduces the fundamental concepts of digital circuits and the architecture, programming, and interfacing of microprocessors and microcontrollers, with a focus on automation applications. Emphasis is placed on the 8085 microprocessor and 8051 microcontrollers, covering their internal architecture, instruction sets, and interfacing techniques. Students will gain foundational knowledge and skills essential for developing automation solutions using microprocessor and microcontroller technologies.

Prerequisite: Basics of Electrical and Electronics Engineering

Course Objective: The students will try to learn
1. Understand basic digital electronics and circuits.
2. Learn 8085 microprocessor architecture and functions.
3. Practice assembly language programming on 8085.
4. Understand memory and I/O interfacing techniques.
5. Learn 8051 and ARM microcontroller architecture and applications.

Course Outcomes: After successful completion of the course, students should be able to
1. Apply digital logic concepts in circuit design.
2. Explain 8085 microprocessor architecture and timing.
3. Write and execute simple 8085 assembly programs.
4. Design memory and I/O interfacing with 8085.
5. Describe microcontroller features and write simple 8051 programs.

Module-I: Basic Concepts of Digital Circuits   **[09]**

Number Systems, Logic Gates, Combinational Circuits, Flip-flops, Sequential Logic Circuits: Counters, Shift Registers. Basic components and computer architecture- CPU, Memory and Peripherals.

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Module-II: Architecture of Microprocessor   [10]
Introduction, Origin, Historical Developments, Introduction to 8085 Functional Block Diagram, Registers, ALU, Bus Systems, Timing and Control Signals, PIN diagram, Machine Cycles, Instruction Cycle and Timing States, Instruction Timing Diagrams, Addressing Modes. Concept of Interrupt, Need for Interrupts, Interrupt structure, Multiple Interrupt requests and their handling, Programmable interrupt controller.

Module-III: Assembly Language Programming   [09]
Instruction Set, Simple programs in 8085 mainly on Addition, Subtraction, Multiplication, Rotation, Ascending and Descending of the given data

Module-IV: Memory and I/O Device Interfacing   [10]

Memory Interfacing - Memory structure and its requirements, Basic Concept in Memory Interfacing, Address Decoding, Interfacing Circuits, Address Decoding and Memory Addresses, Typical Examples on Memory interfacing: Interface (2k x 8) ROM, (8k x 8) EPROM, and (1k x 8) RAM with 8085. IO Interfacing – Basic Interfacing Concepts-Peripheral I/O instructions, I/O Execution, Device Selection and data transfer, absolute vs. Partial Decoding, Input Interfacing, Interfacing I/Os using Decoders

Module–V: Architecture of Microcontroller   [09]

Introduction to Microcontrollers and how they differ from microprocessors, Block diagram of Microcontrollers, Architecture of 8051 microcontroller, Pin Diagram, Instruction set, simple 8051 programming, introduction to ARM microcontroller and its applications.

Text Books:
1.   Ramesh Gaonkar, "Microprocessor Architecture, Programming, and Applications with the 8085", PENRAM International Publishers.
2.   Muhammad Ali Mazidi, Janice Gillispie Mazidi and Rolin D, Mckinlay, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", 2nd Edition, Pearson

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publication, 2007.

Reference Books:

1.   Aditya P Mathur, "Introduction to Microprocessors", Tata McGraw-Hill, Europe; 3rd Edition, 1990.
2.   William H. Gothmann, "Digital Electronics: An Introduction to Theory and Practice", PHI Learning Private Limited.
3.   Patrick J O'Connor, "Digital and microprocessor technology", Prentice-Hall, 1983.
4.   S.J.Cahill, "Digital and Microprocessor Engineering", Wllis Horwood Limited (John Wiley & Sons).
5.   Douglas V. Hall "Microprocessors and Interfacing: Programming and Hardware"

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2450378: Metrology and Machine Tools Laboratory

III Year I Sem	L	T	P	C
	0	0	2	1

PRE-REQUISITES: Production Technology

COURSE OBJECTIVES

- To import practical exposure to the metrology equipment & Machine tools
- To conduct experiments and understand the working of the same.
- To learn the measurement of bores by internal micrometers and dial bore indicators.
- To learn the measurement of the Angle and taper s by Bevel protractor, Sine bars, etc.
- To learn the Step turning and taper turning and thread cutting Drilling and Tapping on lathe machine
- To the operations of Shaping and milling

COURSE OUTCOMES

- CO1 Demonstrate fundamental turning operations such as step turning, taper turning, thread cutting, and knurling on lathe machines and measure specimens using appropriate precision instruments. L3

- CO2 Perform shaping, milling, grinding, and slotting operations on respective machines and inspect the workpieces using surface roughness testers, depth micrometers, and vernier instruments..L3

- CO3 Operate drilling and boring machines to produce accurate holes and internal profiles and evaluate the results using indicators and micrometers L4

- CO4 Use advanced metrological tools such as sine bars, bevel protractors, and height gauges to determine angular dimensions and geometric accuracies.L4

- CO5 Develop tool geometry by grinding single-point cutting tools using tool and cutter grinders and assess the cutting tool profile for machining suitability.L6

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LIST OF EXPERIMENTS: (A minimum of 10 experiments to be conducted)
1. Step turning and taper turning on lathe machine
2. Thread cutting and knurling on lathe machine
3. Machining of groves using slotter and shaper machines
4. Machining of holes using Drilling and boring machines.
5. Gear cutting on the Milling machine
6. Grinding of Tool angles using Cylindrical / Surface Grinding
7. Measurement of lengths, heights, diameters by vernier calipers, micrometers.
8. Measurement of bores by internal micrometers and dial bore indicators.
9. Use of gear teeth vernier calipers for checking the chordal addendum and chordal height of the spur gear
10. Angle and taper measurements by bevel protractor and sine bars.
11. Thread measurement by 2-wire and 3-wire methods.
12. Surface roughness measurement by Tally Surf

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2450379: THEORY OF MACHINERY Laboratory

III Year I Sem

L	T	P	C
0	0	2	1

PRE-REQUISITES: Kinematics of Machinery

COURSE OBJECTIVES

- To impart the knowledge of basic concepts on kinematics and dynamics of mechanical elements.
- To illustrate the effect of gyroscope for different motions.
- To impart the knowledge of various Governors.
- To facilitate the students to know the concepts of balancing of rotating masses and reciprocating masses.
- To introduce mathematical models and solution methods to study torsional vibration.

COURSE OUTCOMES

After completion of the course the student is able to

- Understand types of motion. (L2)
- Analyze forces and torque of components in linkages. (L3)
- Understand forward and inverse kinematics of open loop mechanisms. (L2)
- Illustrate how to balance forces and moments produced by rotating or reciprocating masses of machine members. (L2)
- Understand concept of whirling of shafts to determine critical speed for conditions. (L2)
- Illustrate various Governors, cam and followers. (L2)

LIST OF EXPERIMENTS (A minimum of 10 experiments to be conducted)

1. To determine the state of balance of machines for primary and secondary forces.
2. To determine the frequency of torsional vibration of a given rod.
3. Determine the effect of varying mass on the centre of sleeve in Porter and Proell governor.
4. Find the motion of the follower if the given profile of the cam.
5. Balance masses statically and dynamically for single rotating mass systems.

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6. Determine the critical speed of a given shaft for different n-conditions.
7. For a simple pendulum determine time period and its natural frequency.
8. For a compound pendulum determine time period and its natural frequency.
9. Determine the effect of gyroscope for different motions.
10. Determine time period, amplitude and frequency of undamped free longitudinal vibration of single degree spring mass systems.
11. Determine the pressure distribution of lubricating oil at various load and speed of a Journal bearing.
12. Determine time period, amplitude and frequency of damped free longitudinal vibration of single degree spring mass systems.

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2450380: Thermal Engineering Laboratory

III Year I Sem

L	T	P	C
0	0	2	1

PRE-REQUISITES: Thermodynamics

COURSE OBJECTIVES

- To provide the knowledge to the student about working of IC Engines.
- To train the student to conduct performance and heat balance test on IC Engines.
- To practice the student to calculate the frictional losses in an IC Engine.
- To impart practical exposure on performance of Reciprocating air compressor.
- To make the student to understand the working principle of various types of boilers.

COURSE OUTCOMES

- Identify the various parts of an IC Engine.
- Sketch the Valve and Port Timing diagrams for IC Engines.
- Determine the performance of various types of IC Engines.
- Prepare the heat balance sheet for various types of IC Engines.
- Calculate the frictional power in various types of IC Engines.
- Analyze the performance of reciprocating air compressor.

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LIST OF EXPERIMENTS: (A minimum of 10 experiments to be conducted)

1. Draw the valve and port timing diagrams for four and two stroke engines.
2. Evaluate the performance of 4 -stroke Diesel engines.
3. Evaluate the performance of 2-stroke Petrol engine.
4. Evaluate the performance of 4 -stroke Petrol engines.
5. Evaluation of frictional power by conducting Morse test on 4-stroke multi cylinder petrol engine.
6. Draw the heat balance sheet for 4-stroke Single cylinder Diesel / Petrol engines.
7. Draw the heat balance sheet for 4- stroke multi cylinder petrol engine.
8. Calculate the performance of variable compression ratio engines.
9. Performance test on reciprocating air compressor unit.
10. Study of Steam boilers.
11. Disassembly / assembly of engines.

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III – II

MARRI LAXMAN REDDY INSTITUTE OF TECHNOLOGY AND MANAGEMENT (AUTONOMOUS)

2460332: Design of Transmission Systems

III   YEAR II SEM   **L   T   P   C**
3   0   0   3

Course Overview:

This course introduces the design of essential machine components, focusing on flexible elements, gears, engine parts, gearboxes, and bearings. Students will learn principles of power transmission through belts, ropes, and chains, and gain knowledge in the design of spur, helical, bevel, and worm gears. The course also covers the analysis and design of connecting rods and pistons, along with the layout and design of various gearboxes for machine tools. Additionally, students will explore sliding and rolling contact bearings, including hydrodynamic journal bearings. Emphasis is placed on stress analysis, material selection, efficiency, and application of design software tools.

Prerequisite: Engineering Mechanics and Design of Machine Elements.

Course Objective: The students will try to learn

- ➤ To impart knowledge on the design principles of belts, ropes, chains, and sprockets used in power transmission.
- ➤ To develop understanding of gear design, considering strength, wear, efficiency, and material selection.
- ➤ To analyze and design key engine parts such as connecting rods and pistons.
- ➤ To familiarize students with the design and assembly of various gearboxes for machine tool applications.
- ➤ To provide knowledge on the selection and design of bearings, emphasizing performance analysis and reliability in mechanical systems.

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

- ➤ Illustrate the design principles of belts, ropes, chains, and sprockets for effective power transmission.
- ➤ Analyze and design spur, helical, bevel, and worm gears considering fatigue, wear, and strength criteria.
- ➤ Evaluate stresses and proportions in connecting rods and pistons, and apply design

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procedures for engine parts.

➤ Demonstrate the design and kinematic layout of sliding mesh, constant mesh, and multi-speed gearboxes.

➤ Select and apply appropriate design methods for sliding and rolling contact bearings using performance charts and efficiency considerations.

Module-I:Design of Flexible Elements   [09]

Transmission of power by Belt and Rope Drives, Transmission efficiencies, Belts – Flat and V types –Ropes - pulleys for belt and rope drives. Design of Transmission Chains and Sprocket.

Module-II: Design of Gears   [11]

Gear materials - Design of straight tooth spur & helical gears based on speed ratios, number of teeth, Fatigue strength, Factor of safety, strength and wear considerations. Force analysis – Tooth stresses - Helical gears – Module - normal and transverse, Equivalent number of teeth – forces. Straight bevel gear: Gear materials - Tooth terminology, tooth forces and stresses, equivalent number of teeth, estimation of dimensions of straight bevel gears. Worm Gear: Gear materials - Tooth terminology, Thermal capacity, forces and stresses, efficiency, estimation of dimensions of worm gear pair.

Module-III: Engine Parts   [09]

Engine Parts: Connecting Rod: Thrust in connecting rod – stress due to whipping action on connecting rod ends –Pistons, Forces acting on piston – Construction, Design and proportions of piston.

Module-IV: Gear Boxes   [10]

Geometric progression - Standard step ratio - Ray diagram, kinematics layout -Design of sliding mesh gear box - Design of multi speed gear box (9,12 speed gear box) for machine tool applications- Constant mesh gear box - Speed reducer unit. – Variable speed gear box.

Module–V: Bearings   [09]

Sliding contact and rolling contact bearings - Hydrodynamic journal bearings, Sommerfeld

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Number, Raimondi & Boyd graphs - Selection of Rolling Contact bearings.

TEXT BOOK:

1. Shigley. J., Mischke. C., Budynas, R., and Nisbett. K., "Mechanical Engineering Design", 10 thEdition, Tata McGraw-Hill, 2014.
2. Prabhu. T.J., "Design of Transmission Elements", Mani Offset, Chennai, 2003

REFERENCE BOOK:

1.   Bhandari V, "Design of Machine Elements", 15th Reprint, Tata McGraw-Hill Book Co, 2014 R2.New Technology – Bhattacharya A, The Institution of Engineers, India 1984.

2.   Md. Jalaludeen , Machine Design, Volume II, Design of Transmission Systems, 4th edition,Anuradha Publications, 2014.

3.   C.S.Sharma, KamleshPurohit, "Design of Machine Elements", 1st edition, Prentice Hall ofIndia,Pvt. Ltd., 2004.

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2460333: HEAT TRANSER

III YEAR II SEM   **L T P C**
                                                                               3 0 0 3

Course Overview:

This course introduces the fundamental principles and mechanisms of heat transfer, covering conduction, convection, and radiation with practical engineering applications. Students will study steady and unsteady conduction, fin analysis, forced and free convection, and heat exchangers using LMTD and NTU methods. The course also addresses heat transfer with phase change, including boiling and condensation, along with radiation heat transfer and its practical models. Emphasis is placed on thermodynamic laws, dimensional analysis, correlations, and analytical/empirical methods essential for modern thermal engineering

Prerequisite: Thermodynamics

Course Objective: The students will try to learn

1. Understand the basic modes, mechanisms, and governing laws of heat transfer.
2. Analyse one-dimensional steady and transient heat conduction problems in different geometries.
3. Apply dimensional analysis and correlations to study convective heat transfer in external and internal flows.
4. Evaluate the performance of heat exchangers using analytical and empirical methods..
5. Develop knowledge of phase-change heat transfer and radiation exchange in practical thermal systems.

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

1. Formulate and solve one-dimensional steady-state heat conduction problems in slabs, cylinders, and spheres with and without insulation.
2. Analyze transient heat conduction and finned surfaces using Biot and Fourier numbers and apply chart solutions to engineering systems.
3. Apply dimensional analysis and empirical correlations to predict convective heat transfer in external forced convection flows.
4. Evaluate convective heat transfer in internal flows and estimate heat exchanger performance using LMTD and NTU methods.
5. Analyze boiling, condensation, and radiation heat transfer processes, including black and

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grey body radiation exchange with shields.

Module-I: **[10]**

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.

Module-II: **[09]**

One Dimensional Steady State Conduction Heat Transfer: 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

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**.**

Module-III: **[10]**

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 – Integral Method as approximate method -Application of Von Karman Integral Momentum Equation for flat plate with different velocity profiles.

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

Module-IV: **[09]**

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.

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(AUTONOMOUS)

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

Module–V: **[9]**

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.

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.

Text Books:
   3. Fundamentals of Engineering Heat and Mass Transfer, R.C. Sachdeva, New Age /4th Edition
   4. Heat Transfer, J.P. Holman , Tenth Edition, McGraw Hill /10th Edition.

 Reference Books:
   4. Heat Transfer by a Practical Approach, YunusCengel, Boles, TMH /3rd Edition
   5. Heat transfer, A conceptual Approach, P. K. Sarma, Rama Krishna, New Age /2nd Edition
   6. Heat and mass Transfer, Dr. D. S. Kumar, S. K. Kataria& Sons/2nd Edition
   7. Essential Heat Transfer - Christopher A Long / Pearson/1st Edition
   8. Heat Transfer –Ghoshdastidar / Oxford/2nd Edition

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2460334: FINITE ELEMENT METHOD

B.Tech. III Year II Sem	L	T	P	C
Pre-Requisites: MECHANICS OF SOLIDS	3	0	0	3

Course Objectives:

The aim of the course is to provide the participants an overview on Finite Element Method, Material models, and Applications in material Engineering. At the end of the course, the participants are expected to have fair understanding of:

•   Basics of Finite Element Analysis.

•   Available material models for structural materials.

•   Modeling of engineering systems .

•   Importance of interfaces and joints on the behavior of engineering systems.

•   Implementation of material model in finite element method and applications.

Course Outcomes : After completion of the course the student is able to

•   Apply finite element method to solve problems in solid mechanics, fluid mechanics

•   Formulate and solve problems in one dimensional structures including trusses, beams.

•   Formulate FE characteristic equations for two dimensional elements and analyze plain stress, plain strain, and axi- symmetric problems.

•   Formulate FE characteristic equations in heat transfer applications

•   Formulate FE characteristic equation for dynamic analysis.

•   Knowledge on FEM softwares ANSYS,NASTRAN etc

UNIT–1   **CLASSES:12**

Introduction:

Introduction to Finite Element Methods: General Procedure – Engineering Applications –
Stress – strain relations and strain- displacement relations: Finite Elements: 1- Dimensional, 2 – Dimensional, 3-Dimensional Elements One Dimensional Problems: 1-D Linear bar Elements - Finite element modeling, Coordinates and shape functions. Assembly of Global stiffness matrix and load vector. Finite element equations, Treatment of boundary conditions, Quadratic shape functions for bar element.

LEARNING OUTCOME:

After successful completion of the unit, students will be able to

1. Explain the shape function concept and make use of it in solving one dimensional linear elements (L2).

2. Apply numerical methods on one dimensional bar elements for obtaining displacements, stresses, strains and reaction forces (L3).

UNIT – 2   CLASSES:09

Analysis of Trusses: Derivation of Stiffness Matrix for Plane Truss, Displacement of Stress Calculations. Analysis of Beams: Element stiffness matrix for two noded, two degrees of freedom per node beam element, simple problems on Load Vector, Deflection.

LEARNING OUTCOME:

After successful completion of the unit, students will be able to

1. Explain the shape function concepts on trusses and beams for enriching knowledge on stiffness matrixr (L2).

2. Apply numerical methods on truss and beam elements for obtaining displacements, stresses, strains. (L3).

UNIT–3   CLASSES :10

Finite element modeling of two-dimensional stress analysis with constant strain triangles and treatment of boundary conditions, Estimation of Load Vector, Stresses Finite element modeling of Axi-symmetric solids subjected to Axi-symmetric loading with triangular elements and two dimensional four noded isoparametric elements.

LEARNING OUTCOME:

After successful completion of the unit, students will be able to

1.   Illustrate finite element modelling of triangular, axi-symmetric and four noded elements for obtaining shape functions of two dimensional elements. (L2)

2. Male use of shape functions for developing stiffness matrix of triangular, axisymmetric and four noded elements (L3)

UNIT – 4   CLASSES :08

Steady State Heat Transfer Analysis: one dimensional analysis of Slab, fin and two-dimensional heat conduction analysis of thin plate.

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LEARNING OUTCOME:

After successful completion of the unit, students will be able to

1. Explain the basics of heat transfer for 1D, fin and thin plate for developing mathematical models.(L2)

2.Apply numerical methods on heat transfer problems for developing thermal stiffness matrix and thermal load vector.(L3)

UNIT – 5   **CLASSES :08**

Dynamic Analysis: Formulation of finite element model, lumped and consistent mass matrices, evaluation of Eigen values and Eigen vectors for a stepped bar.

Finite element – formulation to 3 D problems in stress analysis, convergence requirements, Mesh generation and its techniques, introduction to softwares such as ANSYS, ABAQUS, NASTRAN

LEARNING OUTCOME :

After successful completion of the unit, students will be able to

1. Illustrate the concepts of stepped bar for obtaining the Eigen values and Eigen vectors of various structural problems. (L2)

2. Make use of modern tools such as ANSYS, NASTRAN for solving 3D structural and heat transfer problems (L3).

TEXT BOOK :

1.Finite Element Methods: Basic Concepts and applications/Alavala/PHI/3rd Edition

2.Introduction to Finite Elements in Engineering,/ Chandrupatla, Ashok and Belegundu /Pearson/4th Edition

REFERENCE BOOK :

1.An Introduction to the Finite Element Method / Edition-4/J. N. Reddy/ Mc Graw Hill/4th Edition

2.Finite Element Analysis / SS Bhavikatti / New Age/3rd Edition

3.Finite Element Method/Dixit/Cengage/4th Edition

4.The Finite Element method in Engineering/Singiresu S.Rao/5th Edition

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(AUTONOMOUS)

2460303: Introduction to Robotics
(Open Elective II)

III Year II Sem   **L T   P C**
                                                           3 0   0 3

Course Overview:

- Overview of robotics and automation, types of robotic arms & system components.
- Rotation matrices, Euler angles, homogeneous transformations, D-H frame assignment, forward and inverse kinematics for industrial robotic manipulators.
- Jacobian analysis, dynamic modeling using Lagrange-Euler and Newton-Euler methods, and trajectory planning.
- Overview of actuators, sensors, feedback devices.
- Robotic applications in manufacturing, programming methods.

Prerequisite: Nil

Course Objective: The students will try to learn

- The fundamentals of robotics, automation, robotic arms, system components.
- The understanding of robot motion using rotation matrices, Euler angles, D-H parameters and kinematics.
- The knowledge on Jacobians, robot dynamics, and trajectory planning techniques.
- The students to familiarize with actuators, sensors, feedback devices.
- The robotic applications in manufacturing and programming methods.

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

- Describe the fundamentals of robotics, types of robotic arms, system components. (L_2).
- Apply rotation matrices, Euler angles, and D-H notation in solving forward and inverse kinematics problems. (L_3).
- Analyze manipulator dynamics using Jacobians, Lagrange-Euler, and Newton-Euler methods, and planning robot trajectories. (L_4).
- Identify and comparing various actuators, sensors, feedback devices. (L_2).
- Demonstrate applications of robots in manufacturing and applying appropriate robotic programming techniques. (L_3).

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Module-I: **[10]**

Introduction: Automation and Robotics An over view of Robotics present and future applications. Components of the Industrial Robotics: common types of arms. Components, Architecture, number of degrees of freedom Requirements and challenges of end effectors, Design of end effectors,

Module-II: **[09]**

Motion Analysis: Basic Rotation Matrices, Equivalent Axis and Angle, Euler Angles, Composite Rotation Matrices. Homogeneous transformations as applicable to rotation and translation problems.

Manipulator Kinematics: H notation-H method of Assignment of frames-H Transformation Matrix, joint coordinates, and world coordinates, Forward and inverse kinematics serial robots.

Module-III: **[09]**

Differential Kinematics: Differential transformation of manipulators, Jacobians problems. Dynamics: Lagrange Euler and Newton Euler formations Problems.

Trajectory planning: Trajectory planning and avoidance of obstacles, path planning, Slew motion, joint interpolated motion straight line motion.

Module-IV: **[09]**

Robot actuators and sensors: Actuators: Pneumatic, Hydraulic actuators, electric & stepper motors, comparison of Actuators

Velocity sensors, Tactile and Range sensors, Force and Torque sensors End Effectors and Tools

Module–V: **[09]**

Robot Applications: Material Transfer - Material handling, loading, and unloading, spot and continuous arc welding & spray painting - Assembly and Inspection.**Robotic Programming:** Robot Programming methods, Robot Programming languages.

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Text Books:

1. Robotics and Controlby R.K. Mittal & I.J. Nagrath / 1ˢᵗ Edition / Tata McGraw-Hill Education.

2. Introduction to Robotics: Mechanics and Control" by John J. Craig / 3ʳᵈ Edition / Pearson Education.

3. Industrial Robotics / Groover M P /2ⁿᵈEdition / Tata McGraw-Hill Education.

Reference Books:

1. Robot Dynamics and Controls / Spony and Vidyasagar / John Wiley

2. Robot Analysis and control / Asada, Slotine / Wiley Inter-Science

3. Robot Modeling and Controlby Mark W. Spong, Seth Hutchinson, and M. Vidyasagar

MARRI LAXMAN REDDY INSTITUTE OF TECHNOLOGY AND MANAGEMENT (AUTONOMOUS)

2460304: Introduction to Automobile Engineering
(Open Elective II)

III YEAR II SEM   **L T P C**
                                                                  3 0 0 3

Course Overview:

This course provides a comprehensive introduction to the fundamentals of automobiles, including their construction, operation, and modern advancements. Students will learn about the layout, major systems, and components of automobiles, covering engines, fuel systems, cooling and ignition systems, electrical systems, transmission, suspension, braking, steering, emissions, and alternative fuels. The course emphasizes both theoretical knowledge and practical aspects of automobile engineering, preparing learners for applications in design, servicing, and maintenance.

Prerequisite: Thermal Engineering-1

Course Objective: The students will try to learn

1. Elaborate the Systems of Automobile, Components of Engine, fuel & Lubrication system and its requirements.
2. Explain the significance and features of Cooling, Ignition and Electrical Systems.
3. Illustrate the working of transmission system and Suspension systems and its components.
4. Elaborate the function of each accessory of steering and braking system and their role for effective performance of automobile.
5. Discuss the particulates of combustion in CI and SI engines, reasons for formation of particulates and methods adopted to control the pollution.

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

1. Illustrate the function of each and every system of an automobiles including fuel system and injection approaches
2. Explain the Cooling, ignition and electrical system of the Automobile.
3. Describe each component of transmission system of an automobile viz clutch, gear box, propeller shaft and differential and suspension system and the effect of the same on tyre performance and other components of an automobile.
4. Analyze the geometry of the steering mechanism and braking system.

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5. Demonstrate about emission standards, emission control techniques and electrical systems. Student can identify thrust areas for carrying their dissertation in future.

Module-I: **[11]**

Introduction: Layout of automobile – introduction chassis and body components. Types of Automobile engines – Power unit – Introduction to engine lubrication – engine servicing.

Fuel System: S.I. Engine: Fuel supply systems, Mechanical and electrical fuel pump – filters – carburetor – types – air filters – petrol injection. Introduction to MPFI and GDI Systems.

C.I. Engines: Requirements of diesel injection systems, types of injection systems, DI Systems IDI systems. Fuel pump, nozzle, spray formation, injection timing, testing of fuel pumps. Introduction to CRDI and TDI Systems**.**

Module-II: **[10]**

Cooling System: Cooling Requirements, Air Cooling, Liquid Cooling, Thermo, water and Forced Circulation System – Radiators – Types – Cooling Fan - water pump, thermostat, evaporative cooling – pressure sealed cooling – antifreeze solutions.

Ignition System: Function of an ignition system, battery ignition system, constructional features of storage, battery, auto transformer, contact breaker points, condenser, and spark plug – Magneto coil ignition system, electronic ignition system using contact breaker, electronic ignition using contact triggers – spark advance and retard mechanism.

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..

Module-III: **[09]**

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, constant 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.

Suspension System: Objects of suspension systems – rigid axle suspension system, torsion bar, shock absorber, independent suspension system.

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Module-IV: **[09]**

Braking System: Mechanical brake system, Hydraulic brake system, Master cylinder, wheel cylinder tandem master cylinder Requirement of brake fluid, Pneumatic and vacuum brakes.

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.

Module–V: **[09]**

Emissions from Automobiles – Pollution standards National and international – Pollution Control – Techniques – Multipoint fuel injection for SI Engines. Common rail diesel injection Energy alternatives – Solar, Photo-voltaic, hydrogen, Biomass, alcohols, LPG, CNG, liquid Fuels, and gaseous fuels, Hydrogen as a fuel for IC Engines. - Their merits and demerits. Standard Vehicle maintenance practice**.**

Text Books:
1. Automobile Engineering / William H Crouse/10th Edition
2. A Text Book Automobile Engineering–Manzoor, Nawazish Mehdi &Yosuf Ali, Frontline Publications/2nd Edition

Reference Books:

1. A Text Book of Automobile Engineering by R K Rajput, Laxmi Publications/**2nd Edition**
2. Automotive Mechanics / Heitner/**2nd Edition**
3. Automotive Engineering / Newton Steeds & Garret/**13th Edition**
4. Automotive Engines / Srinivasan/**2nd Edition**

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2460345:   Non-Traditional Machining Process
(Professional Elective II)

III Year II Sem

L	T	P	C
3	0	0	3

Course Overview:

This course covers the principles, equipment, applications, and recent advancements in Non-Traditional Machining (NTM) processes. It provides an in-depth understanding of various NTM techniques involving mechanical, chemical, electrochemical, thermal, and hybrid energy sources to machine complex shapes, hard materials, and achieve fine surface finishes.

Prerequisite: Basic knowledge of conventional machining and manufacturing processes.

Course Objective: Upon completion of the course, students will be able to:

1. Remember and understand the necessity and evolution of non-traditional machining processes.
2. Explain the fundamentals and working principles of different NTM techniques.
3. Apply knowledge of NTM processes for machining difficult-to-machine materials.
4. Analyse process capabilities and limitations of various NTM methods.
5. Evaluate and create solutions using hybrid machining technologies based on industrial requirements.

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

1. Explain the need and classification of NTM processes.
2. Understand and describe mechanical, chemical, electrochemical, and thermal NTM processes.
3. Compare different NTM processes based on process parameters and applications.
4. Evaluate machining performance in terms of accuracy, surface finish, and material removal rate.
5. Select suitable NTM processes for complex industrial applications including hybrid techniques.

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Module-I: [10]

Introduction to Non-Traditional Machining: Need, classification, comparison with conventional processes, industrial applications. Mechanical Energy Based Processes: Ultrasonic Machining (USM): working principle, equipment, process parameters, applications. Abrasive Jet Machining (AJM) and Water Jet Machining (WJM): principle, process details, equipment setup, pros and cons.

Module-II: [09]

Chemical and Electrochemical Based Processes:

Chemical Machining (CHM): types, process steps, maskants, etchants.

Electrochemical Machining (ECM): working principle, process parameters, tool design, electrolytes. Electrochemical Grinding (ECG), Electrochemical Honing (ECH): mechanisms and applications.

Module-III: [10]

Thermal Energy Based Processes:

Electric Discharge Machining (EDM): spark generation, dielectric fluid, tool and work material, wire EDM. Laser Beam Machining (LBM): absorption, melting, beam characteristics, thermal damage. Plasma Arc Machining (PAM), Electron Beam Machining (EBM), Ion Beam Machining (IBM): working principles, applications.

Module-IV: [09]

Nano and Finishing Techniques:

Abrasive Flow Machining (AFM), Magnetic Abrasive Finishing (MAF), Chemo-Mechanical Polishing (CMP). Magnetorheological Finishing (MRF), Magnetorheological Abrasive Flow Finishing (MRAFF): mechanisms, process equipment, advantages and limitations.

Module–V: [10]

Hybrid Machining Processes:

Hybrid Machining Processes: Definition and need for hybrid machining, classification based on energy domains, working principles and equipment of major hybrid processes such as Electrochemical Discharge Machining (ECDM), Ultrasonic Assisted EDM and ECM, and Laser Assisted Machining (LAM). Case studies on EDM + USM, ECM + USM and Laser + Chemical Etching. Performance evaluation in terms of productivity, accuracy, and surface quality. Applications in aerospace, biomedical and microelectronics industries. Criteria for selection of

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hybrid processes based on workpiece material, geometry, and surface finish requirements.

Text books:

1. Adithan M., "Unconventional Machining Processes", Atlantic Publishers, 2009.
2. Pandey P.C. and Shan H.S., "Modern Machining Processes", Tata McGraw Hill, 2008.
3. Benedict G.F., "Nontraditional Manufacturing Processes", Marcel Dekker, 1987.

Reference Books:

1. Golam Kibria et al., "Non-traditional Micromachining Processes", Springer, 2017.
2. Kapil Gupta et al., "Hybrid Machining Processes", Springer, 2016.
3. Hassan El-Hofy, "Advanced Machining Processes", McGraw Hill, 2005.

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2460346: **METAL FORMING TECHNOLOGY**
(Professional Elective II)

III Year II Sem   **L T   P C**
                                                                                 3 0   0 3

Course Overview:
Metal Forming Technology provides in-depth knowledge of the principles and processes involved in shaping metals through plastic deformation. The course covers fundamental concepts of stress analysis, metal behavior under different working conditions, and various forming techniques such as forging, rolling, extrusion, drawing, and sheet metal forming. It also introduces recent advancements like superplastic forming, laser forming, and micro-forming. Students will learn to analyze process parameters, identify defects, and apply suitable forming methods for different applications. This course equips learners with practical and theoretical skills essential for modern manufacturing and design industries.

Prerequisite: none

Course Objective: The students will try to learn

1. Understand the fundamentals of stress analysis and the behaviour of metals during forming processes.
2. Explore various forging and rolling techniques along with their applications and defect management.
3. Analyze extrusion and drawing processes, their classifications, equipment, and defect control.
4. Differentiate sheet metal forming methods and advanced high-energy rate forming techniques.
5. Investigate recent advancements in metal forming technologies and their industrial applications.

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

1. Calculate the stresses and analyze the metal flow behaviour in metal forming processes.
2. Identify appropriate forging and rolling processes and analyze possible defects and remedies.

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3. Differentiate extrusion and drawing processes and recommend suitable methods based on application requirements.
4. Apply process parameters to various sheet metal forming methods for defect-free production.
5. Classify and explain advanced and recent metal forming techniques used in modern manufacturing.

Module-I: FUNDAMENTALS OF METAL FORMING   **[10]**

State of stress – Components of stress, symmetry of stress tensor, principal stresses – Stress deviator – von-mises, Tresca yield criteria – Octahedral shear stress and shear strain theory – Flow stress determination – Temperature in metal forming – Hot, cold and warm working – strain rate effects – metallurgical structures – residual stresses – Spring back.

Module-II: **FORGING AND ROLLING**   **[09]**

Classification of forging, closed die forging, Open die forging, Drop forging, Machine forging, Load estimation in forging, analysis of forging: sticking friction model, sliding friction model, pre forming operations and rolling processes – Ring compression test – Post forming heat treatment – defects (causes and remedies)– applications – Roll forming.

Module-III: **[10]**
EXTRUSIONANDDRAWING PROCESSES

Classification of extrusion processes – tool, equipment and principle of these processes – influence of friction – extrusion force calculation – defects (causes and remedies) – Rod/Wire drawing – tool, equipment and principle of processes – defects – Tube drawing and sinking processes – Mannesmann process of seamless pipe manufacturing – Tube bending.

Module-IV: **[09]**
SHEETMETALFORMING PROCESSES

Sheet metal working-shearing, Major operation, Minor operation, Mechanism of Blanking, Piercing, Load estimation in blanking and piercing, Methods of reducing shear force. forming, plate bending, Rubber pad forming, bulging and press brake forming – Explosion forming, electro hydraulic forming, Magnetic pulse forming.

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Module–V: **[09]**

RECENTADVANCES

Super plastic forming – Electro forming – fine blanking – Hydro forming – Peen forming – Laser Forming – Micro forming - P/M forging – Isothermal forging – high speed hot forging – near net shape forming high velocity extrusion – CAD and CAM in forming.

Text Books:

1. Dieter G.E., "Mechanical Metallurgy", McGraw Hill,Co.,S.I.Edition,2001
2. Nagpal G.R."Metalformingprocesses",Khannapublishers,NewDelhi,2004

Reference Books:

1. SeropeKalpakjian,StevenRSchmid,"ManufacturingProcessforEngineeringMaterials",4th Edition, Pearson Education, 2003.
2. Rao, P.N."ManufacturingTechnology",TMHLtd.,2003
3. Edward M.Mielink, "Metal working ScienceEngineering",McGrawHill,Inc,2000.

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(AUTONOMOUS)

2460347: Operation Research
(Professional Elective–II)

III Year II Sem   **L   T   P   C**
                                                       3   0   0   3

Course Objectives: The students will learn to:
1. Acquire knowledge of the concepts and tools of Operations Research.
2. Understand the mathematical models used in Operations Research.
3. Apply these techniques effectively to make informed business decisions.
4. Use various optimization techniques for decision-making.
5. Recognize the mathematical significance of developing appropriate models for specific optimization problems and solving them.

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

1. Understand the problem, identify variables and constants, formulate an optimization model, and apply appropriate optimization techniques. (L2, L3)
2. Solve transportation and assignment problems. (L3)
3. Understand the application of game theory and its real-world uses. (L3)
4. Understand the concepts of sequencing and replacement policies. (L3)
5. Apply dynamic programming techniques to solve linear programming problems (LPP). (L3)

Module-I: **[09]**
Development-definition-characteristics and phases-Types of models-Operations Research models- applications.

Allocation: Linear Programming Problem Formulation-Graphical solution- Simplex method-Artificial variable techniques: Two-phase method, Big-M method.

Module-II: **[09]**

Transportation problem - Formulation-Optimal solution, unbalanced transportation problem Degeneracy.

Assignment problem- Formulation-Optimal solution, - Variants of Assignment problem-Travelling salesman problem.

Module-III: **[10]**

Sequencing- Introduction-Flow-Shop sequencing- n jobs through two machines – n jobs through

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three machines- Job shop sequencing-two jobs through 'm' machines.

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.

Module-IV: [09]

Theory of Games: Introduction- Terminology- Solution of games with saddle points and without saddle points. 2 x 2 games- dominance principle- m x 2 & 2 x n games- Graphical method.

Inventory: Introduction- Single item, Deterministic models- purchase inventory models with one price break and multiple price breaks- Stochastic models _ Demand may be discrete variable or continuous variable- single period model and no setup cost.

Module–V: [09]

Waiting lines: Introduction- Terminology- Single channel- Poisson arrivals and Exponential service times with infinite population.

Dynamic Programming: Introduction- Terminology, Bellman's principle of optimality- Applications of Dynamic programming- shortest path problem- linear programming problem.

Text Books:

1.Operation Research by J.K.Sharma/4th Edition/ MacMilan.

2.Operations Researchby ACS Kumar/1st Edition/ Yesdee

Reference Books:

1. Introduction to OR/Taha/10th Edition/PHI
2. Operations Research/NVS Raju/3rd Revised Edition /SMS Education
3. Operations Research/M.V. Durga Prasad, K.Vijaya Kumar Reddy, J. Suresh Kumar/1st Edition /Cengage

MARRI LAXMAN REDDY INSTITUTE OF TECHNOLOGY AND MANAGEMENT
(AUTONOMOUS)

2460348: FLEXIBLE MANUFACTURING SYSTEMS
(Professional Elective–II)

III Year II Sem	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

Course Overview: This course covers the basics and evolution of Flexible Manufacturing Systems (FMS), including its components, layouts, and applications. It introduces automated machining cells, material handling systems like AGVs and robots, and software tools for tool and production management. Students will also learn about FMS planning, performance evaluation, and real-world case studies for practical understanding.

Course Objective: The students will try to learn

1. Understand the evolution, need, and components of FMS.
2. Learn various FMS layouts and manufacturing cell configurations.
3. Explore key processing stations and unattended machining concepts.
4. Study automation tools like AGVs, robots, and tool management systems.
5. Analyze FMS planning, performance evaluation, and case studies.

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

1. Explain the concept, advantages, and applications of FMS.
2. Identify and compare different FMS layout configurations.
3. Describe the role of automation in machining and material handling.
4. Utilize software tools for managing tools and production in FMS.
5. Evaluate and design basic FMS systems using analytical or simulation models.

Module-I: INTRODUCTION   **[10]**

Understanding of FMS: Evolution of Manufacturing Systems, Definition, objective and Need, Components, Merits, Demerits and Applications Flexibility in Pull and Push type

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Module-II: MANUFACTURING CELLS & UNATTENDED MACHINING   [09]
Classification of FMS Layout: Layouts and their Salient features, Single line, dual line, loop, ladder, robot centre type etc.

Module-III: MANUFACTURERS DRIVING FORCE   [09]

Processing stations: Salient features Machining Centers, turning center, Coordinate measuring machine (CMM), Washing/ Deburring station

Module-IV: SOFTWARE FOR FMS   [11]

Material Handling System: An introduction, Conveyor, Robots, Automated Guided Vehicle (AGV), Automated Storage Retrieval System (ASRS) Management technology: Tool Management, tool magazine, Tool preset, identification, Tool monitoring and fault detection, routing, Production Planning and Control, Scheduling and loading of FMS

Module–V: FMS PLANNING, HARDWARE & IMPLEMENTATION   [09]

Design of FMS: Performance Evaluation of FMS, Analytical model and Simulation model of FMS Case studies: Typical FMS problems from research papers

Text Books:
1. Flexible Manufacturing Cells and System by William W Luggen, Prentice Hall of Inc New Jersey, 1991
2. Flexible Manufacturing system by Reza A Maleki, Prentice Hall of Inc New Jersey, 1991
3. Flexible Manufacturing by John E Lenz, marcel Dekker Inc New York,1989.

Reference Books:
1. Automation, Production Systems and Computer Integrated Manufacturing by Groover, M.P, Prentice Hall.

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(AUTONOMOUS)**

2460381: HEAT TRANSERLABORATORY

III Year II Sem

L	T	P	C
0	0	2	1

PRE-REQUISITES: Thermodynamics

COURSE OBJECTIVES

- To Determine the overall heat transfer coefficient of different conducting systems such as composite slabs, lagged pipes, and concentric spheres.
- To evaluate the thermal conductivity of materials (e.g., metal rods) and assess their Ability to conduct heat.
- To analyze the performance and efficiency of extended surfaces (fins) in enhancing heat Transfer.
- To determine the heat transfer coefficients under different modes of convection (forced and natural) and validate theoretical correlations.
- To study the effectiveness and performance of heat exchangers under parallel and Counter flow arrangements.

COURSE OUTCOMES

- Applications of concepts of Conduction Convection &Radiation Principles.
- Calculation of thermal conductivity Heat Transfer Coefficient of various experiments.
- Calculation of Heat Transfer Coefficient of various experiments.
- Analyzing the Performance parameters of Heat Exchanger.
- Evaluation of Emissivity of Real Surfaces.
- Assessment of Stefen Boltz'smann Constant.

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LIST OF EXPERIMENTS: (A minimum of 10 experiments to be conducted)

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 forced convection
7. Determination of heat transfer coefficient in natural convection.
8. Determination of effectiveness of parallel and counter flow heat exchangers.
9. Determination of emissivity of a given surface.
10. Determination of Stefan Boltzmann constant.
11. Determination of heat transfer rate in drop and film wise condensation.
12. Determination of critical heat flux.
13. Demonstration of heat pipe.
14. Determination of Heat transfer coefficient and instantaneous heat transfer for transient Heat conduction.

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2460382: COMPUTER AIDED ENGINEERING LAB

B.Tech. III Year II Sem.   **L   T   P   C**
                                                                               0   0   2   1

Pre-requisites: Finite Element Methods, AutoCAD

Course Objectives: The students will try to learn:

➢ The systematic design of 2D objects in Ansys software.
➢ The systematic design of 3D objects in Ansys software.
➢ The fundamental modules in Ansys software like sketcher, part modeling.
➢ The estimation of stresses using Ansys software on structural analysis.
➢ The estimation of stresses using Ansys software on thermal analysis.

Course Outcomes:

➢ Explain the theory concepts of Ansys software and its application.
➢ Design 2D models using Ansys software.
➢ Identify the importance of IGES and STEP formats.
➢ Apply concepts of structural analysis in estimating stresses on 3D components.
➢ 5.Understand analysis like thermal and dynamic on the given component.

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List of Experiments:

1. Determination of deflection and stresses in 2D and 3D trusses.
2. Determination of deflection and stresses in 2D and 3D beams.
3. Determination of deflections, principal and Von-mises stresses in plane stress, plane strain.
4. Determination of deflections, principal and Von-mises stresses in Axi-symmetric components.
5. Determination of stresses in 3D and shell structures.
6. Estimation of natural frequencies and mode shapes in cantilever beam.
7. Estimation of natural frequencies and mode shapes in simply supported beam.
8. Estimation of harmonic response analysis in cantilever beam.
9. Estimation of harmonic response analysis in simply supported beam.
10. Study state heat transfer analysis of plane components.
11. Study state heat transfer analysis of axi-symmetric components.
12. Determination of deflections, principal and Von-mises stresses in solid components.

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(AUTONOMOUS)**

2460383: COMPUTER AIDED PRODUCTION DRAWING PRACTICE LAB

B. Tech. III Year II Sem.   **L   T   P   C**
                                                       0   0   2   1

Pre-requisites: Machine Drawing, AutoCAD

Course Objectives: The students will try to learn:

➢ The standard conventions for different materials in working drawing, dimensioning, and title block
➢ The sectional views for various machine elements.
➢ The standard conventions for different machine parts in working drawing.
➢ The assembly drawings given details of part drawing.
➢ The use of GD&T on part and assembly drawings.

Course Outcomes:

➢ Explain the theory concepts of production drawing and its application.
➢ Understand the GD & T symbols used in production drawing.
➢ Design 2D models using AutoCAD software.
➢ Create assembly models given part models using AutoCAD software.
➢ Apply concepts of GD &Ton 3D components.

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List of Experiments:

1. Draw conventions for different materials, dimensioning, title block and BOM.
2. Draw various types of threads using AUTOCAD.
3. Draw a 2D sketch of various machine elements.
4. Draw a 2D sketch of various joints.
5. Draw a 2D sketch of various couplings.
6. Draw a 2D sketch of various bearings.
7. Generate assembly drawing of screw jack for given details.
8. Generate assembly drawing of connecting rod for given details.
9. Generate assembly drawing of stuffing box for given details.
10. Generate assembly drawing of eccentric for given details.
11. Apply of GD & T on machine elements, couplings, bearings.
12. Apply of GD & T on assembly drawings.

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IV - I

MARRI LAXMAN REDDY INSTITUTE OF TECHNOLOGY AND MANAGEMENT
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2470335: INSTRUMENTATIONAND CONTROL SYSTEMS

IV Year I Sem   **L T P C**

                                                                             2 0 0 2

Course Overview:

This course introduces the fundamental principles of instrumentation and measurement systems, covering both classical and modern methods of measuring various physical parameters. It also explores control system elements with real-time industrial applications**.**

Prerequisite:

Basic concepts of physics and engineering mechanics.

Course Objective: The students will try to learn

1. Fundamentals of measurement systems and performance characteristics.
2. Working principles of sensors and transducers for physical quantities.
3. Instrumentation for industrial applications including displacement, pressure, temperature, and speed.
4. Components and functioning of control systems including feedback mechanisms.
5. Advanced topics in smart instrumentation and integration with modern digital platforms.

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

1. Analyze instrumentation systems with static and dynamic performance characteristics.
2. Select appropriate measurement methods for displacement, temperature, and pressure.
3. Evaluate advanced sensors for acceleration, force, torque, and level measurements.
4. Interpret open and closed loop control systems and their industrial relevance.
5. Explore modern trends in instrumentation including IoT, data acquisition, and AI integration.

Module-I: **[09]**

Definition – Basic principles of measurement – Measurement systems, generalized configuration and functional description of measuring instruments – examples. Static and dynamic performance characteristics – sources of errors, classification and elimination of

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errors – calibration techniques.

Module-II: **[11]**
Measurement of Displacement: Theory and construction of various transducers to measure displacement-LVDT,Piezoelectric, Inductive, Capacitive.
Measurement of Temperature: Classification – Expansion Type: Bimetallic Strip, Liquid-in-glass Thermometer; Electrical Resistance Type: Thermistor, Thermocouple, RTD; Radiation Pyrometry: Optical Pyrometer, Infrared Thermometer.
Measurement of Pressure: Classification – Manometers, Bourdon pressure gauges, Diaphragm, Bellows, Dead weight tester, Bulk modulus pressure gauges; Low pressure measurement – Thermal conductivity, Ionization and McLeod gauges.

Module-III: **[09]**
Measurement of Acceleration and Vibration: Principles of seismic instruments – Vibrometer and accelerometer, Piezoelectric accelerometer.
Measurement of Speed: Mechanical tachometers, Electrical tachometers, Non-contact type – Stroboscope, Optical encoders.
Measurement of Force, Torque and Power: Load cells, Strain gauges, Torque meters, Dynamometers.

Module-IV: [09]
Stress-Strain Measurements: Electrical resistance strain gauge – gauge factor –
method of usage Strain gauge Rosettes
Measurement of Humidity: Moisture content in gases – Sling psychrometer, Dew point meter, Absorption type psychrometer.

Module–V: **[10]**
Smart Instrumentation and Industry Trends:
Digital instrumentation systems – Data Acquisition Systems (DAQ), Smart sensors – MEMS – Wireless Sensor Networks, Introduction to Industrial IoT (IIoT).
Flow Measurement: Rotameter, Magnetic, Ultrasonic, Turbine type flow meters, Hot-wire anemometer.

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Level Measurement: Direct and Indirect methods – Capacitive, Ultrasonic, Bubbler, Cryogenic, and Radioactive level indicators.

Advanced Applications: Cloud-based monitoring systems, Basics of AI/ML for condition monitoring and predictive maintenance.

Textbooks:

1. A.K. Tayal – *Instrumentation, Mechanical Measurements and Control*, Galgotia Publications, 2nd Ed.
2. Dr. D.S. Kumar – *Mechanical Measurements and Control*, Metropolitan Book Co., 1st Ed.
3. R.K. Rajput – *Instrumentation and Control Systems*, S. Chand

Reference Books:

1. B.C. Nakra & K.K. Chaudhry – *Instrumentation, Measurement and Analysis*, Tata McGraw Hill, 3rd Ed.
2. A. Nagoor Kani – *Control Systems*, RBA Publications
3. K. Lal Kishore – *Electronic Measurements and Instrumentation*, Pearson

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2470336: CAD/CAM

IV Year I Sem

L	T	P	C
3	0	0	3

Course Overview:

A CAD/CAM course provides training in the integration of Computer-Aided Design (CAD) and Computer-Aided Manufacturing (CAM) technologies. These courses equip individuals with the skills to utilize computer software for designing and manufacturing products, from initial concept to final production. The curriculum typically covers topics like 2D and 3D modeling, CNC machining, and the use of CAD/CAM software like Autodesk Fusion.

Course Objective: The students will try to learn
1. To study about the CAD process and concept of geometric modelling.
2. To study the concepts of wireframe modelling.
3. To study the concepts related to surface modelling.
4. To study the concepts of solid modelling.
5. To study about geometric transformations techniques, data exchange formats and mechanical tolerance.

Course Outcomes: After successful completion of the course, students should be able to
1. Understand the CAD process and geometric modelling concepts.
2. Analyse the utility and application of wire frame modelling.
3. Understand the concepts of surface modelling.
4. Understand and apply the concepts of solid modelling techniques.
5. Understand graphics by using transformations and analyse the utility of data exchange formats with dimensioning and tolerances.

Module-I: **[09]**

Fundamentals of CAD/ CAM, Application of computers for Design and Manufacturing, Benefits of CAD/ CAM - Computer peripherals for CAD/ CAM, Design workstation, Graphic terminal, CAD/ CAM software- definition of system software and application software, CAD/ CAM database and structure.

Geometric Modeling: Wire frame modeling, wire frame entities, Interpolation and approximation of curves, Concept of parametric and non-parametric representation of curves, Curve fitting techniques, definitions of cubic spline, Bezier, and B-spline.

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LEARNING OUTCOME:
1. Understand importance of design concept. (L2).
2. Understand the design process wireframe modeling. (L2)

Module-II: **[10]**

Surface modeling: Algebraic and geometric form, parametric space of surface, Blending functions, parametrization of surface patch, Subdividing, Cylindrical surface, Ruled surface, Surface of revolution Spherical surface, Composite surface, Bezier surface. B-spline surface, Regenerative surface and pathological conditions.

Solid Modelling: Definition of cell composition and spatial occupancy enumeration, Sweep representation, Constructive solid geometry, Boundary representations.

LEARNING OUTCOME:
1. Illustrate design procedures for various surfaces modeling method. (L2)
2. Make use of those design procedures in solid modeling components.(L3)

Module-III: **[09]**

NC Control Production Systems: Numerical control, Elements of NC system, NC part programming: Methods of NC part programming, manual part programming, Computer assisted part programming, Post Processor, Computerized part program, SPPL (A Simple Programming Language). CNC, DNC and Adaptive Control Systems.

LEARNING OUTCOME:
1. Understanding the principles of NC (Numerical Control), CNC (Computer Numerical Control), and DNC (Direct Numerical Control) systems. (L3)
2. Understanding the operation of CNC machines, including setup, programming, and troubleshooting**.** (L4)

Module-IV: **[09]**

Group Technology: Part families, Parts classification and coding. Production flow analysis, Machine cell design.

Computer aided process planning: Difficulties in traditional process planning, Computer aided process planning: retrieval type and generative type, Machinability data systems.

Computer aided manufacturing resource planning: Material resource planning, inputs to MRP, MRP output records, Benefits of MRP, Enterprise resource planning, Capacity requirements planning**.**

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LEARNING OUTCOME:

1. Understand the grouping in various machine parts. (L2)
2. Illustrate various Computer integrated manufacturing method.(L3)

Module–V: **[09]**

Flexible manufacturing system: F.M.S equipment, FMS layouts, Analysis methods for FMS benefits of FMS. **Automated guided vehicles systems (AGVS): Types of AGVS, applications,Introduction to concurrent engineering.**

Computer Integrated Manufacturing: CIM system, Benefits of CIM

LEARNING OUTCOME:

3. Understanding the principles of computer-aided design, including geometric modeling (wireframe, surface, and solid modeling), part modeling, assembly modeling, and drafting (L4)
4. Understanding the principles of Computer-Aided Manufacturing, includingCNC(Computer Numerical Control) machining, NC part programming, and the differences between conventional and CNC machines. (L5)

Text Books:

1. CAD/CAM Concepts and Applications / Alavala / 2nd edition/PHI
2. CAD/CAM Principles and Applications / P. N. Rao / 3rd edition/Mc Graw Hill

Reference Book:

1. CAD/CAM/ Groover M.P/ 4th edition/ Pearson.
2. CAD/CAM/CIM/ Radhakrishnan and Subramanian / 2nd edition/ New Age.
3. Harold Belofsky, Plastics, Product Design and Process Engineering, 3rd edition/HanserPublishers, 2002.

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(AUTONOMOUS)

2470305: Additive Manufacturing and its Application
(Open Elective - III)

IV   YEAR ISEM   **L   T   P   C**
                                                                          3   0   0   3

Course Overview:

This course introduces the fundamentals of Rapid Prototyping (RP) and Additive Manufacturing (AM), covering its historical development, process chains, classifications, and limitations. Students will explore liquid-based systems such as Stereo Lithography Apparatus (SLA) and Solid Ground Curing (SGC), solid-based systems including Laminated Object Manufacturing (LOM) and Fused Deposition Modeling (FDM), and powder-based systems like Selective Laser Sintering (SLS) and Three-Dimensional Printing (3DP). Emphasis is placed on working principles, process parameters, advantages, limitations, and industrial case studies. The course concludes with diverse applications in aerospace, automotive, healthcare, jewelry, GIS, architecture, and bioengineering, enabling students to apply RP technologies in real-world design and manufacturing.

Prerequisite: Manufacturing Process.

Course Objective: The students will try to learn
  ➢ To understand fundamentals, history, classifications, advantages, limitations, and process chain of RP.
  ➢ To learn principles, processes, applications, and case studies of SLA and SGC systems.
  ➢ To study models, processes, and industrial applications of LOM and FDM technologies.
  ➢ To explore processes, advantages, disadvantages, and applications of SLS and 3DP methods.
  ➢ To understand RP applications in engineering, aerospace, automotive, medical, and bioengineering fields.

Course Outcomes: After successful completion of the course, students should be able to
  ➢ Demonstrate knowledge of RP fundamentals, classifications, limitations, and process chains effectively.
  ➢ Illustrate the working principles, processes, and applications of SLA and SGC systems.
  ➢ Apply design understanding of LOM and FDM processes to industrial applications.
  ➢ Analyze SLS and 3DP methods with respect to performance, advantages, and applications.

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➢ Utilize RP technologies for solving real-world problems in engineering, healthcare, and other industries.

Module-I: Introduction   [10]

Introduction: Prototyping fundamentals, Historical development, Fundamentals of Rapid Prototyping, Advantages, and Limitations of Rapid Prototyping, commonly used Terms, Classification of RP process, Rapid Prototyping Process Chain: Fundamental Automated Processes, Process Chain.

Module-II:Liquid-based Rapid Prototyping Systems   [09]

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

Module-III:Solid-based Rapid Prototyping Systems   [11]

Solid-based Rapid Prototyping Systems: Laminated Object Manufacturing (LOM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Fused Deposition Modeling (FDM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.

Module-IV:Powder Based Rapid Prototyping Systems   [09]

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.

Module–V:Additive Manufacturing Applications   [09]

RP Applications: Application - Material Relationship, Application in Design, Application in Engineering, Analysis and Planning, Aerospace Industry, Automotive Industry, Jewelry Industry, Coin Industry, GIS application, Arts and Architecture. RP Medical and Bioengineering Applications: Planning and simulation of complex surgery, Customized Implants & Prosthesis,

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Design and Production of Medical Devices, Forensic Science and Anthropology, Visualization of Bio molecules.

TEXT BOOKS:

1. Rapid prototyping; Principles and Applications /Chua C.K., Leong K.F. and LIM C.S/World Scientific Publications
2. Rapid Manufacturing /D.T. Pham and S.S. Dimov/Springer

REFERENCE BOOKS:

1. Terry Wohlers, Wholers Report 2000, Wohlers Associates
2. Rapid Prototyping and Manufacturing /PaulF.Jacobs/ASME

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2470306: NON-CONVENTIONAL ENERGY SOURCES
(Open Elective - III)

IV Year I Sem

	L	T	P	C
	3	0	0	3

Course Overview:

➢ Covers solar radiation principles, environmental impact, measurement instruments, and analysis of terrestrial and extra-terrestrial radiation data.

➢ Explores solar collectors, thermal analysis, and applications like solar heating, cooling, drying, distillation, and photovoltaic conversion.

➢ Discusses wind energy systems, performance characteristics, and biomass conversion through anaerobic/aerobic digestion and bio-gas applications.

➢ Focuses on geothermal, ocean thermal energy conversion (OTEC), tidal and wave energy, and mini-hydel power plants, emphasizing energy potential and conversion technologies.

➢ Introduces DEC methods like thermoelectric generators, MHD systems, and fuel cells, explaining their working principles, thermodynamic aspects, materials, and economic feasibility.

Prerequisite:

Course Objective: The students will try to learn

➢ The need of the non-convectional energy sources.

➢ The comparison of various solar collectors.

➢ The identification of energy resources utilization systems

➢ The source and potential of wind energy and classifications of wind mills.

➢ The principles of bio-conversion, ocean energy and geo thermal energy.

CourseOutcomes:Aftersuccessfulcompletionofthecourse,studentsshouldbeableto

➢ Choose the appropriate renewable energy as an alternate for conventional power in any application. (L_3)

➢ Understand principles of various solar collectors and using them in different applications. (L_2)

➢ Inculcate the knowledge on usage of alternate energy sources in I.C Engines. (L_3)

➢ Know various energy conversion techniques. (L_2)

➢ Analyze how large-scale heat energy demands in domestic, institutional, and industrial sectors can be met using solar thermal, biogas, PV cells, wind, geothermal, and MHD systems. (L_4)

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Module-I: **[10]**

Principles of Solar Radiation, Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power - Physics of the sun, the solar constant, extra-terrestrial and terrestrial solar radiation, Solar radiation on titled surface, Instruments for measuring solar radiation and sun shine, solar radiation data.

Module-II: **[09]**

Solar Energy Collection Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors. Solar Energy Storage and Applications: Different methods, sensible, latent heat and stratified storage, solar ponds. Solar applications - solar heating/ cooling techniques, solar distillation and drying, Photovoltaic energy conversion.

Module-III: **[09]**

Wind Energy Sources and potentials, horizontal and vertical axis windmills, performance characteristics. Bio-Mass: Principles of Bio-Conversion, Anaerobic /aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, I.C. Engine operation,   and economic aspects.

Module-IV: **[09]**

Geothermal Energy Resources, types of wells, methods of harnessing the energy, potential in India. OTEC: Principles, utilization, setting of OTEC plants, thermodynamic cycles. Tidal and Wave Energy: Potential and conversion techniques, mini-hydel power plants, their economics.

Module–V: **[09]**

Direct Energy Conversion Need for DEC, Carnot cycle, limitations, Principles of DEC. Thermo-electric generators, Seebeck, Peltier and Joule Thompson effects, figure of merit, materials, applications, MHD generators, principles, dissociation and ionization, hall effect, magnetic flux, MHD accelerator, MHD engine, power generation systems, electron gas dynamic conversion,

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economic aspects. Fuel cells, principle, faraday's laws, thermodynamic aspects, selection of fuels and operating conditions.

Text Books:
1.Renewable Energy Sources/Twidell& Weir /Taylor and Francis / 2nd Special Indian Edition.
2.Non- conventional Energy Sources / G.D. Rai / Dhanpat Rai and Sons/ Latest Edition
3.Energy Resources Utilization and Technologies/Anjaneyulu & Francis/BS Publications/2012

Reference Books:

1.Principles of Solar Energy / Frank Krieth& John F Kreider / Hemisphere Publications
2.Non-Conventional Energy Systems / K Mittal / Wheeler.
3.Non-Conventional Energy / Ashok V Desai / Wiley Eastern

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(AUTONOMOUS)

2470349: REFRIGERATION AND AIRCONDITIONING
(Professional Elective–III)

IV YEAR I SEM   **L   T   P   C**
                                                               3   0   0   3

Course Overview:

This course introduces the principles, systems, and applications of refrigeration and air conditioning. Students will study different refrigeration cycles, refrigerants, system components, and absorption systems, along with advanced and non-conventional refrigeration methods. The course also covers psychometric processes, human comfort requirements, and air conditioning systems for residential, commercial, and industrial applications. Emphasis is placed on energy efficiency, environmental impact, and design aspects relevant to modern thermal engineering practices.

Prerequisite: Thermodynamics

Course Objective: The students will try to learn

1. Understand the basic principles, cycles, and applications of refrigeration systems.
2. Analyze vapor compression refrigeration, compound compression, and system components.
3. Study absorption, steam jet, cryogenic, and unconventional refrigeration systems.
4. Apply psychometric for comfort air conditioning and heating/cooling load calculations.
5. Gain knowledge of air conditioning systems, ventilation, fans, blowers, and modern control equipment.

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

1. Explain refrigeration fundamentals, refrigeration cycles, and performance evaluation using COP.

2. Analyze vapor compression systems, operating parameters, and refrigerant properties including ODP and GWP.

3. Compare absorption, steam jet, and cryogenic refrigeration systems for different applications.

4. Use psychometric charts to evaluate comfort conditions and calculate heating/cooling loads.

5. Select suitable air conditioning systems, ventilation methods, and auxiliary equipment for engineering applications.

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(AUTONOMOUS)

Module-I: **[10]**
Introduction to refrigeration: Necessity and applications, UNIT of refrigeration and C.O.P, Mechanical refrigeration, types Reversed Carnot cycle of refrigeration.
Air Refrigeration: Bell Coleman cycle, Open and Dense air systems, Actual refrigeration system. Necessity of aircraft refrigeration, Aircraft refrigeration systems-Types.

Module-II: **[09]**
Vapour Compression Refrigeration: Performance of Complete vapor compression system. Actual Vs Ideal cycle - Effect of operating parameters on COP,
Components of Vapor Compression System: The condensing unit – Evaporators – Expansion valve – Refrigerants – Properties – ODP & GWP - Load balancing of vapor compression Unit.
Compound Compression: Flash inter-cooling – flash chamber – Multi-evaporator & Multistage systems.

Module-III: **[10]**
Vapor absorption system – Simple and modified aqua – ammonia system – Representation on Enthalpy –Concentration diagram. Lithium – Bromide system Three fluid system – HCOP.
Steam Jet refrigeration system: Representation on T-s and h-s diagrams . Thermo-electric – Vortex tube & Pulse tube – working principles**.**
Production of Low Temperature: Liquefaction system, Liquefaction of gases, Hydrogen and Helium, Cascade System – Applications– Dry ice system.

Module-IV: **[09]**
Air Conditioning: Psychometric properties and processes – Construction of Psychometric chart. Requirements of Comfort Air –conditioning – Thermodynamics of human body – Effective temperature and Comfort chart – Parameters influencing the Effective Temperature.
Heating Load Calculations: Summer/ Winter heating load calculation-heat losses through structureheat losses due to infiltration. Effects of solar radiation and internal heat sources on heating loads. Air Heating System: Classification - gravity warm heating system, forced warm

air heating system balancing a warm air heating system, warm air furnaces, air cleaners, humidifiers & De-humidifiers.

Module–V: **[9]**
Air Conditioning Systems: All Fresh air, Re-circulated air with and without bypass, with reheat systems – Calculation of Bypass Factor, ADP, RSHF, ESHF and GSHF for different systems.
Ventilation: Ventilation and Infiltration: Requirement of ventilation air, various sources of infiltration air, ventilation and infiltration as a part of cooling load. Fans and Blowers: Types, performance characteristics, series and parallel arrangement, selection procedure. Equipments and Controls: Chillers, Condensing units, Cooling coils, bypass factors, humidifiers, dehumidifiers

Text Books:
1. Refrigeration & Air Conditioning by C.P. Arora, TMH/4th Edition
2. Refrigeration & Air Conditioning by Arora &Domkundwar, DhanpatRai/3rd Edition.
3. Refrigeration and Air Conditioning by Manohar Prasad/3rd Edition

Reference Books:
1. Basic Refrigeration & Air Conditioning by P.N. Ananthanarayanan, McGraw Hill/3rd Edition
2. Refrigeration and Air Conditioning by Stoecker, McGraw Hill/2nd Edition
3. Refrigeration and Air Conditioning by Dr. S.S. Thipse, Jaico/2nd Edition
4. Refrigeration and Air Conditioning by Jordan&Preister, Prentice Hal/2nd Edition
5. Refrigeration and Air Conditioning by Dossat, McGraw Hill/5th Edition

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(AUTONOMOUS)

2470350: Automobile Engineering
(Professional Elective–III)

IV YEAR I SEM   **L T P C**
                                                               3 0 0 3

Course Overview:

This course provides a comprehensive introduction to the fundamentals of automobiles, including their construction, operation, and modern advancements. Students will learn about the layout, major systems, and components of automobiles, covering engines, fuel systems, cooling and ignition systems, electrical systems, transmission, suspension, braking, steering, emissions, and alternative fuels. The course emphasizes both theoretical knowledge and practical aspects of automobile engineering, preparing learners for applications in design, servicing, and maintenance.

Prerequisite: Thermal Engineering-1

Course Objective: The students will try to learn

1. Elaborate the Systems of Automobile, Components of Engine, fuel & Lubrication system and its requirements.
2. Explain the significance and features of Cooling, Ignition and Electrical Systems.
3. Illustrate the working of transmission system and Suspension systems and its components.
4. Elaborate the function of each accessory of steering and braking system and their role for effective performance of automobile.
5. Discuss the particulates of combustion in CI and SI engines, reasons for formation of particulates and methods adopted to control the pollution.

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

1. Illustrate the function of each and every system of an automobiles including fuel system and injection approaches
2. Explain the Cooling, ignition and electrical system of the Automobile.
3. Describe each component of transmission system of an automobile viz clutch, gear box, propeller shaft and differential and suspension system and the effect of the same on tyre performance and other components of an automobile.
4. Analyze the geometry of the steering mechanism and braking system.
5. Demonstrate about emission standards, emission control techniques and electrical systems.

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Student can identify thrust areas for carrying their dissertation in future.

Module-I: **[11]**

Introduction: Layout of automobile – introduction chassis and body components. Types of Automobile engines – Power unit – Introduction to engine lubrication – engine servicing.

Fuel System: S.I. Engine: Fuel supply systems, Mechanical and electrical fuel pump – filters – carburetor – types – air filters – petrol injection. Introduction to MPFI and GDI Systems.

C.I. Engines: Requirements of diesel injection systems, types of injection systems, DI Systems IDI systems. Fuel pump, nozzle, spray formation, injection timing, testing of fuel pumps. Introduction to CRDI and TDI Systems**.**

Module-II: **[09]**

Cooling System: Cooling Requirements, Air Cooling, Liquid Cooling, Thermo, water and Forced Circulation System – Radiators – Types – Cooling Fan - water pump, thermostat, evaporative cooling – pressure sealed cooling – antifreeze solutions.

Ignition System: Function of an ignition system, battery ignition system, constructional features of storage, battery, auto transformer, contact breaker points, condenser, and spark plug – Magneto coil ignition system, electronic ignition system using contact breaker, electronic ignition using contact triggers – spark advance and retard mechanism.

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..

Module-III: **[09]**

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, constant 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.

Suspension System: Objects of suspension systems – rigid axle suspension system, torsion bar, shock absorber, independent suspension system.

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Module-IV: **[09]**

Braking System: Mechanical brake system, Hydraulic brake system, Master cylinder, wheel cylinder tandem master cylinder Requirement of brake fluid, Pneumatic and vacuum brakes.

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.

Module–V: **[10]**

Emissions from Automobiles – Pollution standards National and international – Pollution Control – Techniques – Multipoint fuel injection for SI Engines. Common rail diesel injection Energy alternatives – Solar, Photo-voltaic, hydrogen, Biomass, alcohols, LPG, CNG, liquid Fuels, and gaseous fuels, Hydrogen as a fuel for IC Engines. - Their merits and demerits. Standard Vehicle maintenance practice**.**

Text Books:
1. Automobile Engineering / William H Crouse/10th Edition
2. A Text Book Automobile Engineering–Manzoor, Nawazish Mehdi &Yosuf Ali, Frontline Publications/2nd Edition

Reference Books:

1. A Text Book of Automobile Engineering by R K Rajput, Laxmi Publications/**2nd Edition**
2. Automotive Mechanics / Heitner/**2nd Edition**
3. Automotive Engineering / Newton Steeds & Garret/**13th Edition**
4. Automotive Engines / Srinivasan/**2nd Edition**

MARRI LAXMAN REDDY INSTITUTE OF TECHNOLOGY AND MANAGEMENT
(AUTONOMOUS)

2470351: Computational Fluid Dynamics
(Professional Elective–III)

B. Tech. IV Year, I Sem.

L	T	P	C
3	0	0	3

Pre-requisite: Heat Transfer and Fluid Mechanics

Course Objectives: The students will learn to
1. Understand the fundamental principles of heat transfer and fluid mechanics.
2. Develop the ability to formulate governing equations for real-world thermal and fluid flow problems.
3. Analyze the behavior of heat and fluid flow using theoretical and mathematical models.
4. Apply appropriate numerical techniques (such as finite difference or finite volume methods) to solve the governing equations.
5. Interpret numerical results to draw meaningful physical insights and support engineering decision-making.

Course Outcomes: After successful completion of the course, students will be able to:
1. Classify different types of partial differential equations (PDEs) relevant to heat transfer and fluid flow problems.
2. Select and apply appropriate numerical techniques (e.g., Finite Difference Method) to solve PDEs.
3. Solve basic heat transfer and fluid flow problems using numerical methods.
4. Interpret numerical results and understand their physical significance.
5. Recognize the importance of validating numerical solutions against analytical or experimental data.

Module-I: **[11]**

Basic Aspects of the Governing Equations – Physical Boundary Conditions – Methods of solutions of Physical Problems – Need for Computational Fluid Dynamics – Different numerical/CFD techniques – FDM, FEM, FVM etc., - Main working principle - CFD as a research and design tool – Applications in various branches of Engineering

Mathematical behavior of Partial Differential Equations (Governing Equations): Classification of linear/ quasi linear PDE – Examples - Physical Processes: Wave Equations and Equations of Heat Transfer and Fluid Flow – Mathematical Behavior - General characteristics – Its

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significance in understanding the physical and numerical aspects of the PDE – One way and Two Way variables – Well posed problems – Initial and Boundary Conditions
Solution of Simultaneous Algebraic Equations: Direct Method – Gauss Elimination – LU Decomposition – Pivoting – Treatment of Banded Matrices – Thomas Algorithm
Iterative Method: Gauss Seidel and Jordan Methods - Stability Criterion.

Module-II: [09]
Finite Difference Method: Basic aspects of Discretization – Finite Difference formulae for first order and second order terms – Solution of physical problems with Elliptic type of Governing Equations for different boundary conditions - Numerical treatment of 1D and 2D problems in heat conduction, beams etc., - Solutions –Treatment of Curvelinear coordinates – Singularities – Finite Difference Discretization – Solution of 1D heat conduction problems in Heat conduction in curve linear coordinate.

Module-III: [10]
FDM: Solution of physical problems with Parabolic type of Governing Equations – Initial Condition Explicit, implicit and semi implicit methods – Types of errors – Stability and Consistency – Von Neumann Stability criterion– Solution of simple physical problems in 1D and 2D – Transient Heat conduction problems- ADI scheme - Simple Hyperbolic type PDE - First order and Second order wave equations – Discretization using Explicit method - Stability criterion – Courant Number – CFL Condition - Its significance - Treatment of simple problems.

Module-IV: [09]
Finite Difference Solution of Unsteady Inviscid Flows: Lax – Wendroff Technique – Disadvantages – Maccormack's Technique.

Fluid Flow Equations – Finite Difference Solutions of 2D Viscous Incompressible flow problems – Vorticity and Stream Function Formulation – Finite Difference treatment of Lid Driven Cavity Problem -Application to Cylindrical Coordinates with example of flow over infinitely long cylinder and sphere – Obtaining Elliptic Equations.

Module–V: [09]
Finite Difference Applications in Fluid flow problems: Fundamentals of fluid Flow modeling using Burger's Equation – Discretization using FTCS method with respect to Upwind Scheme

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and Transport Property – Upwind Scheme and Artificial Viscosity.

Solutions of Navier Stokes Equations for Incompressible Fluid Flows: Staggered Grid – Marker and Cell (MAC) Formulation – Numerical Stability Considerations – Pressure correction method - SIMPLE Algorithm.

Text Books:

1. Computational Fluid Dynamics: The basics with applications/ John D Anderson/McGraw Hill Publications.

2. Numerical Heat Transfer and Fluid Flow/ S.V. Patankar/ Mc Graw Hill

Reference Books:

1. Computational Fluid Flow and Heat Transfer / K Muralidharan and T Sudarajan/ Narosa Publishers
2. Computational Methods for Fluid Dynamics / Firziger&Peric/ Springer.
3. Computational Fluid Dynamics/Chung T. J./Cambridge/Second Edition.

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(AUTONOMOUS)

2470352: HYDRAULIC AND PNEUMATICS
(Professional Elective-III)

L	T	P	C
3	0	0	3

B.Tech. IV Year

Pre-requisites: Fluid Mechanics and Hydraulics Machinery COURSE OBJECTIVES

1. To know the concepts of hydraulics & pneumatics.
2. To learn the applications of hydraulics and pneumatics in automobiles.
3. To know the advantages and applications of Fluid Power Engineering and Power Transmission System.
4. Know the components of hydraulic and pneumatic circuits.
5. To learn the Applications of Fluid Power System in automation of Machine Tools and others Equipment's.

Course Outcomes: After completion of the course the student is able to

1. Understand the Properties of fluids, Fluids for hydraulic systems and distribution of fluid power. (L1)
2. Design and analysis of typical hydraulic circuits. (L4)
3. Identify the accessories used in fluid power system. (L2)
4. Filtration systems and maintenance of system. (L4)
5. Explain safe handling of hydraulic fluids, cylinders, control valves and hoses. (L3)

UNIT – 1: BASIC COMPONENTS OF HYDRAULICS   CLASSES:12

Introduction to oil hydraulics and pneumatics, their structure, advantages and limitations. ISO symbols, energy losses in hydraulic systems. Applications, Basic types and constructions of Hydraulic pumps and motors. Pump and motor analysis. Performance curves and parameters.

Learning outcome:

1.   To list the basic components required in hydraulic and pneumatic power systems. (L1)
2.   Describe the basic working principle of hydraulic and pneumatic power systems. (L2)

UNIT – 2: ACTUATORS AND VALVES   CLASSES:12

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Hydraulic actuators, types and constructional details, lever systems, control elements – direction, pressure and flow control valves. Valve configurations, General valve analysis, valve lap, flow forces and lateral forces on spool valves. Series and parallel pressure compensation flow control valves. Flapper valve Analysis and Design.

Learning outcome:

1.   Distinguish between a single-acting and a double- acting hydraulic cylinders. (L2)

2.   Understand and explain the construction, operation, and application of various pressure, control and flow control valves. (L1)

UNIT – 3: HYDRAULIC CIRCUITS   CLASSES :12

Proportional control valves and servo valves. Nonlinearities in control systems (backlash, hysteresis, dead band and friction nonlinearities). Design and analysis of typical hydraulic circuits. Regenerative circuits, high low circuits, Synchronization circuits, and accumulator sizing.

Learning outcome:

1.   To understand and appreciate the functions and applications of accumulators. (L2)

2.   Describe the construction and operation of various accumulator circuits. (L4)

UNIT – 4: BASIC COMPONENTS OF PNEUMATIC   CLASSES :09

Intensifier circuits Meter-in, Meter-out and Bleed-off circuits; Fail Safe and Counter balancing circuits, accessories used in fluid power system, Filtration systems and maintenance of system. Components of pneumatic systems; Direction, flow and pressure control valves in pneumatic systems. Development of single and multiple actuator circuits. Valves for logic functions; Time delay valve; Exhaust and supply air throttling;

Learning outcome:

1.   To understand and appreciate the functions and applications of pressure intensifier. (L1)

2.   Understand and explain the construction, operation, and application of air pressure regulator and flow control valve. (L5)

UNIT – 5: CONTROL SYSTEMS AND APLLICATINS   CLASSES :09

Examples of typical circuits using Displacement – Time and Travel-Step diagrams. Will-dependent control, Travel-dependent control and Time dependent control, combined control,

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Program Control, Electropneumatic control and air-hydraulic control, Ladder diagrams. Applications in Assembly, Feeding, Metal working, materials handling and plastics working.

Learning outcome:

1.   Understand the technology of fluidics and how fluidics is used to control fluid power systems. (L1)

2.   Apply and design fluidic logic circuits for various fluid power systems. (L3)

Text books:

1.   Fluid Power Control systems/ Pippenger, J.J., and R. M. Koff/ New York: McGraw Hill.

2.   "Fluid Power Systems: modeling, simulation and microcomputer control"/ John Watton/ Prentice Hall International.

Reference books:

1.   Fundamentals of Fluid Power Control. / John Watton/ 1st Ed. Cambridge University Press, 2009

2.   "Fluid Power with applications"/ Anthony Esposito / Pearson Education.

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(AUTONOMOUS)**

2470353: COMPOSITE MATERIALS
(Professional Elective-IV)

	L	T	P	C
	3	0	0	3

Pre-requisites: Manufacturing Process

COURSE OBJECTIVES

1.   To gain an understanding of the fundamentals, classifications, applications, and mechanical behavior of composite materials.

2.   To acquire knowledge of composite processing methods and manufacturing techniques.

3.   To study the mechanics of composites and analyze them using FEM and optimization approaches.

4.   To develop insights into nanocomposites and their processing techniques.

5.   To explore recent advancements and applications of composite materials.

COURSE OUTCOMES: After completion of the course the student is able to

1.   Identify the properties of different composites. (L3)

2.   Demonstrate manufacturing methods for various composites. (L4)

3.   Understand the basic mechanics of composite laminates. (L1)

4.   Explain recent developments in nanocomposites, including metal, polymer, and ceramic matrix types. (L2)

5.   Describe the applications of composite materials. (L5)

UNIT – 1: BASICS OF COMPOSITE MATERIALS   CLASSES:10

Definition-Classification of composites based on reinforcement & matrix-Reinforcements -Types of fibers (Glass fibre, kevlarfibre, Carbon fibre, Organic fibre, whiskers)-Matrix Materials-Polymers (Thermoplastic and Thermosets).

LEARNING OUTCOME:

1.   Define composite materials and classify them based on reinforcement and matrix type. (L1)

2.   Differentiate between types of fibers and matrix materials with examples of their applications. (L2)

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UNIT – 2: MANUFACTURING OF COMPOSITES-I   CLASSES:10

Processing of Polymer Matrix Composite-Hand layup & Spray technique - Filament winding – Pultrusion – Resin transfer moulding. Advantages and limitations of respective processes.

LEARNING OUTCOME:

1.   Name different polymer matrix composite processes like hand layup, spray, filament winding, pultrusion, and resin transfer molding. (L1)

2.   Explain the main advantages and limitations of these processes. (L2)

UNIT – 3: MANUFACTURING OF COMPOSITES-II   CLASSES :10

Metal Matrix Composite - Liquid-State Processes, In Situ Processes- Ceramic Matrix Composite-Cold Pressing and Sintering, Hot Pressing, Infiltration, Direct Oxidation, In Situ Chemical Reaction Techniques – Solgel – Advantages and limitations of respective processes.

LEARNING OUTCOME:

1.   List different metal and ceramic matrix composite types and their processing methods. (L1)

2.   Describe the advantages and limitations of these processing methods. (L2)

UNIT – 4: NANO COMPOSITES   CLASSES :09

Carbon/carbon composites-processing-properties-Nano Composites-Polymer clay nano composites- CNT based composites - Self healing composites- Bio Composites-Hybrid composites - core-shell structure- sandwich composites.

LEARNING OUTCOME:

1.   List different types of advanced composites like carbon/carbon, nanocomposites, self-healing, bio, hybrid, core-shell, and sandwich composites. (L1)

2.   Describe basic properties and uses of these advanced composites. (L2)

UNIT – 5: RECENT APPLICATIONS   CLASSES :09

Manufacturing defects & inspection - Applications in aircraft, Space, automotive & commercial; Carbon, CNT, graphene-based composites applications- Optimization of composites - Application of FEM for design and analysis of composites – a case study.

LEARNING OUTCOME:
1. Identify defects in composites and how they are checked in industries. (L1)
2. Describe uses of carbon, CNT, and graphene composites and basic design methods. (L2)

TEXT BOOKS:
1. Krishnan K Chawla, Composite Materials: Science and Engineering, International Edition, Springer, 2012, ISBN:978-0-387-74364-6.
2. Mallick P.K., Fiber Reinforced Composites: Materials, Manufacturing and Design, 2nd edition, CRC press, New Delhi, 2010, ISBN:0849342058.

REFERENCE BOOKS:
1. Jamal Y. Sheikh-Ahmad, Machining of Polymer Composites, 3rd edition, Springer, USA, 2009. ISBN: 978-0-387-35539-9.
2. Mallick, P.K. and Newman.S., Composite Materials Technology, 2nd edition, Hanser Publishers, 2003.
3. Harold Belofsky, Plastics, Product Design and Process Engineering, 3rd edition, Hanser Publishers, 2002.

**MARRI LAXMAN REDDY INSTITUTE OF TECHNOLOGY AND MANAGEMENT
(AUTONOMOUS)**

2470355: PRODUCTION PLANNING AND CONTROL
(Professional Elective IV)

IV Year B. Tech. MECH I – Sem
B.Tech. IV Year ISem   **L   T   P   C**
                                                                      3   0   0   3

Pre-requisites: Extracting the Type of Materials Required, Machine Utilization, Numbers of Workers Required Etc.

COURSEOBJECTIVES

• To understand the problems and opportunities faced by the operations manager in manufacturing and service organizations.

 • To develop an ability to apply PPC concepts in a various areas like marketing, accounting, finance, engineering, personnel management, logistics, etc.

 • To integrate operations concepts with other functional areas of business

• To understand the PPC function in both manufacturing and service organizations.

• To examine several classic Operations Management planning topics including production planning and inventory control

. • To learn several important contemporary topics relevant to business managers of all functional disciplines, including quality management, lean concepts, and sustainability

COURSEOUTCOMES: After completion of the course the student is able to

1. Recognize the objectives, functions, applications of PPC and forecasting techniques.

 2. Explain different Inventory control techniques.

 3. Solve routing and scheduling problems

 4. Summarize various aggregate production planning techniques.

5. Describe way of integrating different departments to execute PPC functions

UNIT–I   **CLASSES:12**

Introduction: Definition – Objectives of Production Planning and Control – Functions of production planning and control– Types of production systems– Organization of production planning and control department. Forecasting – Definition- uses of forecast- factors affecting the forecast- types of forecasting- their uses –general principle of forecasting. Forecasting techniques quantitative and qualitative techniques. Measures of forecasting errors**.**

LEARNINGOUTCOME:

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1. Understand concepts of PPC
2. Analyse & apply forecasting methods

UNIT-II   **CLASSES:8**

Inventory management – Functions of inventories – relevant inventory costs – ABC analysis – VED analysis–Basic EOQ model- Inventory control systems –continuous review systems and periodic review systems, MRP I, MRP II, ERP, JIT Systems – Basic Treatment only. Aggregate planning – Definition –aggregate-planning strategies –aggregate planning methods–transportation model.

LEARNINGOUTCOME:

1.Various types of production systems(L1)

2. Various characteristics of the production system(L2)

UNIT–III   **CLASSES:10**

Line Balancing: Terminology, Methods of Line Balancing, RPW method, Largest Candidate method and Heuristic method. Routing–Definition–Routingprocedure–Factors affecting routing procedure, Route Sheet.

LEARNINGOUTCOME:

1. Know about the process planning 2. Various characteristics of process planning

UNIT-V   **CLASSES:08**

Dispatching:Definition–activitiesofdispatcher–dispatchingprocedures various forms used in dispatching. Follow up: definition – types of follow up – expediting – definition – expediting procedures-Applications of computers in planning and control.

LEARNING OUTCOME:

1.Variouscharacteristicsofdispatching. (L2) 2. Becoming a public safety dispatcher means choosing dispatching not only as a career, but as a moral commitment to maintain public trust. (L1)

TEXTBOOKS:

1. Operations management–Heizer-Pearson. 2. Production and Operations Management/ Ajay Garg /McGraw-Hill.

REFERENCE BOOKS:

1. Production Planning and Control- Text & cases/ SK Mukhopadhyaya /PHI.ProductionPlanningandControl- Jain &Jain– Khanna publications.

MARRI LAXMAN REDDY INSTITUTE OF TECHNOLOGY AND MANAGEMENT
(AUTONOMOUS)

Mechanical Vibrations
(Professional Elective IV)

IV Year I Sem   **L T P C**
                                                                     3 0 0 3

Course Overview:

1. Introduction to vibration concepts and analysis of SDOF systems under free and forced vibrations with damping and vibration isolation.

2. Analysis of SDOF system response to non-periodic excitations using impulse, step, ramp inputs, convolution integral, shock spectrum, and Laplace transform methods.

3. Study of undamped and damped multi-degree systems, normal modes, modal analysis, vibration absorbers, and torsional vibrations in mechanical systems.

4. Study of vibrations in strings, beams, bars, and shafts; evaluation of critical speeds with and without damping.

5. Measurement of vibrations using vibrometers, velocity meters, accelerometers, and analysis using numerical methods like Rayleigh, Stodola, Rayleigh-Ritz, matrix iteration, and Holzer's method.

Prerequisite: Engineering Mechanics, Strength of materials

Course Objective: The students will try to learn

1.Thefundamental concepts of mechanical vibrations and the behavior of SDOF systems.

2.Theanalytical skills for evaluating free and forced vibrations in SDOF systems.

3.The students with the modeling and analysis of multi-degree-of-freedom (MDOF) systems.

4.The knowledge on the vibration behaviour of continuous systems.

5.The ability to use vibration measurement instruments and numerical methods.

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

1.Understand the causes and effects of vibration in mechanical systems (L2)

2.Outlinevarious schematic models and formulating governing equations of motion. (L2)

3.Analyze rotating and reciprocating systems and computing critical speeds. (L4)

4. Evaluate machine supporting structures, vibration isolators, and absorbers. (L5)

5. Demonstrate vibration measuring instruments and explaining role of damping, stiffness, and inertia in mechanical systems. (L3)

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Module-I: **[08]**

 Introduction: Introduction to vibrations & basic concepts

Single degree of Freedom systems - I: Undamped and damped free vibrations; forced vibrations coulomb damping; Response to excitation; rotating unbalance and support excitation; vibration isolation and transmissibility.

Module-II: **[10]**

SINGLE DEGREE OF FREEDOM SYSTEMS – II Response to non-periodic excitations, Unit impulse, Unit step and unit ramp functions, Response to arbitrary excitations, The convolution integral, Shock spectrum, System response by the Laplace Transformation method.

Module-III: **[10]**

Two-degree freedom systems: Principal modes- undamped and damped free and forced vibrations; undamped vibration absorbers; Multi degree freedom systems: Matrix formulation, stiffness and flexibility influence coefficients; Eigen value problem; normal modes and their properties; Free and forced vibration by Modal analysis; Method of matrix inversion; Torsional vibrations of multi- rotor systems and geared systems; Discrete- Time systems.

Module-IV: **[09]**

Continuous system: Free vibration of strings – longitudinal oscillations of bars- traverse vibrations of beams- Torsional vibrations of shafts.

Critical speeds of shafts: Critical speeds without and with damping, secondary critical speed.

Vibration measuring instruments: Vibrometers, velocity meters & accelerometers

Module–V: **[09]**

Vibration measuring instruments: Vibrometers, velocity meters & accelerometers

Numerical Methods: Rayleigh's Stodola's, Matrix iteration, Rayleigh- Ritz Method and Holzer's methods

Text Books:

 1. Mechanical Vibrations by Singiresu S. Rao / SI Edition, 6th Edition /Pearson India

 2. Mechanical Vibrationsby G. K. Grover / 5th Edition/Nem Chand & Bros.

 3. Theory of Vibrations with Applications by W. T. Thomson and M. D. Dahleh / 5th Edition /US Edition

 Reference Books:

 1. Vibration Problems in Engineering by S. Timoshenko, D.H. Young, and W. Weaver

 2. Fundamentals of Vibrations by Leonard Meirovitch

 3. Vibrations and Noise for Engineers by C. Sujatha

MARRI LAXMAN REDDY INSTITUTE OF TECHNOLOGY AND MANAGEMENT (AUTONOMOUS)

2470384: CAD & CAM LAB

B. Tech. IV Year I Sem.   L   T   P   C
                                                                              0   0   2   1

Pre-requisites: Machine Drawing

Course Objectives: The students will try to learn:
1. The systematic design of 2D & 3D objects in AUTOCAD & CATIA software.
2. The fundamental modules in CATIA software like sketcher, part modelling.
3. The strong foundation with Ansys software on various analysis.
4. The ability to develop designs and analysis using CATIA software.
5. The ability to generate programs for 2D components using Cam software.

Course Outcomes:
1. Explain the theory concepts of CAD/CAM software's and its application.
2. Create 2D and 3D models using CAD software is like AUTOCAD, CATIA.
3. Apply concepts of FEM in CAE software like ANSYS.
4. Understand analysis like structural, thermal, and dynamic on the given components.
5. Develop part programs for lathe and milling operations.

List of Experiments:
1. Drafting: Development of part drawings for various components in the form of orthographic and isometric. Representation of dimensioning and tolerances.
2. Part Modeling: Generation of various 3D Models through Protrusion, revolve, sweep. Creation of various features. Study of parent child relation. Feature based and Boolean based modeling and Assembly Modeling. Study of various standard Translators. Design of simple components.
3. Determination of deflection and stresses in 2D and 3D trusses and beams.
4. Determination of deflections, principal and Von-mises stresses in plane stress, plane strain and Axi-symmetric components.
5. Determination of stresses in 3D and shell structures.
6. Estimation of natural frequencies and mode shapes, Harmonic response of 2Dbeam.
7. Study state heat transfer analysis of plane and axi-symmetric components.

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8. Development of process sheets for various components based on Tooling and Machines.
9. Development of manufacturing defects and tool management systems.
10.   Study of various post processors used in NC Machines.
11.   Development of NC code for free form and sculptured surfaces using CAM software.
12. Machining of simple components on NC lathe and Mill by transferring NC
    Code / from CAM software.

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(AUTONOMOUS)**

2470385: INSTRUMENTION AND CONTROL SYSTEMS LAB

B. Tech. IV Year I Sem   **L T P C**

                                                  0 0 2 1

PRE-REQUISITES:-COURSEOBJECTIVES

➢ Impart an adequate knowledge and expertise to calibrate instruments available in an industry.

➢ Impart knowledge on various working principles and design of instruments.

➢ Understand calibration of measuring instruments for temperature.

➢ Understand the functioning of strain gauges for measuring pressure, load, and vibrations.

➢ Apply calibration of measuring instruments of flow and speed measurement.

COURSEOUTCOMES:

After completion of the course the student is able to:

- Analyse errors, integrate and interpret different types of measurements (L3).

- Understand how physical quantities are measured and how they are converted to electrical or other forms (L2).

- Evaluate the measurement of speed in engineering applications and the importance of speed measurement in instrumentation (L4).

- Visualize the areas affected with pressure in equipment and calibrate the pressure measuring devices (L3).

- Comprehend the level of liquid in any container and the various applications of measurement of flow (L4).

- Analyse instrumentation and control systems and their applications in various industries (L4).

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LIST OF EXPERIMENTS

(A minimum of 10 experiments to be conducted)

1. Calibration of pressure gauges
2. Calibration of transducer for temperature measurements
3. Study and calibration of LVDT transducer for displacement measurements
4. Calibration of strain gauge
5. Calibration of thermocouple for temperature measurements
6. Calibration of capacitive transducer for angular displacement
7. Study and calibration of photo and magnetic speed pickups for the measurement of speed
8. Calibration of resistance temperature detector for temperature measurements
9. Study and calibration of Rotameter for flow measurement
10. Study and use of a Seismic pickup for the measurement of vibration
11. Study and calibration of McLeod gauge for low pressure
12. Measurement and Control of Temperature Loop of a Process using Resistance Temperature Detector with SCADA

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IV - II

MARRI LAXMAN REDDY INSTITUTE OF TECHNOLOGY AND MANAGEMENT (AUTONOMOUS)

2480357: TOTAL QUALITY MANAGEMENT
(Professional Elective-V)

L	T	P	C
3	0	0	3

B.Tech. IV Year II Sem

Pre-requisites: Nil

COURSE OBJECTIVES

1. To understand the fundamental concepts of Total Quality Management (TQM) and its role in improving business performance.
2. To develop the ability to apply process quality management tools such as statistical quality control, control charts, and acceptance sampling.
3. To emphasize the importance of customer focus, satisfaction, and benchmarking in achieving competitive advantage.
4. To analyze and implement strategies for organizing TQM, improving productivity, and reengineering processes in organizations.
5. To gain knowledge of the cost of quality and ISO 9000 standards, including their implementation, certification process, and benefits to organizations.

COURSE OUTCOMES: After completion of the course the student is able to

1. Explain the fundamental concepts of Total Quality Management (TQM) and its impact on organizational performance. (L2)
2. Apply statistical quality control tools and techniques (control charts, acceptance sampling) for effective process management. (L3)
3. Analyze customer requirements, satisfaction measures, and benchmarking practices to improve quality and competitiveness. (L4)
4. Evaluate productivity improvement methods, quality circles, and reengineering approaches for organizational excellence. (L5)
5. Design and develop quality systems using ISO 9000 standards, including documentation and certification processes. (L6)

UNIT – 1: Introduction to TQM and Process Quality Management   CLASSES:10

Introduction: The concept of TQM, Quality and Business performance, attitude and involvement of top management, communication, culture and management systems. Management of Process

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(AUTONOMOUS)

Quality: Definition of quality, Quality Control, a brief history, Product Inspection vs, Process Control, Statistical Quality Control, Control Charts and Acceptance Sampling.

LEARNING OUTCOME:

1.   Define the concept of TQM, quality, and their relationship with business performance. (L1)

2.   Explain process quality management, product inspection, and statistical quality control methods. (L2)

UNIT – 2: Customer Focus, Satisfaction, and Benchmarking   CLASSES:10

Customer Focus and Satisfaction: 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.

LEARNING OUTCOME:

1.   Analyze customer focus, internal customer conflict, and buyer–supplier relationships in achieving quality. (L4)

2.   LO2: Illustrate the benchmarking process, its benefits, and pitfalls in organizations. (L2)

UNIT – 3: Organizing for TQM, Productivity, and Reengineering   CLASSES :10

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.

LEARNING OUTCOME:

1.   Compare traditional management with TQM-oriented organizing methods, including quality circles. (L4)

2.   Apply productivity measurement techniques and reengineering approaches to improve organizational efficiency. (L3)

UNIT – 4:   Cost of Quality and Quality Management   **CLASSES :09**

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.

LEARNING OUTCOME:

1.   Define quality costs and their categories with examples. (L1)

2.   Evaluate the use of quality cost information in decision-making and management systems. (L5)

UNIT – 5: ISO 9000 Standards and Quality Certification   **CLASSES :09**

ISO9000: Universal Standards of Quality: ISO around the world, The ISO9000 ANSI/ASQCQ-90. Series Standards, benefits of ISO9000 certification, the third-party audit, Documentation ISO9000 and services, the cost of certification implementing the system.

LEARNING OUTCOME:

1.   Explain the ISO 9000 series standards and their significance for organizations. (L2)

2.   Develop documentation and certification procedures for implementing ISO 9000. (L6)

TEXT BOOKS:

1.   Total Quality Management: Text, cases and Readings, Third Edition - Joel E. Ross.

2.   Beyond TQM - Robert L. Flood.

REFERENCE BOOKS:

1.   Statistical Quality Control – Eugene Grant, Richard McGraw-Hill, 2017.

2.   Total Quality Management, Besterfiled D. H., Pearson Education Asia – 2015-4th Edition.

3.   The Management and Control of Quality, Evans J. R, and Lindsay W. M., Southwestern (Thomson Learning), Fifth Edition.

MARRI LAXMAN REDDY INSTITUTE OF TECHNOLOGY AND MANAGEMENT (AUTONOMOUS)

2480358: QUALITY RELIABILITY

(Professional Elective-V)

L	T	P	C
3	0	0	3

B.Tech. IV Year II Sem

Pre-requisites: Nil

COURSE OBJECTIVES

1. Provide fundamental knowledge on quality concepts, evolution, and customer orientation.
2. Develop skills in using statistical process control (SPC) tools for quality improvement.
3. Introduce acceptance sampling techniques and their role in decision-making.
4. Build analytical ability in reliability engineering, failure analysis, and maintainability.
5. Equip students with design strategies for enhancing system reliability and product development.

COURSE OUTCOMES: After completion of the course the student is able to

1. Explain quality fundamentals, quality costs, and customer-focused approaches. (L2)
2. Apply statistical quality control tools and control charts for process monitoring. (L3)
3. Evaluate acceptance sampling plans and associated risks using O.C. curves. (L5)
4. Analyze system reliability measures, maintainability, and availability from failure data. (L4)
5. Design reliability improvement techniques through redundancy, fault tree analysis, and product life cycle optimization. (L6)

UNIT – 1: Fundamentals of Quality and Statistical Tools   CLASSES:10

Introduction: -definitions of quality, Evolution of Quality: Inspection, Quality Control, Quality assurance Customer-Orientation: Internal & External Customer Concept, Life cycle approach to quality costs- Prevention; Appraisal and Failure costs. Seven SPC tools -Histogram, Check sheets, Ishikawa diagrams, Pareto, Scatter diagrams, Control charts and flow chart.

LEARNING OUTCOME:

1. Define quality concepts, evolution, and customer orientation. (L1)
2. Apply the seven QC tools to analyze process quality issues. (L3)

UNIT – 2: Control Charts and Process Capability Analysis   CLASSES:10

Control chart for attributes –control chart for non-conforming– p chart and np chart – control chart for nonconformities– C and U charts, Control chart for variables – X chart, R chart and σ chart -State of control and process out of control identification in charts, pattern study and process capability studies.

LEARNING OUTCOME:

1.   Differentiate between control charts for variables and attributes. (L2)

2.   Analyze process capability and interpret control chart patterns. (L4)

UNIT – 3: Acceptance Sampling and Operating Characteristic Curves   CLASSES :10

Lot by lot sampling – types – probability of acceptance in single, double, multiple sampling techniques – O.C. curves – producers Risk and consumers Risk. AQL, LTPD, AOQL concepts standard sampling plans for AQL and LTPD- uses of standard sampling plans.

LEARNING OUTCOME:

1.   Explain acceptance sampling techniques and their applications. (L2)

2.   Evaluate risks (producer's and consumer's) using O.C. curves and AQL/LTPD. (L5)

UNIT – 4: Reliability Engineering and Maintainability   CLASSES :09

Reliability engineering - fundamentals – failure data analysis, mean failure rate, Mortality curves concept of burn –in period, useful life and wear out phase of a system, mean time to failure, meantime between failure, hazard rate – failure density and conditional reliability Maintainability and availability – simple problems.

LEARNING OUTCOME:

1.   Calculate reliability measures such as MTTF, MTBF, and hazard rate. (L3)

2.   Assess system availability and maintainability through failure data analysis. (L5)

UNIT – 5: Advanced Reliability Techniques in Product Development   CLASSES :09

System reliability: Series, Parallel and Mixed configurations, Reliability improvement techniques, use of Pareto analysis – design for reliability – redundancy unit and standby redundancy- fault tree analysis – Optimization in reliability – Product design – Product analysis – Product development – Product life cycles

LEARNING OUTCOME:

1.   Model system reliability for series, parallel, and mixed configurations. (L3)

2.   Design reliability improvement strategies using redundancy and fault tree analysis. (L6)

TEXT BOOKS:

1.   Total Quality Management by Dale H. Besterfield, Carol Besterfield-Michna, Glen H. Besterfield and Mary Besterfield-Sacre, Pearson Educaiton, revised 3rd Edition, 2012.
2.   Reliability Engineering, by E.Bala Guruswamy, Tata McGraw Hill, 2002.
3.   Introduction to Quality and Reliability Engineering, Jiang R, Springer Publication, 2015.

REFERENCE BOOKS:

1.   Total Quality Management – Dr. S. Kumar, Laxmi Publication Pvt. Ltd. 2006
2.   Reliability Engineering by Srinath L. S., Affiliated East West Press. 4th Edition, 2011
3.   Quality Engineering in Production Systems, by G Taguchi , McGraw Hill, 1989
4.   Quality Control & Application by B. L. Hanson & P. M. Ghare, Prentice Hall of India

MARRI LAXMAN REDDY INSTITUTE OF TECHNOLOGY AND MANAGEMENT
(AUTONOMOUS)

2480359: ARTIFICIAL INTILLEGENT IN MECHANICAL ENGINEERING
(Professional Elective-V)

L	T	P	C
3	0	0	3

B. Tech. IV Year II Sem

Pre-requisites: Linear Algebra, Probability, Statistics, Logical Reasoning.
COURSE OBJECTIVES
1. Acquaint with fundamentals of artificial intelligence and machine learning.
2. Learn feature extraction and selection techniques for processing data set.
3. Understand basic algorithms used in classification and regression problems.
4. Outline steps involved in development of machine learning model.
5. Implement and analyze machine learning model in mechanical engineering problems

COURSE OUTCOMES: After completion of the course the student is able to
1. Demonstrate fundamentals of artificial intelligence and machine learning. (L2)
2. Apply feature extraction and selection techniques. (L3)
3. Apply machine learning algorithms for classification and regression problems. (L3)
4. Devise and develop a machine learning model using various steps. (L5)
5. Simulate machine learning model in mechanical engineering problem. (L3)

UNIT – 1: Introduction to Artificial Intelligence   **CLASSES:12**

Introduction to AI, Problem formulation, Problem Definition, Production systems, Control strategies, Search strategies, Problem characteristics, Production system characteristics, Specialized production systems, Problem solving methods, Problem graphs, Matching, Indexing and Heuristic functions, Hill Climbing, Depth first and Breath first, Constraints satisfaction — Related algorithms, Measure of performance and analysis of search algorithms.

LEARNING OUTCOME:
1. Understand the basics of problem AI. (L2)
2. Understand the basic Algorithms of AI. (L2)

UNIT – 2: Introduction to Machine Learning   **CLASSES:10**

Introduction and basic concepts – Need for machine learning – Types of machine learning – Supervised, Unsupervised learning – Reinforced learning – Deep learning Versus Machine

learning – Relation between - Machine Learning and Statistics-Machine learning methods based on time-Static Learning-Dynamic learning - - Function Approximation.

LEARNING OUTCOME:

1.   Demonstrate fundamentals of artificial intelligence and machine learning. (L2)

2.   Understand the basic algorithms of ML (L2)

UNIT – 3: Artificial Intelligence in Robotics   CLASSES :10

Reinforcement Learning- planning and search, localization, tracking, mapping and control- A* search algorithms- path smoothing algorithms - SLAM algorithm- Precision agriculture-Assistance Robots-Robot Performance Optimization-Case studies.

LEARNING OUTCOME:

1.   Understand the concept of AI Algorithm (L2)

2.   Apply AI Techniques to Robotics. (L3)

UNIT – 4: Applications of Machine Learning in Industrial Sectors

CLASSES :08

Applications of machine learning in Industrial sectors - Energy sector: oil and gas - Basic materials sector: Chemicals and Basic resources - Industrials sector - Industrial manufacturing - Industry 4.0: Introduction - Industry smartization - Industry smartization; Component level case study - Industry smartization: Machine level case study - Industry smartization; Production level case study - Industry smartization: Distribution level case study - Machine Learning Challenges and Opportunities within Smart Industries

LEARNING OUTCOME:

1.   Understand the Applications of ML (L2).

2.   Apply ML Algorithms to Industrial Sector (L3).

UNIT – 5: Application of AI in Mechanical Manufacturing Industries

CLASSES :08

Fault diagnosis- Quality inspection- Improving the safety of working places- Material modeling and smart materials-Automobile engineering- building self-driving cars and autonomous vehicles, Auto parking Machine learning in Machine Tools and Manufacturing Industries.

LEARNING OUTCOME:

1.   Understand the Applications of AI (L2).

2.   Apply AI Algorithms to Manufacturing Industries (L3).

TEXT BOOKS:

1.   Kaushik Kumar, Divya Zindani, Paulo Davim, Artificial Intelligence in Mechanical and Industrial Engineering, ISBN 9781003011248, CRC Press, 2021.

2.   B Joshi, Machine Learning and Artificial Intelligence, Springer, 2020.

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REFERENCE BOOKS:
1.   Solanki, Kumar, Nayyar, Emerging Trends and Applications of Machine Learning, IGI Global, 2018.
2.   Gebrail Bekda,Sinan Melih Nigdeli,Melda Yücel, "Artificial Intelligence and Machine Learning Applications in Civil, Mechanical, and Industrial Engineering (Advances in Computational Intelligence and Robotics)", 2019.
3.   Mangey Ram, J. Paulo Davim, Soft Computing Techniques and Applications in Mechanical Engineering, IGI Global, USA, DOI: 10.4018/978-1-5225-3035- 0, 2022.ISBN13: 9781522530350

**MARRI LAXMAN REDDY INSTITUTE OF TECHNOLOGY AND MANAGEMENT
(AUTONOMOUS)**

2480360: SURFACE ENGINEERING AND TRIBOLOGY
(Professional Elective-V)

	L	T	P	C
	3	0	0	3

B. Tech. IV Year

Pre-requisites: Fluid mechanics, Design of machine members-II

COURSE OBJECTIVES

1.   Gain knowledge of surface coating methods, including electrodeposition, organic coatings, electroless and conversion coatings.

2.   Understand advanced surface modification processes and laser-assisted methods.

3.   Learn standards, quality control, and measurement techniques for coated and treated surfaces.

4.   Understand the fundamentals of surface properties, tribology, wear, friction, lubrication, and corrosion mechanisms.

5.   Learn various surface cleaning and pretreatment techniques for metallic and electronic materials.

COURSE OUTCOMES: After completion of the course the student is able to

1.   Apply surface cleaning and pretreatment techniques to prepare materials for industrial applications. (L3)

2.   Select and implement advanced surface modification processes to improve material performance. (L3)

3.   Evaluate surface engineering standards, ASTM methods, and quality control procedures for measuring depth, thickness, hardness, and friction. (L5)

4.   Describe surface properties, wear types, corrosion mechanisms, and methods for corrosion control. (L2)

5.   Evaluate different bearings, their friction, lubrication, and materials for practical use. (L5)

UNIT – 1: Surface Properties and Cleaning   CLASSES:10

Introduction to surface properties. Tribology, surface degradation, wear (adhesive, abrasive, oxidative, corrosive, erosive, fretting). Friction and lubrication. Corrosion: types, passivity,

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growth & breakdown of passive film, corrosion control. Surface pretreatment of metallic and electronic materials. Mechanical cleaning, polishing. Chemical cleaning (acid, alkaline, acetone, carbon tetrachloride). Alumina & diamond polishing, degreasing, ultrasonic cleaning

LEARNING OUTCOME:
1.   Explain the fundamental concepts of surface properties, tribology, wear mechanisms, friction, lubrication, and corrosion with its control methods. (L2)
2.   Apply different surface pretreatment and cleaning techniques (mechanical, chemical, polishing, ultrasonic) for preparing metallic and electronic materials. (L3)

UNIT – 2: Surface Coatings and Modification   **CLASSES:10**

Introduction to surface coating techniques. Electrode position: principle, parameters, Faraday's laws. Electrodeposition of copper, nickel, chromium, gold. Organic coatings: paints, constituents, requirements, formulation, enamel & special paints (heat resistant, fire retardant). Electroless coatings, conversion coatings. Advanced processes: PVD, CVD, ion beam methods, electron beam methods. Laser-assisted processes: alloying, melting, ablation, sprayed deposits, direct metal deposition.

LEARNING OUTCOME:
1.   Describe basic coating techniques like electrodeposition, organic, electroless, conversion, and advanced processes (PVD, CVD, ion beam, electron beam, laser). (L2)
2.   Select and apply suitable coating methods to improve material performance in industries. (L3)

UNIT – 3: Standards and Measurements
CLASSES :10

Terminology, laboratory accreditation, sampling. Surface finish evaluation for bare & coated materials. Product quality standards for coatings (conversion, galvanized, electrodeposited, vapor deposited). ASTM standards: depth, thickness, hardness, friction coefficient.

LEARNING OUTCOME:
1.   Explain basic terms, lab accreditation, sampling, and surface finish evaluation for bare and coated materials. (L2)

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2.   Apply product quality standards and ASTM methods to measure coating depth, thickness, hardness, and friction. (L3)

UNIT – 4: Fundamentals of Lubrication and Bearing Design   CLASSES :09

Viscosity and Fluid Flow: Absolute & kinematic viscosity, temperature variation, viscosity index, measurement, viscometers. Hydrostatic Lubrication: Step bearing, pivoted pad thrust bearing, hydrostatic lifts, squeeze films, journal bearing applications. Hydrodynamic Theory: Petroff's equation, Reynolds equation (2D & 3D), side leakage effects, sliding & journal bearings, minimum oil film thickness, oil whip & whirl, anti-friction bearings.

LEARNING OUTCOME:

1.   Understand the concepts of viscosity, its measurement methods, and its role in hydrostatic and hydrodynamic lubrication systems. (L2)

2.   Apply Reynolds and Petroff's equations to analyze pressure distribution, load capacity, and film thickness in journal and thrust bearings. (L3)

UNIT – 5: Bearing Performance, Types and Materials   CLASSES :09

Friction and Power Losses: Calibration of friction loss, concentric bearings, bearing modulus, Sommerfeld number, heat balance, design considerations. Air and Hydrostatic Bearings: Hydrodynamic & hydrostatic journal/thrust bearings, compressibility effects, boundary & dry friction concepts. Bearing Types and Materials: Wick oiled bearings, oil rings, pressure feed bearings, partial bearings, externally pressurized bearings, requirements & types of bearing materials.

LEARNING OUTCOME:

1.   Evaluate frictional losses, heat balance, and performance parameters of different bearings under practical operating conditions. (L5)

2.   Differentiate among various bearing types and materials, and assess their suitability for specific industrial applications. (L4)

TEXT BOOKS:

1.   Ramnarayan chattopadhyay, advanced thermally assisted surface engineering processes, kluwer academic publishers, 2004

2.   Engineering Tribology/ Prasanta Sahoo / PHI/3rd Edition, 2011.

REFERENCE BOOKS:

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1.   Sudarshan T S, Surface modification technologies – an engineer's guide; Marcel Dekkar, Newyork, 1989.

2.   Adamson A W and Gast A P, Physical chemistry of surfaces, 6th Ed., John Willey & Sons 1997.

3.   Tribology – B.C. Majumdar, 2nd Edition 2008.

4.   Fundamentals of Tribology, Basu, Sen Gupta and Ahuja/PHI, 2015

MARRI LAXMAN REDDY INSTITUTE OF TECHNOLOGY AND MANAGEMENT
(AUTONOMOUS)

2480361: Fuzzy logic & Artificial neural networks
(Professional elective - VI)

IV Year II Sem	L	T	P	C
	3	0	0	3

Course Overview:

This course introduces the principles of fuzzy logic and artificial neural networks (ANNs), focusing on their role in intelligent control systems. Students will learn about fuzzy sets, relations, algorithms, and the design of fuzzy logic controllers. The course also covers various neural network architectures, including MLP, Hopfield networks, and Kohonen maps. Emphasis is placed on integrating neural networks with fuzzy logic to develop neuro-fuzzy control systems. Practical case studies help students apply these techniques to real-world problems. By the end of the course, students will be able to design, analyze, and implement intelligent systems for dynamic applications.

Prerequisite: Engineering Mathematics

Course Objective: The students will try to learn

1. Understand the concepts of fuzzy sets, fuzzy relations, and fuzzy algorithms for building intelligent decision systems.
2. Design and implement fuzzy logic controllers using fuzzification, decision-making, and defuzzification processes.
3. Understand the architecture and functioning of various neural networks such as mlp, hopfield networks, and kohonen maps.
4. Integrate neural networks with fuzzy logic and apply neuro-control schemes for dynamic system control.
5. Develop neuro-fuzzy control systems by optimizing fuzzy logic controllers using neural networks for adaptive applications.

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

1. Demonstrate an understanding of fuzzy relations and fuzzy algorithms.

2. Design and analyze fuzzy logic controllers for practical applications.
3. Explain neural network architectures and their learning mechanisms.
4. Apply neural network schemes to solve identification and control problems in various sectors.
5. Implement neuro-fuzzy control systems and optimize fuzzy logic controllers using neural networks.

Module-I: [10]
Fuzzy sets – Fuzzy relations – Fuzzy conditional statements – Fuzzy rules – Fuzzy algorithm – functional diagram.

Module-II: [09]
Fuzzy logic controller – Fuzzification interface – Knowledge hase – Decision making logic – Defuzzification interface – Design of Fuzzy logic controller – Case study.

Module-III: [09]
Artificial Neuron – MLP – Backpropagation – Hopfield Networks – Kohenen self-organising maps – Adaptive Resonance.

Module-IV: [09]
Schemes of Neuro-control-Identification & control of dynamical systems – case study.

Module–V: [09]
Adaptive fuzzy systems – optimization of membership function and rule base of fuzzy logic controller using neural networks – fuzzy neuron – case study.

Text Books:
1. Klir G.J., and T.A., Fuzzy Sets, uncertainty and information, Prentice Hall of India, New Delhi,2020.
2. Nie & Linkers : Fuzzy Neural Control : Principles, Algorithms and Applications, PHI,2021

Reference Books:
1. Simon Hayking, Neural Network,ISA, Research triangle Parke, 2018.
2. Kosco b., Neural Networks and Fuzzy systems : A Dynamical approach to machine Intelligence, Prentice Hall, USA, 2019.
3. Hertz j., Korgh A., and Palmer R.G. Introduction to the Theory of Neural Computation Addison – Wesley Publishing Co., California, 2021.

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(AUTONOMOUS)**

2480362: Introduction to Industry 4.0

(Professional elective - VI)

IV Year II Sem	L	T	P	C
	3	0	0	3

Course Overview: This course provides an introduction to Industry 4.0, its origin, evolution, and impact on manufacturing and business transformation. It explores key concepts, enabling technologies, and smart systems that drive the fourth industrial revolution. Students will gain insights into advanced automation, Industrial Internet of Things (IIoT), smart logistics, robotics, and the evolving role of workers in digital industries. Emphasis is also placed on India's preparedness and the roadmap for adopting Industry 4.0 in various sectors.

Prerequisite: Manufacturing processes, Fundamental knowledge of electronics and computer systems

Course Objective: The students will try to learn

1. Understand the fundamentals and evolution of Industry 4.0.
2. Learn about enabling technologies and smart factory concepts.
3. Explore industrial trends and big data in smart business transformation.
4. Study the roadmap and frameworks for Industry 4.0 implementation.
5. Analyze challenges, workforce trends, and future strategies.

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

1. Describe the evolution and concept of Industry 4.0.
2. Identify key technologies and components of Industry 4.0 systems.
3. Explain trends in smart manufacturing and industrial data analytics.
4. Develop a basic roadmap for implementing Industry 4.0 strategies.
5. Discuss the future challenges, skills, and opportunities in the Industry 4.0 era.

Module-I:Introduction to Industry 4.0   **[09]**

Introduction, Idea of Industry 4.0, Various Industrial Revolutions, Origin concept of Industry 4.0, Industry 4.0 Production system, How is India preparing for Industry 4.0, Comparison of Industry 4.0 Factory and Today's Factory.

Module-II:Trends in Industry 4.0   [09]

Introduction, Main Concepts and Components of Industry 4.0, State of Art Technologies, Proposed Framework for Industry 4.0, Trends of Industrial Big Data and Smart Business Transformation.

Module-III:Roadmap for Industry 4.0   [10]

Introduction, Proposed Framework for Technology Roadmap: Strategy Phase, Development Phase, Smart Manufacturing, Types of Smart Devices, Smart Logistics, Smart Cities, Predictive Analytics.

Module-IV:Advances in the Era of Industry 4.0   [09]

Introduction, Recent Technological Components of Robots- Advanced Sensor Technologies, Internet of Things, Industrial Robotic Applications- Manufacturing, Maintenance and Assembly, IIoT- Industrial IoT.

Module–V:The Role of Industry 4.0 and Future Aspects   [09]

Introduction, Challenges & Future of Works and Skills for Workers in the Industry 4.0 Era, Strategies for competing in an Industry 4.0 world.

Text Books:

1. Industry 4.0 The Industrial Internet of Things, Alasdair Gilchrist, Apress Publisher, ISBN-13 (pbk): 978-1-4842-2046-7 2)
2. Industry 4.0: Managing The Digital Transformation, Alp Ustundag, EmreCevikcan, Springer, 2018 ISBN 978-3-319-57869-9. 3)
3. Designing the industry - Internet of things connecting the physical, digital and virtual worlds, OvidiuVermesan and Peer Friess, Rivers Publishers, 2016 ISBN 978-87- 93379-81-7

Reference Books:

1. The concept Industry 4.0- An Empirical Analysis of Technologies and Applications in Production Logistics, Christoph Jan Bartodziej, Springer Gabler, 2017 ISBN 978-3- 6581-6502-4.
2. "Internet of Things- A hands on approach", Arshdeep Bahga and Vijaya Madisetti
3. Arcthitecting for the Cloud-AWS Best Practices
4. Artificial Intelligence a modern approach by Peter Norvig, Rusell

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2480363: SOLAR ENERGY TECHNOLOGY

(Professional elective - VI)

IVYEAR IISEM

	L	T	P	C
	3	0	0	3

Course Overview:

This course introduces the principles, systems, and applications of refrigeration and air conditioning. Students will study different refrigeration cycles, refrigerants, system components, and absorption systems, along with advanced and non-conventional refrigeration methods. The course also covers psychometric processes, human comfort requirements, and air conditioning systems for residential, commercial, and industrial applications. Emphasis is placed on energy efficiency, environmental impact, and design aspects relevant to modern thermal engineering practices.

Prerequisite: Heat Transfer

Course Objective: The students will try to learn

1. Introduce the principles of solar radiation, measurement, estimation, and collection techniques.
2. Study the design and working of solar water heating and power generation systems..
3. Understand methods of thermal energy storage and applications of various solar devices.
4. Analyze direct energy conversion using solar cells, their performance, and efficiencies.
5. Evaluate the economics, life cycle costs, and cost–benefit analysis of solar energy systems.

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

1. Explain solar radiation concepts, measurement techniques, and collector performance analysis.
2. Design solar water heating layouts and analyze solar power generation systems..
3. Apply principles of thermal energy storage and assess solar devices like stills, dryers, and ponds.
4. Evaluate the performance of solar cells and calculate conversion efficiencies.
5. Perform economic analysis and cost optimization of solar energy applications.

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Module-I: **[10]**
Introduction – Solar energy option, specialty and potential – Sun – Earth – Solar radiation, beam and diffuse – measurement – estimation of average solar radiation on horizontal and tilted surfaces – problems – applications. Capturing solar radiation – physical principles of collection – types – liquid flat plate collectors – construction details – performance analysis – concentrating collection – flat plate collectors with plane reflectors – cylindrical parabolic collectors – Orientation and tracking – Performance Analysis.

Module-II: **[09]**
Design of Solar Water Heating System and Layout: Power generation – solar central receiver system – Heliostats and Receiver – Heat transport system – solar distributed receiver system – Power cycles, working fluids and prime movers, concentration ratio.

Module-III: **[10]**
Thermal Energy Storage: Introduction – Need for – Methods of sensible heat storage using solids and liquids – Packed bed storage – Latent heat storage – working principle – construction – application and limitations. Other solar devices – stills, air heaters, dryers, Solar Ponds & Solar Refrigeration, active and passive heating systems.

Module-IV: **[09]**
Direct Energy Conversion: solid-state principles – semiconductors – solar cells – performance – modular construction – applications. conversion efficiencies calculations.

Module–V: **[09]**
Economics: Principles of Economic Analysis – Discounted cash flow – Solar system – life cycle costs – cost benefit analysis and optimization – cost-based analysis of water heating and photo voltaic applications.

Text Books:
1.   Principles of solar engineering/ Kreith and Kerider/Taylor and Franscis/2ⁿᵈ Edition.
2.   Solar energy thermal processes/ Duffie and Beckman/John Wiley & Sons/5ᵗʰ Edition

Reference Books:
1. Solar energy: Principles of Thermal Collection and Storage/ Sukhatme/TMH/2ⁿᵈ edition.
2. Solar energy/ Garg/TMH 5. Solar energy/ Magal/Mc Graw Hill/2ˢᵗ edition
3. Solar Thermal Engineering Systems / Tiwari and Suneja/Narosa/4ᵗʰ edition.

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4. Power plant Technology/ El Wakil/TMH/2nd edition.

2480364: INDUSTRIAL MANAGEMENT
(Professional elective - VI)

IV Year II Sem   **L T P C**
                                                            3 0 0 3

Prerequisites: None

Course objectives:

- ➢ Understand the philosophies of management gurus
- ➢ Understand the various types of organization structures and their features, and their advantages and disadvantages.
- ➢ Learning various Industrial Engineering Practices like Operations Management techniques, work study, statistical quality control techniques, Job evaluation techniques and network analysis techniques.

Course outcomes:

- ➢ Understand the fundamental principles of management
- ➢ Differentiate between various organizational structures and analyze their merits, demerits
- ➢ Apply operations management techniques such as plant layout design, production systems, line balancing, and value analysis to improve productivity
- ➢ Evaluate work study and statistical quality control tools, and develop solutions for enhancing efficiency and maintaining quality standard
- ➢ Construct project networks using PERT/CPM techniques and determine critical paths, project durations, and cost optimization strategies for effective project management

Module-I: **[10]**
Introduction to Management: Entrepreneurship and organization – Nature and Importance of Management, Functions of Management, Taylor's Scientific Management Theory, Fayol's Principles of Management, Maslow's Theory of Human Needs, Douglas McGregor's Theory X and Theory Y, Herzberg's Two-Factor Theory of Motivation, Systems Approach to Management, Leadership Styles, Social responsibilities of Management

Module-II: **[09]**
Designing Organizational Structures: Departmentalization and Decentralization, Types of

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Organization structures – Line organization, Line and staff organization, functional organization, Committee organization, matrix organization, Virtual Organization, Cellular Organization, team structure, boundary less organization, inverted pyramid structure, lean and flat organization structure and their merits, demerits and suitability.

Module – III: **[09]**
Operations Management: Objectives- product design process- Process selection-Types of production system (Job, batch and Mass Production), Plant location-factors- Urban-Rural sites comparison- Types of Plant Layouts- Design of product layout- Line balancing (RPW method) Value analysis-Definition-types of values- Objectives- Phases of value analysis- Fast diagram

Module - IV: **[09]**
Work Study: Introduction — definition — objectives — steps in work study — Method study — definition, objectives — steps of method study. Work Measurement — purpose — types of study — stop watch methods — steps — key rating — allowances — standard time calculations — work sampling. Statistical Quality Control: variables-attributes, Shewart control charts for variables- chart, R chart, – Attributes- Defective-Defect- Charts for attributes-p-chart -c chart (simple Problems), Acceptance Sampling- Single sampling- Double sampling plans-OC curves.

Module – V: **[09]**
Job Evaluation: Methods of job evaluation — simple routing objective systems — classification method factor comparison method, point method, benefits of job evaluation and limitations. Project Management (PERT/CPM): Network Analysis, Programme Evaluation and Review Technique (PERT), Critical Path Method (CPM), Identifying critical path, Probability of Completing the project within given time, Project Cost Analysis, Project Crashing. (simple problems)

TEXT BOOKS
1. Industrial Engineering and Management/O.P. Khanna/Khanna Publishers.
2. Industrial Engineering and Management Science/T.R. Banga and S.C. Sarma/Khanna Publishers.
REFERENCE BOOKS
1. Motion and Time Study by Ralph M Barnes! John Willey & Sons Work Study by lLO.
2. Human factors in Engineering & Design/Ernest J McCormick /TMH.
3. Production & Operation Management /Paneer Selvam/PHI.

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4. Industrial Engineering Management/NVS Raju/Cengage Learning.
5. Industrial Engineering Hand Book/Maynard.
6. Industrial Engineering Management I Ravi Shankar/Galgotia