

I SEMESTER SYLLABI COMMON FOR ALL BRANCHES

Applicable to the students admitted to

R-2021: CBCS

**Academic year 2021-2022
onwards**



VEL TECH HIGH TECH

Dr. RANGARAJAN Dr. SAKUNTHALA ENGINEERING COLLEGE

An Autonomous Institution

**#60, Avadi – Vel Tech Road, Vel Nagar,
Avadi, Tamil Nadu 600062**



VEL TECH HIGH TECH

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Accredited by NBA, New Delhi & Accredited by NAAC with "A" Grade & CGPA of 3.27

LIST OF ABBREVIATIONS

S. No.	Abbreviations	Detailed Description
1	HSMC	Humanities & Social Science including Management Courses
2	BSC	Basic Science Courses
3	ESC	Engineering Science Courses
4	PCC	Professional Core Courses
5	PEC	Professional Elective Courses
6	OEC	Open Elective Courses
7	PROJ	Project Work
8	EEC	Employability Enhancement Courses
9	MC	Mandatory Courses

Curriculum (R2021)

SEMESTER I										
S. No.	Course Code	Course Title	Category	CIE Marks	SEE Marks	Total marks	Credits			
							L	T	P	C
THEORY										
1	21EN11T	Communicative English	HSMC	40	60	100	3	0	0	3
2	21MA12T	Matrices and Differential Calculus	BSC	40	60	100	3	1	0	4
3	21PH13T	Engineering Physics I	BSC	40	60	100	3	0	0	3
4	21CY14T	Engineering Chemistry	BSC	40	60	100	3	0	0	3
5	21CS15IT	Problem Solving and Python Programming	ESC	40	60	100	2	0	4	4
6	21ME16T	Engineering Graphics	ESC	40	60	100	4	0	0	4
PRACTICAL										
7	21BS17P	Physics and Chemistry Laboratory	BSC	40	60	100	0	0	4	2
8	21ME18P	Engineering Practices Laboratory	ESC	40	60	100	0	0	4	2
TOTAL										25



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Course code	21EN11T	Semester	I						
Category	HUMANITIES & SOCIAL SCIENCE INCLUDING MANAGEMENT COURSES (HSMC)					L	T	P	C
Course Title	COMMUNICATIVE ENGLISH (COMMON FOR ALL BRANCHES)					3	0	0	3

COURSE OBJECTIVES:

- To exhibit the students of Engineering and Technology to develop their listening and to recall the pattern of listening.
- To facilitate the learners to develop speaking skills to convey their ideas and views in the real context.
- To develop their reading skills and grasp the central ideas of the text.
- To expose them to acquire writing technique with basic grammar.
- To motivate the students to use appropriate vocabulary in academic and categorize the inferences in writings.

PREREQUISITE:

- Foundation of language with Basic English Grammar.

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C101. 1	<i>Listen</i> to different talks and lectures and understand them easily.	K1
C101. 2	<i>Communicate</i> their thoughts confidently using communicative strategies	K2
C101. 3	<i>Read</i> and grasp different genres of texts effortlessly	K2
C101. 4	<i>Write</i> grammatically correct academic, business and technical texts	K3
C101. 5	<i>Apply</i> the appropriate vocabulary to communicate efficiently in all forms of communication.	K4

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
C101.1	-	-	-	-	-	-	-	-	1	3	-	1	-	-	-
C101.2	-	-	-	-	-	-	-	-	1	3	-	1	-	-	-
C101.3	-	-	-	-	-	-	-	-	1	3	-	1	-	-	-
C101.4	-	-	-	-	-	-	-	-	1	3	-	1	-	-	-
C101.5	-	-	-	-	-	-	-	-	1	3	-	1	-	-	-
C101.6	-	-	-	-	-	-	-	-	1	3	-	1	-	-	-
C101	-	-	-	-	-	-	-	-	1	3	-	1	-	-	-

Note: 1: Slight, 2: Moderate, 3: Substantial

UNIT I BASIC GRAMMAR I AND READING FOR INFORMATION 9**PRACTICAL**

LISTENING: Listening to short dialogues with good accent

SPEAKING : Introducing oneself - Exchanging personal information

TUTORIAL

READING : Reading short comprehension passages- practice skimming and scanning for specific information

WRITING: Parts of speech - Sentence patterns – Tenses – ‘wh’- questions - Yes/No questions -Countable and Uncountable nouns

VOCABULARY AND GRAMMAR: Affixation – word formation - Synonyms and Antonyms.

UNIT II BASIC GRAMMAR II AND SHARING INFORMATION 9**PRACTICAL**

LISTENING : Listening to documentaries - inspiring speeches of great leaders and practicing opinion sharing

SPEAKING : Self-introduction - peer introduction - picture description - JAM

TUTORIAL

READING: Note-making- Critical reading finding key information in a given text - shifting facts from opinions and paraphrasing

WRITING: Autobiographical writing (writing about one’s leisure time activities, hometown - favourite place and school life) - Biographical writing (place, people)

VOCABULARY AND GRAMMAR: Compound Words – Guessing meaning of words contexts - One Word substitutes – Pronouns- Adjectives – Adverbs – Imperatives - Direct and Indirect questions.

UNIT III BASIC GRAMMAR III AND FREE WRITING 9**PRACTICAL**

LISTENING : News Bulletins - Ted talks - telephonic conversations

SPEAKING : functions of Language - giving reasons - talking about future plans - comparing and contrasting - making suggestions

TUTORIAL

READING: Current Affairs - newspaper reading /magazines - loud in the classroom

WRITING: Coherence and cohesion in writing- cause and effect - compare & contrast and narrative & analytical paragraphs.

VOCABULARY AND GRAMMAR: Discourse marker - Reference words - Process description - Conjunctions – Prepositions - Articles - Degrees of comparison.

PRACTICAL

LISTENING : Listen to audio/ Conversation from BEC/IELTS /TOFEL.

SPEAKING : Interpersonal Skills: Role play/group discussion/debate/ conduct of meeting

TUTORIAL

READING: Reading different types of texts /genres/ for comprehension and pleasure – related with human values.

WRITING: Letter writing (informal letters) and formal letters – rejecting and accepting Letters - Personal emails and etiquette.

VOCABULARY AND GRAMMAR: Single Word substitutes - Use of abbreviations Acronyms - Cloze reading - interpreting visual materials - Jumbled sentences - Subject verb agreement - Modal verbs - Phrasal verbs.

UNIT V BASIC GRAMMAR V AND LANGUAGE DEVELOPMENT**PRACTICAL**

LISTENING : Listen to official meetings to know about the project proposal.

SPEAKING : Discussing the project and the proposals in the group - Creative writing and speaking - Poster making and description - project proposals.

TUTORIAL

READING: Reading comparison and contrast text with the deeper level of meaning **WRITING**
: Essay writing - different types of essays - dialogue writing

VOCABULARY AND GRAMMAR: Word association (connotations) - Lexical items (fixed / semi fixed expressions) - Clause - Direct and indirect speech - Correction of errors.

Total: 45 Periods

Extensive Reading:

Kalam , Abdul. The Wings of Fire , Universities Press, Hyderabad. 19

LEARNING RESOURCES:**TEXT BOOKS:**

1. Board of Editors, Department of English, Anna University, Chennai. Using English:A Course Book for Undergraduate Engineers and Technologists, Orient Black Swan: Chennai,2017.
2. Dhanavel, S.P. English and Communication Skills for Students of Science and Engineering. Orient Black Swan Publications, Chennai,2011.

REFERENCES:

1. Raman, Meenakshi & Sangeetha Sharma, Technical Communication: English Skills for Engineers. Oxford University Press, NewDelhi.2011.

2. Regional Institute of English. English for Engineers. Cambridge University Press, New Delhi. 2006
3. Rizvi M, Ashraf. Effective Technical Communication. Tata McGraw- Hill Publishing Company Limited, New Delhi, 2007.
4. Rutherford, Andrea J. Basic Communication Skills for Technology. Pearson Edition (II Edition), NewDelhi, 2001.
5. Mandel, Steve. *Effective Presentation Skills*. New Delhi: Viva Books Pvt. Ltd., 2004.
6. Kilmet, Stephen. "The Resume and "The Computerized Resume." In Writing for Design Professionals.
7. Writing Cover Letters-Kilmet, Stephen. "Cover Letter, "and" Enclosures and Attachments." in Writing for Design Professionals New York.



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Course code	21MA12T	Semester	I				
Category	BASIC SCIENCE COURSE (BSC)			L	T	P	C
Course Title	MATRICES AND DIFFERENTIAL CALCULUS (COMMON FOR ALL BRANCHES)			4	0	0	4

COURSE OBJECTIVES:

- To apply advanced matrix knowledge to solve engineering problems
- To improve their ability in solving geometrical applications of differential calculus
- To familiarize with the application of differential equations

PREREQUISITE:

- Basic Mathematics skills at 12th level

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
At the end of the course students are able to		
C102.1	<i>Solve</i> Engineering problems using matrices.	K3
C102.2	<i>Use</i> various test to discuss the convergence of infinite series.	K2
C102.3	<i>Apply</i> the geometrical concepts to solve differential calculus.	K4
C102.4	<i>Compute</i> partial derivatives of functions of several variables.	K2
C102.5	<i>Apply in Engineering many physical initial</i> and boundary value problems can be described by ODE.	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C102.1	3	3	-	-	-	-	-	-	-	-	-	-
C102.2	3	2	-	-	-	-	-	-	-	-	-	-
C102.3	3	3	-	-	-	-	-	-	-	-	-	-
C102.4	3	2	-	-	-	-	-	-	-	-	-	-
C102.5	3	2	-	-	-	-	-	-	-	-	-	-
C102	3	2	-	-	-	-	-	-	-	-	-	-

Note: 1: Slight, 2: Moderate, 3: Substantial



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Course code	21PH13T	Semester	I				
Category	BASIC SCIENCE COURSE (BSC)			L	T	P	C
Course Title	ENGINEERING PHYSICS I (COMMON FOR ALL BRANCHES)			3	0	0	3

COURSE OBJECTIVES:

- To understand the importance of polarization, optical fiber and Lasers
- To familiar the knowledge of electromagnetic waves oscillations
- To understand the importance of quantum physics
- To cognize the basics of heat and thermodynamics
- To express the basics of crystal physics

PREREQUISITE:

- High School Maths and Physics

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C103.1	<i>Utilize</i> the concepts of polarization, optical fiber and Lasers for engineering applications	K3
C103.2	<i>Apply</i> the knowledge of electromagnetic waves oscillations	K3
C103.3	<i>Understand</i> the importance of quantum physics.	K2
C103.4	<i>Cognize</i> the basics of heat and thermodynamics	K2
C103.5	<i>Express</i> the basics of crystal physics	K2

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
C103.1	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-
C103.2	2	2	1	-	-	-	-	-	-	-	-	-	-	-	-
C103.3	2	2	1	-	-	-	-	-	-	-	-	-	-	-	-
C103.4	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-
C103.5	2	-	1	-	-	-	-	-	-	-	-	-	-	-	-
C103	2	2	1	-	-	-	-	-	-	-	-	-	-	-	-

Note: 1: Slight, 2: Moderate, 3: Substantial

UNIT I PHOTONICS 9

Polarization and Fiber Optics: Electromagnetic waves - Production and analysis of linearly, elliptic and circularly polarized light-Polaroid and applications of polarization. Fiber optics - principle of operation – numerical aperture - acceptance angle and applications of fiber optics.

Optical Sources: Characteristics of Lasers - Spontaneous and Stimulated Emission of Radiation - Population Inversion - Einstein's Coefficients and Relation between them - Applications of Lasers.

UNIT II WAVES AND OSCILLATION 9

Oscillatory motion: Differential equation of SHM- Velocity and acceleration- Restoring Force-Frequency response - phase response and resonance-Analogy with LCR circuits and oscillators-Energy and energy loss- Damped oscillations- Significance in control systems - vibration and vibration isolation.

Wave motion: Definition of a plane progressive wave- Attenuation of waves- Phase Velocity- Introduction to numerical methods for solution of wave equation- Importance of spherical and plane wave fronts.

UNIT III QUANTUM MECHANICS 9

Need for Quantum Physics-Historical overviews - Matter waves - De-Broglie's concept of matter waves - Properties of matter waves - Photo electric effect - Heisenberg's uncertainty principle – Statement - Interpretation and application - Schrödinger's time dependent and time independent equations - Operators - Eigen values and Eigen functions - Expectation values -Physical significance of wave function-Quantum superposition and entanglement for Qbits (quantitatively)

UNIT IV HEAT AND THERMODYNAMICS 9

Heat and internal energy - Specific heat and calorimetry - Latent Heat coefficient of linear thermal expansion - Methods of measurement of thermal expansion - Thermal expansion -Applications - The bimetallic strip - Differential equation of one-dimensional heat flow - Lee's disc apparatus for determination of thermal conductivity - Thermal Insulation- Heat dissipation and heat sinking of electronic devices-solid state refrigerators (qualitatively)

UNIT V CRYSTAL PHYSICS 9

Introduction of Crystallography - Space Lattice - Unit Cell - Lattice Parameters – Crystal Systems - Bravais Lattices - Miller Indices and its applications - Crystal Planes and Directions- Inter Planar Spacing of Orthogonal Crystal Systems - Atomic Radius - Co-ordination Number and Packing Factor of SC, BCC, FCC – Crystal growth –Solution growth -Structure determination by x-ray diffraction method (cubic structure).

Total: 45 Periods**LEARNING RESOURCES:****TEXT BOOKS:**

1. Richard Wolfson, "Essential University Physics", Vols. 1 and 2. Pearson Education, Singapore, 2011.
2. Gaur R K, Gupta S L, "Engineering Physics", DhanpatRai Publications, 2013.

REFERENCES:

1. Halliday D., Resnick R. and Walker J., “Fundamentals of Physics”, Wiley Publications, 2008.
2. Avadhanulu M. N., “Engineering Physics”, S. Chand & Co., 2007.
3. Purcell E. M., “Electricity and Magnetism – Berkeley Physics Course”, Vol. 2, Tata McGraw-Hill, 2008.
4. Paul A. Tipler and Gene Mosca, “Physics for Scientists and Engineers”, W.H. Freeman and Company, New York, 2004.



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Course code	21CY14T	Semester	I				
Category	BASIC SCIENCE COURSE (BSC)			L	T	P	C
Course Title	ENGINEERING CHEMISTRY (COMMON FOR ALL BRANCHES)			3	0	0	3

COURSE OBJECTIVES:

- To make the students conversant with water quality parameters and treatment techniques.
- To get the basic idea about the polymers, electrochemistry and corrosion.
- To deal with the information about various types of fuels and energy sources.

PREREQUISITE:

- Basic Chemistry Skills

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
At the end of the course students are able to		
C104.1	<i>Understand</i> the water related problems and their treatment techniques.	K2
C104.2	<i>Explain</i> the applications of polymers and reinforced plastics.	K2
C104.3	<i>Acquire</i> knowledge on electrochemistry and corrosion.	K2
C104.4	<i>Summarize</i> the types of fuels and its production process and calculate the CV values.	K2
C104.5	<i>Classify</i> the non-conventional energy sources and its applications.	K2

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
C104.1	2	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-
C104.2	2	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-
C104.3	2	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-
C104.4	2	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-
C104.5	2	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-
C104	2	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-

Note: 1: Slight, 2: Moderate, 3: Substantial

UNIT I WATER AND ITS TREATMENT 9

Introduction - characteristics - alkalinity - types and determination - hardness - types expression of hardness - units - estimation of hardness of water by EDTA - numerical problems -boiler feed water-requirements-boiler troubles – scale & sludge -disadvantages (wastage of fuels, decrease in efficiency, boiler explosion) -softening of hard water - external treatment process - demineralization and zeolite, internal treatment - boiler compounds (carbonate, phosphate, Calgon, sodium aluminate and colloidal conditioning methods) – desalination of brackish water –reverse osmosis.

UNIT II POLYMERS AND REINFORCED PLASTICS 9

Introduction - classification of polymers - Natural and synthetic - Thermoplastic and Thermosetting, Functionality - Degree of polymerization, Properties of polymers: T_g, Tacticity, Molecular weight - weight average, number average and polydispersity index. Types – addition, condensation and Copolymerization – free radical, cationic and anionic polymerization mechanism - Preparation, properties and uses of PVC, Nylon- 6,6, Teflon and Epoxy resin. Plastics - Compounding of plastics – moulding methods – injection, extrusion and compression – Engineering plastics-applications-fibre-reinforced plastics (FRP) – carbon and glass– applications.

UNIT III ELECTROCHEMISTRY AND CORROSION 9

Electrochemical cell - redox reaction, electrode potential- origin of electrode potential-oxidation potential-reduction potential - measurement and applications - electrochemical series and its significance - Nernst equation (derivation and problems). Corrosion- causes- factors- types: chemical, electrochemical corrosion (galvanic, differential aeration), corrosion control - material selection and design aspects - electrochemical protection – sacrificial anode method and impressed current cathodic method. Paints- constituents and function Electroplating of Copper and electroless plating of nickel-Chemical conversion coatings-phosphate, chromate, chemical oxide, and anodized coatings.

UNIT IV FUELS AND COMBUSTION 9

Fuels: Introduction - classification of fuels - coal - analysis of coal (proximate and ultimate) - carbonization - manufacture of metallurgical coke (Otto Hoffmann method) - petroleum – refining-manufacture of synthetic petrol (Bergius process) – knocking - octane number- cetane number - natural gas - compressed natural gas (CNG) - liquefied petroleum gases (LPG) – synthesis, advantages and commercial application of power alcohol and biodiesel. Combustion of fuels: Introduction - calorific value - higher and lower calorific values- theoretical calculation of calorific value –problems- ignition temperature - spontaneous ignition temperature - explosive range - flue gas analysis (ORSAT Method).

UNIT V ENERGY SOURCES AND STORAGE DEVICES 9

Energy-Types- Non-renewable energy- Nuclear fission - nuclear fusion - differences between nuclear fission and fusion - nuclear chain reactions - nuclear energy - light water nuclear power plant - breeder reactor - solar energy conversion - solar cells - wind energy. Batteries, fuel cells and supercapacitors: Types of batteries - primary battery (dry cell) secondary battery (lead acid battery, lithium-ion-battery) fuel cells - H₂-O₂ fuel cell.

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. P.C. Jain and Monika Jain, Engineering Chemistry, DhanpatRai, Publishing Company (P) Ltd., New Delhi, 2015.
2. S.S Dara&S.S Umare, A Text book of Engineering Chemistry, S.Chand & Company Ltd., New Delhi, 2015.

REFERENCES:

1. S. Vairam,P. Kalyani and Suba Ramesh., Engineering Chemistry, Wiley India Pvt. Ltd, New Delhi, 2013.
2. B.K.Sharma, Engineering Chemistry, Krishna Prakasan Media (P) Ltd., Meerut, 2014.
3. Prasanta Rath, Engineering Chemistry, Cengage Learning India Pvt. Ltd, Delhi, 2015.
4. Shikha Agarwal, Engineering Chemistry-Fundamentals and Applications, Cambridge University Press, Delhi, 2015.
5. V.R.Gowariker, N.V.Viswanathan, J.Sreedhar, Polymer Science, New Age International (P) Ltd., Publishers, New Delhi, 2011.



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Course code	21CS15IT	Semester		I			
Category	ENGINEERING SCIENCE COURSE (ESC)			L	T	P	C
Course Title	PROBLEM SOLVING AND PYTHON PROGRAMMING (COMMON FOR ALL BRANCHES)			2	0	4	4

COURSE OBJECTIVES:

- To be familiar with the basics of algorithmic problem solving.
- To construct python programs with conditionals, loops and functions.
- To use python data structures-Lists, Tuples and Dictionaries.

PREREQUISITE:

- Basic Mathematics Skills and Computer Knowledge

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
At the end of the course students will be able to		
C105. 1	<i>Develop</i> algorithmic solutions to simple computational problems	K3
C105. 2	<i>Construct</i> simple Python programs for solving problems.	K3
C105. 3	<i>Build</i> Python programs with conditionals and loops.	K3
C105. 4	<i>Demonstrate</i> a Python program into functions.	K2
C105. 5	<i>Show</i> compound data using Python lists, tuples, and dictionaries.	K2
C105. 6	<i>Read</i> and write data from/to files in Python Programs.	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
C105. 1	3	2	1	-	-	-	-	-	-	-	-	-	2	2
C105. 2	3	2	1	-	-	-	-	-	-	-	-	-	2	2
C105. 3	3	2	1	-	-	-	-	-	-	-	-	-	2	2
C105. 4	3	2	1	-	-	-	-	-	-	-	-	-	2	2
C105. 5	3	2	1	-	-	-	-	-	-	-	-	-	2	2
C105. 6	3	2	1	-	-	-	-	-	-	-	-	-	2	2
C105	3	2	1	-	-	-	-	-	-	-	-	-	2	2

Note: 1: Slight, 2: Moderate, 3: Substantial

UNIT- I ALGORITHMIC PROBLEM SOLVING AND BASICS OF PYTHON 8

Algorithms-building blocks of algorithms (statements, state, control flow, functions), simple Strategies for developing algorithms (iteration, recursion)-pseudo code- flow chart-programming language. Introduction to Python-Features of Python-Python Interpreter: Interactive and script mode- Values and types, variables, Keywords, Identifiers, operators, precedence of operators, expression, Comments.

UNIT-II CONTROL FLOW, FUNCTIONS 8

Conditional statements-Iterative statements, Functions: Built-in functions, user defined function-Function Arguments-Fruitful functions and void functions- local and global variable - function composition- recursion-Lambda Functions.

UNIT-III MODULES, PACKAGES, STRINGS 4

Modules-Packages-Strings-string operations, string functions and methods.

UNIT-IV LISTS, TUPLES, DICTIONARIES 5

Lists- list operations, list methods, list loop, mutability, aliasing, cloning lists-Tuples-Tuple assignment, Operations on Tuples, Tuple as return value- Dictionaries- operations and methods-Sets-Operations on sets.

UNIT-V FILES AND EXCEPTIONS 5

Files –Types of files, file operations, file methods, format operator-command line arguments-Errors and Exceptions, handling exceptions.

List of Experiments: 30 Periods

1. Write a python program to demonstrate basic data types in python.
2. Write a python program using conditional statements.
3. Write a python program using Iterative statements.
4. Write a python program using built-in and user defined functions.
5. Write a python program using lambda functions and recursions.
6. Write a python program to demonstrate Strings and its Operations.
7. Write a python program to demonstrate lists, tuples and its operations.
8. Write a python program to demonstrate Sets and its operations.
9. Write a python program to demonstrate Dictionaries and its operations.
10. Write a python program to demonstrate Files and its Operations.

30 Periods**Total: 60 Periods**

LEARNING RESOURCES:

TEXT BOOKS:

1. Reema Thareja, “Python Programming using Problem Solving Approach”, OXFORD University Press, 2017.
2. Allen B. Downey, “Think Python: How to Think Like a Computer Scientist“, 2nd edition, Updated for Python 3, Shroff/O’Reilly Publishers, 2016.

REFERENCES:

1. Ashok Namdev Kamthane, Amit Ashok Kamthane, “Programming and Problem Solving with Python”, Mc-Graw Hill Education, 2018.
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, “Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd, 2016.
3. Kenneth A. Lambert, “Fundamentals of Python: First Programs”, CENGAGE Learning, 2012.

Sl. No.	Description of Equipment	Required numbers (For batch of 30 students)
1	Standalone desktops with Python [Open Source]	30 Nos



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Course code	21ME16T	Semester	I				
Category	ENGINEERING SCIENCE COURSE (ESC)			L	T	P	C
Course Title	ENGINEERING GRAPHICS (COMMON FOR ALL BRANCHES)			1	3	0	4

COURSE OBJECTIVES:

- To develop in students, graphic skills for communication of concepts, ideas and design of engineering products.
- To expose them to existing national standards related to technical drawings.

PREREQUISITE:

- Engineering Drawing Skills

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
At the end of the course students are able to		
C106.1	<i>Familiarize</i> with the fundamentals and standards of Engineering graphics.	K2
C106.2	<i>Develop</i> freehand sketching of basic geometrical constructions and multiple views of objects.	K3
C106.3	<i>Draw</i> orthographic projection of lines and plane surfaces.	K3
C106.4	<i>Construct</i> projection of solids, Section and development of surfaces.	K3
C106.5	<i>Visualize</i> isometric and perspective projections	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
C106. 1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C106. 2	3	3	-	-	-	-	-	-	-	-	-	1	1	-	-	-
C106. 3	3	3	2	-	-	1	-	1	-	1	-	1	1	-	-	-
C106. 4	3	3	2	-	-	1	-	1	-	1	-	1	1	-	-	-
C106. 5	3	3	2	-	-	1	-	1	-	1	-	1	1	-	-	-
C106	3	3	2	-	-	1	-	1	-	1	-	1	1	-	-	-

Note: 1: Slight, 2: Moderate, 3: Substantial

CONCEPTS AND CONVENTIONS (Not for Examination)**1**

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

UNIT I PLANE CURVES AND FREEHAND SKETCHING**7+12**

Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square, Triangle and circle – Drawing of tangents and normal to the above curves. Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three-Dimensional objects – Layout of views– Freehand sketching of multiple views from pictorial views of objects.

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACE**6+12**

Orthographic projection– principles-Principal Planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes – Determination of true lengths and true inclinations by rotating line method and traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method. Applications – Drawing interpretation and process planning, circuit design.

UNIT III PROJECTION OF SOLIDS**5+12**

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method, auxiliary plane method. Applications – Engineering design, automotive modelling, X-rays.

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES**5+12**

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones. Applications – Design of piping, Fabrication, body building, defect analysis.

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS**6 + 12**

Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones– combination of two solid objects in simple vertical positions – Perspective projection of simple solids–Prisms, pyramids and cylinders by visual ray method and vanishing point method. Applications–constructions, photography, animation and image processing.

Total: 90 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Natrajan K.V., “A text book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, 2010.
2. Bhatt N.D. and Panchal V.M., “Engineering Drawing”, Charotar Publishing House, 51th Edition, 2019.

REFERENCES:

1. Venugopal K. and Prabhu Raja V., “Engineering Graphics”, New Age International (P) Limited, 2015.
2. Basant Agarwal and Agarwal C.M., “Engineering Drawing”, Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
3. Gopalakrishna K.R., “Engineering Drawing” (Vol. I&II combined), Subhas Stores, Bangalore, 2007.
4. Luzzader, Warren.J. and Duff, John M., “Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
5. N S Parthasarathy and Vela Murali, “Engineering Graphics”, Oxford University, Press, New Delhi, 2015.
6. Shah M.B., and Rana B.C., “Engineering Drawing”, Pearson, 3rd Edition, 2013.

Publication of Bureau of Indian Standards:

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
3. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4. IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods.

Special points applicable to Semester End Examination on Engineering Graphics:

1. There will be five questions, each of either-or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. Students will be permitted to use appropriate scale to fit solution within A3 size.
4. The examination will be conducted in appropriate sessions on the same day



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Course code	21BS17P	Semester	I				
Category	BASIC SCIENCE COURSE (BSC)			L	T	P	C
Course Title	PHYSICS AND CHEMISTRY LABORATORY (COMMON FOR ALL BRANCHES)			0	0	4	2

COURSE OBJECTIVES:

- To test basic understanding of physics of materials including properties of matter, thermal and optical properties.
- To encourage the students to familiarize with experimental determination of velocity of ultrasonic waves and band gap determination.

PREREQUISITE:

- Basic measurement skills

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C107.1	<i>Estimate</i> the various water quality parameters like alkalinity, hardness (total, temporary, & permanent), dissolved oxygen content, and chloride content.	K2
C107.2	<i>Investigate</i> the metals and ions present in any given sample using various analytical techniques.	K2
C107.3	<i>Analyze</i> the properties such as conductance of solutions, and redox potentials.	K2
C107.4	<i>Determine</i> various moduli of elasticity and also various thermal and optical properties of materials.	K2
C107.5	<i>Determine</i> the velocity of ultrasonic waves, band gap determination and viscosity of liquids.	K2

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
C107.1	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-
C107.2	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-
C107.3	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-
C107.4	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-
C107.5	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-
C107	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-

Note: 1: Slight, 2: Moderate, 3: Substantial

PHYSICS LABORATORY
LIST OF EXPERIMENTS
 (Any SIX Experiments)

1. Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia of disc
2. Non-uniform bending - Determination of young's modulus
3. Lee's disc Determination of thermal conductivity of a bad conductor
4. Laser- Determination of the wave length of the laser using grating, Estimation of laser parameters
5. Optical fibre -Determination of Numerical Aperture and acceptance angle
6. Ultrasonic interferometer - determination of the velocity of sound and compressibility of Liquids
7. Determination of Band gap of a semiconductor
8. Spectrometer- Determination of wavelength using gating

Total: 30 Periods

REFERENCES:

1. Physics Practicals, Department of Physics, Vel Tech High Tech Dr.Rangarajan Dr.Sakunthala Engineering College 2021
2. Wilson J.D. and Hernandez C.A., "Physics Laboratory Experiments", Houghton Mifflin Company, New York 2005

Lab Requirements

Sl. No.	Description of Equipment	Required numbers (For batch of 30 students)
1.	Torsional Pendulum, stop clock, suspension metallic wire: two different thickness, two identical cylindrical mass, screw gauge, wooden scale	5
2.	Uniform bending: 1-meter wooden scale, two-knife edges, travelling microscope, two weight hanger with slotted weights, screw gauge, Vernier calliper, pin	5
3.	Non-uniform bending: 1 meter wooden scale, two-knife edges, travelling microscope, weight hanger with slotted weights, screw gauge, Vernier calliper, pin	5
4.	Diode laser (green or red), fiber optic cable, movable arrangement with a screen for measuring spot size (zig), meter scale, stand	5
5.	He-Ne/Diode laser (red), Green diode laser, Grating, Screen, Iron stand (3 Nos), 1m wooden scale, thread.	5
6.	Ultrasonic interferometer apparatus with high frequency wave generator, cell, micrometer, PZ crystal, water or other liquids	5
7.	450 inclined glass plate set-up, two optically plane glass plates, sodium vapour lamp, travelling microscope, thin wire/thin strip of paper	5
8.	Post office box, 5V power supply, thermometer, galvanometer, semiconductor (thermistor), variable temperature bath set-up (oil, temperature controller, vessel, hot plate.	5

CHEMISTRY LABORATORY
LIST OF EXPERIMENTS
(Any SIX Experiments)

1. Determination of permanent, total and temporary hardness of water sample.
2. Estimation of HCl using Na_2CO_3 as primary standard and Determination of alkalinity in water sample.
3. Determination of DO Content of water sample by Winkler's method.
4. Determination of chloride content of water sample by Argentometric method.
5. Determination of strength of given HCl using pH meter.
6. Estimation of Fe^{2+} by Potentiometric titration.
7. Determination of molecular weight of PVA using Ostwald viscometer.
8. Estimation of Iron content in water sample using spectrophotometer (1,10 – Phenanthroline/thiocyanate method).
9. Conductometric titrations of strong acid Vs strong base.
10. Determination of strength of acid in a mixture using conductivity meter.
11. Corrosion experiment-weight loss method.
12. Estimation of sodium and potassium present in water using flame photometer.

Total: 30 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Jeffery G.H., Bassett J., Mendham J. and Denny vogel's R.C, "Text book of quantitative analysis chemical analysis", ELBS 5th Edn. Longman, Singapore publishers, Singapore, 1996.
2. Kolthoff I.M., Sandell E.B. et al. "Quantitative chemical analysis", Mcmillan, Madras 1980.
3. Furniss B.S. Hannaford A.J, Smith P.W.G and Tatchel A.R., "Vogel's Textbook of practical organic chemistry", LBS Singapore (1994).

Lab Requirements

Sl. No.	Description of Equipment	Required numbers (For batch of 30 students)
1.	PH meter	10 nos
2.	Conductivity meter	10 nos
3.	Potentiometer	10 nos
4.	Flame photometer	2 nos
5.	Electronic Balance (Four digit)	1 no
6.	Hot Air Oven	1 no
7.	Spectrophotometer	2 nos
8.	Magnetic stirrer	2 nos



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Course code	21ME18P	Semester	I				
Category	ENGINEERING SCIENCE COURSE (ESC)			L	T	P	C
Course Title	ENGINEERING PRACTICES LABORATORY (COMMON FOR ALL BRANCHES)			0	0	4	2

COURSE OBJECTIVES:

- To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering

PREREQUISITE:

- Basic knowledge of engineering skills

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
At the end of the course students will be able to		
C108. 1	Demonstrate on Smithy operations, Foundry operations models and machine assembly practice of centrifugal pump and air-conditioner	K2
C108. 2	Experiment with pipe connections and plumbing works	K3
C108. 3	Make use of welding equipment to join the structures.	K3
C108. 4	Explain carpentry components, for the joint used in roofs, doors, windows and furniture.	K5
C108. 5	Develop sheet metal models, fitting models and do basic machining operations	K6

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
C108. 1	3	-	-	-	-	2	2	-	2	1	1	2	-	-	-	-
C108. 2	3	-	-	-	-	2	2	-	2	1	1	2	-	-	-	-
C108. 3	3	-	-	-	-	2	2	-	2	1	1	2	-	-	-	-
C108. 4	3	-	-	-	-	2	2	-	2	1	1	2	-	-	-	-
C108. 5	3	-	-	-	-	2	2	-	2	1	1	2	-	-	-	-
C108	3	-	-	-	-	2	2	-	2	1	1	2	-	-	-	-

Note: 1: Slight, 2: Moderate, 3: Substantial

I CIVIL ENGINEERING PRACTICE**12****Buildings:**

- a) Study of plumbing and carpentry components of residential and industrial buildings, Safety aspects.

Plumbing Works:

- a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers and elbows in household fittings.
- b) Study of pipe connections requirements for pumps and turbines.
- c) Preparation of plumbing line sketches for water supply and sewage works.
- d) Hands-on-exercise:
Basic pipe connections-Mixed pipe material connection-Pipe connections with different joining components
- e) Demonstration of plumbing requirements of high-rise buildings

Carpentry using Power Tools only:

- a) Study of the joints in roofs, doors, windows and furniture.
- b) Hands-on-exercise:
Wood work, joints by sawing, Planning and cutting.

II MECHANICAL ENGINEERING PRACTICE**18****Welding:**

- a) Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding.
- b) Gas welding practice

Basic Machining:

- a) Simple Turning and Taper turning
- b) Drilling Practice

Sheet Metal Work:

- a) Forming & Bending:
- b) Model making – Trays and funnels.
- c) Different type of joints.

Machine assembly practice:

- a) Study of centrifugal pump
- b) Study of air conditioner

Demonstration on:

- a) Smithy operations, upsetting, swaging, setting down and bending. Example –Exercise – Production of hexagonal headed bolt.
- b) Foundry operations like mould preparation for gear and step cone pulley.
- c) Fitting – Exercises – Preparation of square fitting and V – fitting models.

Total: 30 Periods

GROUP B (ELECTRICAL & ELECTRONICS)

III ELECTRICAL ENGINEERING PRACTICE

14

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair case wiring
4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
5. Measurement of energy using single phase energy meter.
6. Measurement of resistance to earth of an electrical equipment.

IV ELECTRONICS ENGINEERING PRACTICE

16

1. Study of Electronic components and equipments – Resistor, colour coding measurement of AC signal parameter (peak-peak, rms period, frequency) using CR.
2. Study of logic gates AND, OR, EX-OR and NOT.
3. Generation of Clock Signal.
4. Soldering practice – Components Devices and Circuits – Using general purpose PCB.
5. Measurement of ripple factor of HWR and FWR.

Total: 30 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Chapman, W.A.J. Workshop Technology, Edward Arnold, 2001.

REFERENCES:

1. Raghuwanshi B.S., Workshop Technology Vol. I & II, DhanpathRai & Sons.
2. Kannaiah P. and Narayana K.L., Workshop Manual, 2 Edn, Scitech publishers.
3. John K.C., Mechanical Workshop Practice. 2nd Edn. PHI 2010.
4. JeyapooanT. and Pranitha S., Engineering Practices Lab Manual, 3rd Edn. Vikas Pub.2008

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

Sl.No.	Description of Equipment	Required Numbers (for batch of 30 students)
Part I: Civil Engineering Practices		
(a)	Plumbing Work:	
1)	Pipe Vice	15 Nos.
2)	Die Holder with Die set	15 Nos.
(b)	Wood Work	
1)	Tri Square	15 Nos.
2)	Hand Saw	15 Nos.
3)	Carpentry bench wise	15 Nos.
4)	Firmer Chisel	15 Nos.
5)	Motrin Chisel	15 Nos.
6)	Iron Jack	15 Nos.
7)	Mallet	15 Nos.
8)	Bench hold fastens	15 Nos.
9)	Wooden Bench Hook	15 Nos.
10)	Wood Cutting Machine	2 Nos.
Part II: Mechanical Engineering Practices		
(a)	Welding Work:	
1)	Arc welding unit	5 Nos.
2)	Gas welding unit	2 Nos.
(b)	Basic Machining Work:	
1)	Lathe Machines	5 Nos.
2)	Drilling Machines	5 Nos.
(c)	Assembly Work:	
1)	Centrifugal pump	2 Nos.
2)	Air-conditioner unit	2 Nos.
3)	Household mixer	2 Nos.
(d)	Sheet Metal Work:	
1)	Steel rule	2 Nos.
2)	Bend snips	5 Nos.
3)	Straight snips	5 Nos.
4)	Scriber	5 Nos.
5)	Divider	5 Nos.
6)	Trammel	5 Nos.
7)	Prick Punches	5 Nos.
8)	Centre punches	5 Nos.
9)	Pliers	5 Nos.
10)	Ball pean hammer	5 Nos.
11)	Raising hammer	5 Nos.
12)	Riverting hammer	5 Nos.
13)	Square free hammer	5 Nos.
14)	Anvil	3 Nos.
15)	Swage block	3 Nos.
16)	Wige gauges	2 Nos.
(e)	Foundry Work	
1)	Cope and Drag Box	5 Nos.
2)	Pattern	5 Nos.
3)	Solid pattern	5 Nos.
4)	Split pattern	5 Nos.
5)	Runner	5 Nos.

6)	Riser	5 Nos.
7)	Sprue	5 Nos.
8)	Sand reamer	5 Nos.
9)	Trowel	5 Nos.
PART-III Electrical Practices		
1)	Assorted electrical components for house wiring	15 sets
2)	Electrical measuring instruments	10 sets
3)	Study purpose items: Iron box, fan and regulator, emergency lamp	One each
4)	Megger (250V/500V)	1 No.
5)	Power Tools: (a) Range Finder (b) Digital Live-wire detector	2 Nos 2 Nos
PART-IV Electronics Practices		
1)	Soldering guns	10 No.
2)	Assorted electronic components for making circuits	50 No.
3)	Small PCBs	10 No.
4)	Multi Meters	10 No.
5)	Study purpose items: Telephone, FM radio, low-voltage power supply	2 each

CURRICULUM AND II SEMESTER SYLLABI

Applicable to the students admitted to

B.E- MECHANICAL ENGINEERING

R-2021: CBCS

**Academic year 2021-2022
onwards**



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R-2021: CBCS CURRICULA

II SEMESTER SYLLABI

LIST OF ABBREVIATIONS

S. No.	Abbreviations	Detailed Description
1	HSMC	Humanities & Social Science including Management Courses
2	BSC	Basic Science Courses
3	ESC	Engineering Science Courses
4	PCC	Professional Core Courses
5	PEC	Professional Elective Courses
6	OEC	Open Elective Courses
7	PROJ	Project Work
8	EEC	Employability Enhancement Courses
9	MC	Mandatory Courses

Category Based Credit Split-Up – Semester Wise

Semester	HSMC	BSC	ESC	PCC	PEC	OEC	Project /EEC	MC	Total Credit
1	3	12	10	-	-	-	-	-	25
2	3	4	9	8	-	-	-	-	24
3	-	4	4	14	-	-	-	0	22
4	-	3	-	17	-	-	1	0	21
5	-	-	-	17	3	3	1	-	24
6	-	-	-	13	3	3	2	-	21
7	-	-	-	15	3	-	2	-	20
8	-	-	-	-	6	-	6	-	12
Total credits	6 (3.59 %)	23 (13.17 %)	23 (13.17 %)	84 (50.29 %)	15 (8.98 %)	6 (3.59 %)	12 (7.18 %)	0	169

B.E.-Mechanical Engineering Curriculum (R2021)

SEMESTER I										
S. No.	Course Code	Course Title	Category	CIE Marks	SEE Marks	Total marks	Credits			
							L	T	P	C
THEORY										
1	21EN11T	Communicative English	HSMC	40	60	100	3	0	0	3
2	21MA12T	Matrices and Differential Calculus	BSC	40	60	100	3	1	0	4
3	21PH13T	Engineering Physics I	BSC	40	60	100	3	0	0	3
4	21CY14T	Engineering Chemistry	BSC	40	60	100	3	0	0	3
5	21CS15IT	Problem Solving and Python Programming*	ESC	40	60	100	2	0	4	4
6	21ME16T	Engineering Graphics	ESC	40	60	100	4	0	0	4
PRACTICAL										
7	21BS17P	Physics and Chemistry Laboratory	BSC	40	60	100	0	0	4	2
8	21ME18P	Engineering Practices Laboratory	ESC	40	60	100	0	0	4	2
TOTAL										25

SEMESTER II										
S. No.	Course Code	Course Title	Category	CIE Marks	SEE Marks	Total marks	Credits			
							L	T	P	C
THEORY										
1	21EN21T	Technical English	HSMC	40	60	100	3	0	0	3
2	21MA22T	Vector Calculus and Complex Integration	BSC	40	60	100	3	1	0	4
3	21ME23T	Production Technology-I	PCC	40	60	100	3	0	0	3
4	21EE24T	Basic Electrical, Electronics and Instrumentation Engineering	ESC	40	60	100	3	0	0	3
5	21ME25T	Engineering Materials & Metallurgy	PCC	40	60	100	3	0	0	3
6	21ME26T	Engineering Mechanics	ESC	40	60	100	3	1	0	4
PRACTICAL										
7	21ME27P	Production Technology-I Laboratory	PCC	40	60	100	0	0	4	2
8	21EE28P	Basic Electrical and Electronics Engineering Laboratory	ESC	40	60	100	0	0	4	2
TOTAL										24

SEMESTER III										
S. No.	Course Code	Course Title	Category	CIE Marks	SEE Marks	Total marks	Credits			
							L	T	P	C
THEORY										
1	21ME31T	Engineering Thermodynamics	PCC	40	60	100	3	1	0	4
2	21ME32T	Fluid Mechanics and Machinery	PCC	40	60	100	3	0	0	3
3	21ME33T	Production Technology-II	PCC	40	60	100	3	0	0	3
4	21MA34T	Series, Transforms and Partial Differential Equations	BSC	40	60	100	3	1	0	4
5	21HE35IT	Electrical Drives and Controls	ESC	40	60	100	2	0	4	4
6	21MC01T	Constitution of India	MC	40	60	100	2	0	0	0
PRACTICAL										
7	21ME37P	Production Technology-II Laboratory	PCC	40	60	100	0	0	4	2
8	21ME38P	Computer Aided Machine Drawing Laboratory	PCC	40	60	100	0	0	4	2
TOTAL										22

SEMESTER IV										
S. No.	Course Code	Course Title	Category	CIE Marks	SEE Marks	Total marks	Credits			
							L	T	P	C
THEORY										
1	21ME41T	Computer Aided Design	PCC	40	60	100	3	0	0	3
2	21ME42T	Strength of Materials	PCC	40	60	100	3	0	0	3
3	21ME43T	Kinematics of Machinery	PCC	40	60	100	3	1	0	4
4	21ME44T	Thermal Engineering	PCC	40	60	100	3	0	0	3
5	21MA45T	Statistics and Numerical Methods	BSC	40	60	100	3	0	0	3
6	21MC02T	Environmental Sciences	MC	40	60	100	2	0	0	0
PRACTICAL										
7	21ME47P	Fluid Mechanics and Machinery & Strength of Materials Laboratory	PCC	40	60	100	0	0	4	2
8	21ME48P	Thermal Engineering Laboratory	PCC	40	60	100	0	0	4	2
9	21EE01P	Mini Project - I	EEC	40	60	100	0	0	2	1
TOTAL										21

SEMESTER V										
S. No.	Course Code	Course Title	Category	CIE Marks	SEE Marks	Total marks	Credits			
							L	T	P	C
THEORY										
1	21ME51T	Heat and Mass Transfer	PCC	40	60	100	3	0	0	3
2	21ME52T	Design of Machine Elements	PCC	40	60	100	3	1	0	4
3	21ME53T	Metrology and Measurements	PCC	40	60	100	3	0	0	3
4	21ME54T	Dynamics of Machines	PCC	40	60	100	3	0	0	3
5	-	Professional Elective - I	PEC	40	60	100	3	0	0	3
6	-	Open Elective - I	OEC	40	60	100	3	0	0	3
PRACTICAL										
7	21ME57P	Metrology and Measurements Laboratory	PCC	40	60	100	0	0	4	2
8	21ME58P	Kinematics and Dynamics Laboratory	PCC	40	60	100	0	0	4	2
9	21EE03P	Technical Seminar	EEC	100	-	100	0	0	2	1
TOTAL										24

SEMESTER VI										
S. No.	Course Code	Course Title	Category	CIE Marks	SEE Marks	Total marks	Credits			
							L	T	P	C
THEORY										
1	21ME61T	Design of Transmission Systems	PCC	40	60	100	3	1	0	4
2	21ME62T	Engine Testing and Certification	PCC	40	60	100	3	0	0	3
3	21ME63T	Finite Element Analysis	PCC	40	60	100	3	1	0	4
4	-	Professional Elective II	PEC	40	60	100	3	0	0	3
5	-	Open Elective II	OEC	40	60	100	3	0	0	3
PRACTICAL										
6	21ME66P	Computer Aided Machining Laboratory	PCC	40	60	100	0	0	4	2
7	-	Mini Project - 2	EEC	40	60	100	0	0	2	1
8	-	Internship	EEC	0	100	100	0	0	2	1
TOTAL										21



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SEMESTER VII										
S. No.	Course Code	Course Title	Category	CIE Marks	SEE Marks	Total marks	Credits			
							L	T	P	C
THEORY										
1	21ME71T	Engineering Failure Analysis	PCC	40	60	100	3	0	0	3
2	21ME72T	Process Planning and Cost Estimation	PCC	40	60	100	3	0	0	3
3	21ME73T	Product Design and Development	PCC	40	60	100	3	0	0	3
4	21ME74T	Micro controller and Mechatronics	PCC	40	60	100	2	0	4	4
5	-	Professional Elective III	PEC	40	60	100	3	0	0	3
PRACTICAL										
6	21ME76P	Simulation and Analysis Laboratory	PCC	40	60	100	0	0	4	2
7	-	Project Work – Phase-I	PROJ	40	60	100	0	0	4	2
TOTAL										20

SEMESTER VIII										
S. No.	Course Code	Course Title	Category	CIE Marks	SEE Marks	Total marks	Credits			
							L	T	P	C
THEORY										
1	-	Professional Elective IV	PEC	40	60	100	3	0	0	3
2	-	Professional Elective V	PEC	40	60	100	3	0	0	3
PRACTICAL										
3	-	Project Work – Phase - II	PROJ	40	60	100	0	0	12	6
TOTAL										12

LIST OF PROFESSIONAL ELECTIVE COURSES

Sl. No.	COURSE CODE	COURSE TITLE
Professional Elective I (V SEM)		
1.	21ME551PT	Automobile Engineering
2.	21ME552PT	Gas Dynamics and Jet Propulsion
3.	21ME553PT	Intellectual Property Rights
4.	21ME554PT	Composite materials and Nano Technology
5.	21ME555PT	Hydraulics and Pneumatics
Professional Elective II (VI SEM)		
6.	21ME641PT	Professional Ethics in Engineering
7.	21ME642PT	Artificial Intelligence
8.	21ME643PT	Renewable Energy Sources
9.	21ME644PT	Computational Fluid Dynamics
10.	21ME645PT	Unconventional Machining Processes
Professional Elective III (VII SEM)		
11.	21ME751PT	Data Science
12.	21ME752PT	Refrigeration and Air conditioning
13.	21ME753PT	Computer Integrated Manufacturing
14.	21ME754PT	Industrial Corrosion and Tribology
15.	21ME755PT	Maintenance Engineering
Professional Elective IV (VIII SEM)		
16.	21ME811PT	Non Destructive Testing and Evaluation
17.	21ME812PT	Total Quality Management
18.	21ME813PT	Industrial Robotics
19.	21ME814PT	New product Development
20.	21ME815PT	Theory of Metal Cutting and Joining
Professional Elective V (VIII SEM)		
21.	21ME821PT	Power Plant Engineering
22.	21ME822PT	Micro Electro Mechanical Systems
23.	21ME823PT	Production Planning and Control
24.	21ME824PT	Advanced Manufacturing Management
25.	21ME825PT	Lean Manufacturing

LIST OF OPEN ELECTIVE COURSES

S. No.	COURSE CODE	NAME OF THE COURSE
1	21ME01OT	Industry 4.0
2	21ME02OT	Robotics and Industrial Automation
3	21ME03OT	3D Printing
4	21ME04OT	Fundamentals of Electric and Hybrid Vehicles



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Course code	21EN21T	Semester		II			
Category	HUMANITIES & SOCIAL SCIENCE INCLUDING MANAGEMENT COURSES (HSMC)			L	T	P	C
Course Title	TECHNICAL ENGLISH (Common for all Branches)			3	0	0	3

COURSE OBJECTIVES:

- To make the students of engineering and technology to enhance their ability on reading and comprehending the different texts
- To improve their creative and critical thinking so as to use in demanding contexts
- To equip the learners with the skills of writing convincing job Applications and effective reports
- To develop their speaking skills to make technical presentations and participate in group discussions
- To facilitate them to hone their soft skills

PREREQUISITE:

- Technical writing and basic English grammar.

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C201. 1	<i>Read</i> and understand general and technical texts	K2
C201. 2	<i>Apply</i> creative and critical thinking and communicate their ideas efficiently	K2
C201. 3	<i>Participate</i> in group discussions and deliver short speeches effectively	K3
C201. 4	<i>Write</i> effectively and persuasively in academic and workplace contexts	K3
C201. 5	<i>Experiment with</i> the future challenges confidently and successfully	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
C201. 1	-	-	-	-	-	-	-	-	1	3	-	2	-	-	-
C201. 2	-	-	-	-	-	-	-	-	1	3	-	2	-	-	-
C201. 3	-	-	-	-	-	-	-	-	1	3	-	2	-	-	-
C201. 4	-	-	-	-	-	-	-	-	1	3	-	2	-	-	-
C201. 5	-	-	-	-	-	-	-	-	1	3	-	2	-	-	-
C201	-	-	-	-	-	-	-	-	1	3	-	2	-	-	-

Note: 1: Slight, 2: Moderate, 3: Substantial

UNIT-I TECHNICAL WRITING AND VISUAL CONVERSION 9**PRACTICAL****LISTENING** :Listening to pronunciation of longer words.**SPEAKING** :Making out meaning of pictorial and graphical representations.**TUTORIAL****READING** :Understanding logic and sequencing in reading inferring the exact meaning of text**WRITING** :Extended Definition- Writing Instructions, Checklists & Recommendations- Reading short technical text from Journal.**VOCABULARY:** Technical vocabulary- Regular and Irregular verbs.**UNIT- II TECHNICAL WRITING AND GUIDELINES PREPARATION 9****PRACTICAL****LISTENING** : Comprehensive listening - Listening to telephonic conversations – short and long conversations from different domains, listening to various pre-recorded

conversations and speeches.

SPEAKING : Delivering short speeches in the class.**TUTORIAL****READING** : Technical reading on innovations and innovators.**WRITING** : Conditional clauses, Numerical adjectives, Process Description**VOCABULARY:** Collocation, Verbal Analogies.**UNIT-III TECHNICAL PROCESS WRITING 9****PRACTICAL****LISTENING** : Listening to documentaries and making notes.**SPEAKING** : Basic speaking practice based on BEC, IELTS, and TOFEL.**TUTORIAL****READING** : longer text both general and technical –practice in speed reading**WRITING** : Purpose statements, words are used as nouns and verbs- describing a process – use of sequence word - Interpretation of Graphs and Charts.**VOCABULARY:** Sequence words –Misspelled words -Embedded sentences.**UNIT- IV TECHNICAL WRITING AND BUSINESS LETTERS 9****PRACTICAL****LISTENING** : listening to native accents.**SPEAKING** : Group Discussions - Process, Skills, Guidelines, Evaluation, Oral Presentation - Planning, Preparing, Organizing and Presenting.**TUTORIAL****READING** : Reading for detailed comprehension.**WRITING** : Cause and effect, impersonal passive voice, idioms and phrases, - Letter writing, job application, business correspondence (letters) – calling for quotations, placing order, complaint letters, preparing a memo, notice and e-mail itinerary.**VOCABULARY:** clauses and If conditionals.

UNIT-V TECHNICAL WRITING AND REPORT WRITING

9

PRACTICAL

LISTENING : TED /ink talks

SPEAKING : Starting a Career — vision statement, preparing logo and tagline, making short term and long-term goals, setting plans.

TUTORIAL

READING : Reading and understanding technical articles.

WRITING : Degrees of comparison, editing, Email etiquette, Mispronounced words –
Report writing survey, feasibility, industrial visit, reporting various incidents and accidents, Minutes of meeting.

VOCABULARY: Reported speech.

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Department of English, Anna University, Chennai. Mindscapes: English for Technologists and Engineers. Orient Black Swan, Chennai.
2. Dhanavel, S.P. English and Communication Skills for Students of Science and Engineering. Orient Black Swan Publications, Chennai, 2011.

REFERENCE BOOKS:

1. Rizvi, M. Ashraf, “Effective Technical Communication”, Tata McGraw— Hill, 2006.
2. Ibbotson, Mark, “Cambridge English for Engineering”, Cambridge University Reference Press, 2008
3. Richard Johnson-Sheehan, “Technical Communication Today” 4th Edition Books Longman Publishing Group, 2011.
4. Richard Johnson-Sheehan, “Technical Communication Today” 4th Edition Books Longman Publishing Group, 2011
5. Porter, Patricia A., and Margaret Grant, “Communicating Effectively in English: Oral Communication for Non-Native Speakers”, 2nd Edition, Wadsworth, 1992.
6. Gopaldaswamy, Ramesh & Ramesh Mahadevan. ACE of Soft Skills: Attitude, Communication and Etiquette for Success, New Delhi: Pearson, 2010.

Extensive Reading:

Wells, H G. The Time Machine, Peacock, India, 2008.



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Course code	21MA22T	Semester	II				
Category	BASIC SCIENCE COURSE (BSC)			L	T	P	C
Course Title	VECTOR CALCULUS AND COMPLEX INTEGRATION (Common for all Branches)			3	1	0	4

COURSE OBJECTIVES:

- To improve their ability in vector calculus
- To expose to the ideas of analytic functions
- To solve differential equation using the concept of Laplace Transform.

PREREQUISITE:

- Mathematics skills at Sem-I level

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C202.1	<i>Apply</i> the vector calculus concepts to solve engineering problems.	K3
C202.2	<i>Apply</i> the concept of mapping to solve Linear equation.	K3
C202.3	<i>Apply</i> the complex integration problem ideas to solve engineering problems.	K3
C202.4	<i>Understand</i> the concepts of multiple integrals.	K2
C202.5	<i>Apply</i> the concepts of Laplace transformation to solve Differential Equations.	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C202.1	3	2	-	-	-	-	-	-	-	-	-	-
C202.2	3	2	-	-	-	-	-	-	-	-	-	-
C202.3	3	2	-	-	-	-	-	-	-	-	-	-
C202.4	2	2	-	-	-	-	-	-	-	-	-	-
C202.5	3	2	-	-	-	-	-	-	-	-	-	-
C202	3	2	-	-	-	-	-	-	-	-	-	-

Note: 1: Slight, 2: Moderate, 3: Substantial

SYLLABUS**No. of Credits: 4****UNIT I VECTOR CALCULUS****12**

Gradient, divergence, curl – Solenoidal and irrotational fields – Vector identities– Directional derivatives – Line, surface and volume integrals –Green's, Gauss divergence and Stoke's theorems (without proof) .

UNIT II ANALYTIC FUNCTIONS**12**

Limit of a complex functions-Derivative of $f(z)$ -Definition of Analytic Function – Cauchy Riemann equations – Properties of analytic functions - Determination of harmonic conjugate – Milne-Thomson's method – Conformal mappings: $1/z$, az , $az+b$ and bilinear transformation.

UNIT III COMPLEX INTEGRATION**12**

Line integral – Cauchy's integral theorem (statements only) – Cauchy's integral formulae and its applications – Taylor's and Laurent's expansions (statements only) – Singularities – Poles and Residues – Cauchy's residue theorem (statement only) – Contour integration – Unit circle and semicircular contour.

UNIT IV MULTIPLE INTEGRALS**12**

Double integration in Cartesian and polar coordinates – Change of order of integration – Area as double integral – Triple integration in Cartesian coordinates – Conversion from Cartesian to polar – Volume as a double and Triple Integral.

UNIT V LAPLACE TRANSFORMS**12**

Definition-Conditions for existence- Transforms of elementary functions – Properties of Laplace Transform-Transforms of periodic functions – Transforms of derivatives and integrals– Inverse transforms – Convolution theorem– Applications of Laplace transforms for solving linear ordinary differential equations up to second order with constant coefficients only- Unit step function and Unit impulse function [simple problems only]

Total: 60 Periods**LEARNING RESOURCES:****TEXT BOOKS:**

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

REFERENCES:

1. E. Kreyszig, **Advanced Engineering Mathematics**, John Wiley & Sons. Singapore, 10th Edition, 2012.
2. M.K. Venkataraman, **Engineering Mathematics: Vol I and II**, National Publishing., Chennai 2001.
3. T. Veerarajan, **Engineering Mathematics**, Tata McGraw Hill Publishing Co, New Delhi, 2004.



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Course code	21ME23T	Semester	II				
Category	PROFESSIONAL CORE COURSE (PCC)			L	T	P	C
Course Title	PRODUCTION TECHNOLOGY-I			3	0	0	3

COURSE OBJECTIVES:

- To introduce the concepts of basic manufacturing processes and fabrication techniques, such as metal casting, metal joining, metal forming and manufacture of plastic components.

PREREQUISITE:

- Basic knowledge of engineering skills

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C203.1	Explain different metal casting processes, associated defects, merits and demerits	K2
C203.2	Compare different metal joining processes.	K2
C203.3	Summarize various hot working and cold working methods of metals.	K2
C203.4	Explain various sheet metal making processes.	K2
C203.5	Distinguish various methods of manufacturing plastic components.	K2

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
C203.1	-	-	3	-	3	-	-	-	1	2	-	-	-	-	-	-
C203.2	-	-	3	2	3	2	-	-	1	2	-	-	-	-	-	-
C203.3	2	-	3	-	-	-	-	-	1	2	-	-	-	-	-	-
C203.4	2	-	3	-	-	-	-	-	1	2	-	-	-	-	-	-
C203.5	-	-	3	-	2	-	-	-	-	2	-	-	-	-	-	-
C203	2	-	3	2	3	2	-	-	1	2	-	-	-	-	-	-

Note: 1: Slight, 2: Moderate, 3: Substantial

SYLLABUS**No. of Credits: 3****UNIT I METAL CASTING PROCESSES 9**

Sand Casting : Sand Mould – Type of patterns - Pattern Materials – Pattern allowances – Moulding - sand Properties and testing – Cores – Types and applications – Moulding machines– Types and applications; Melting furnaces : Blast and Cupola Furnaces; Principle of special casting processes : Shell - investment – Ceramic mould – Pressure die casting - Centrifugal Casting - CO₂ process – Stir casting; Defects in Sand casting- Testing and inspection of castings.

UNIT II JOINING PROCESSES 9

Operating principle, basic equipment, merits and applications of: Fusion welding processes: Gas welding - Types – Flame characteristics; Manual metal arc welding – Gas Tungsten arc welding - Gas metal arc welding – Submerged arc welding – Electro slag welding; Operating principle and applications of: Resistance welding - Plasma arc welding – Thermit welding – Electron beam welding – Friction welding and Friction Stir Welding; Brazing and soldering; Weld defects: types, causes and cure.

UNIT III METAL FORMING PROCESSES 9

Hot working and cold working of metals – Forging processes – Open, impression and closed die forging – forging operations. Rolling of metals– Types of Rolling – Flat strip rolling – shape rolling operations – Defects in rolled parts. Principle of rod and wire drawing – Tube drawing – Principles of Extrusion – Types --Hot and Cold extrusion.

UNIT IV SHEET METAL FORMING PROCESSES 9

Sheet metal characteristics – shearing, bending and drawing operations – Stretch forming operations – Formability of sheet metal – Test methods –special forming processes-Working principle and applications – Hydro forming – Rubber pad forming – Metal spinning-- Introduction of Explosive forming, magnetic pulse forming, peen forming, Super plastic forming – Micro forming-Powder metallurgy-production of metal powders-stages in powder metallurgy.

UNIT V MANUFACTURE OF PLASTIC COMPONENTS 9

Types and characteristics of plastics – Molding of thermoplastics – working principles and typical applications – injection molding – Plunger and screw machines – Compression molding, Transfer Molding – Typical industrial applications – introduction to blow molding –Rotational molding – Film blowing – Extrusion – Thermoforming – Bonding of Thermoplastics.

Total: 45 Periods**LEARNING RESOURCES:****TEXT BOOKS:**

1. HajraChouldhary S.K and Hajra Choudhury. AK., "Elements of workshop Technology", volume I and II, Media promoters and Publishers Private Limited, Mumbai, 2018.
2. Kalpakjian. S, "Manufacturing Engineering and Technology", Pearson Education India Edition, 2017.

REFERENCES:

1. Gowri P. Hariharan, A.SureshBabu, "Manufacturing Technology I", Pearson Education, 2018.
2. Paul Degarma E, Black J.T and Ronald A. Kosher, "Materials and Processes, in Manufacturing" Eight Edition, Prentice – Hall of India, 2017.
3. Rao, P.N. "Manufacturing Technology Foundry, Forming and Welding", 4th Edition, TMH-2018.
4. Roy. A. Lindberg, "Processes and Materials of Manufacture", PHI / Pearson education, 2017.
5. Sharma, P.C., "A Text book of production Technology", S.Chand and Co. Ltd., 2018.



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Course code	21EE24T	Semester	II			
Category	ENGINEERING SCIENCE COURSE (ESC)		L	T	P	C
Course Title	BASIC ELECTRICAL, ELECTRONICS AND INSTRUMENTATION ENGINEERING Common for (CSE, IT, AI&DS, BIOTECH, CIVIL, MECH, CSE(AI&ML))		3	0	0	3

COURSE OBJECTIVES:

- The course is intended to introduce the students to basic theorems and laws in DC and AC circuits.
- This course aims at giving adequate exposure to students on the principles of electrical machines.
- The course will enable the students to acquire knowledge on fundamentals and applications of various electronic devices and measuring instruments.

PREREQUISITE:

- Engineering Physics, Mathematics

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C204.1	<i>Impart</i> knowledge on electrical circuit components, laws and theorems.	K2
C204.2	<i>Analyze</i> the behavior of ac circuits components in power system	K3
C204.3	<i>Illustrate</i> the working of various ac machines, dc machines and special machines along with its characteristics.	K2
C204.4	<i>Infer</i> and <i>relate</i> the working and applications of various electronics devices and circuits.	K2
C204.5	<i>Categorize</i> the specific instruments for electrical measurements.	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
C204.1	3	2	-	-	-	-	-	-	2	-	1	1
C204.2	3	2	-	-	-	-	-	-	2	-	1	1
C204.3	3	2	-	-	-	-	-	-	2	-	1	1
C204.4	3	2	-	-	-	-	-	-	-	-	1	1
C204.5	3	2	-	-	-	-	-	-	2	-	1	1
C204	3	2	-	-	-	-	-	-	2	-	1	1

Note: 1: Slight, 2: Moderate, 3: Substantial

SYLLABUS**No. of Credits: 3****UNIT I DC CIRCUITS 9**

Basic circuit components (R, L & C) - Ohms Law - Kirchoff's Law – voltage and current division -source transformation-steady state solution of DC circuits - Nodal analysis, Mesh analysis-Thevenin's Theorem, Norton's Theorem, Maximum Power transfer -Superposition Theorem.

UNIT II AC CIRCUITS 9

Introduction to AC circuits – waveforms and RMS value – power and power factor, Analysis of single-phase ac circuits consisting of RL and RLC combinations -Resonance- Balanced and Unbalanced three-phase circuits-Star and Delta connections.

UNIT III ELECTRICAL MACHINES 9

Principles of operation and characteristics of DC machines, Construction and operation of Single-Phase transformer – Three phase transformer connections – Autotransformer. Construction and types of Single phase and Three phase Induction motor, Construction and working principle of Alternator, Stepper motors – Brushless DC Motors.

UNIT IV ELECTRONIC DEVICES & CIRCUITS 9

Types of Materials – Silicon & Germanium - PN Junction diodes – Structure, Operation and Characteristics – Display devices-LED, Laser diodes – Zener diode - Bipolar Junction Transistor – Characteristics and applications –Amplifiers - Basics, types and applications, Oscillators-Basics, types and its applications—D/A and A/D converters.

UNIT V MEASUREMENTS & INSTRUMENTATION 9

Introduction to transducers - Classification of Transducers: Resistive, Inductive, Capacitive Thermolectric, piezoelectric, photoelectric, Hall effect. Types and principle of indicating Instruments – Multimeters, Wattmeter, instrument transformers (CT and PT), Oscilloscopes.

TOTAL: 45 PERIODS**LEARNING RESOURCES:****TEXT BOOKS:**

1. D P Kothari and IJ Nagarath, —Basic Electrical and Electronics Engineering, McGraw Hill Education (India) Private Limited, Third Reprint ,2016
2. Leonard S Bobrow, “Foundations of Electrical Engineering”, Oxford University Press, 2013
3. D.V.S. Moorthy, ‘Transducers and Instrumentation’, Prentice Hall of India Pvt Ltd, 2007.

REFERENCES:

1. Del Toro, “Electrical Engineering Fundamentals”, Pearson Education, New Delhi, 2007
2. John Bird, “Electrical Circuit Theory and Technology”, Elsevier, First Indian Edition, 2006
3. N K De, Dipu Sarkar, “Basic Electrical Engineering”, Universities Press (India)Private Limited 2016
4. David A. Bell, “Electronic devices and circuits”, Oxford University higher education,5th edition2008.
5. Allan S Moris, “Measurement and Instrumentation Principles”, Elseveir, First Indian Edition, 2006.



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Course code	21ME25T	Semester	II				
Category	PROFESSIONAL CORE COURSE (PCC)			L	T	P	C
Course Title	ENGINEERING MATERIALS AND METALLURGY			3	0	0	3

COURSE OBJECTIVES:

The course objective of this course is to prepare the students for:

- To impart knowledge on the structure, properties, treatment, testing and applications of metals and non-metallic materials so as to identify and select suitable materials for various engineering applications.

PREREQUISITE:

- Engineering Physics

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C205.1	<i>Understand</i> the concept of crystal structures, alloys and phase diagram and construct the Iron-Iron carbon diagram.	K2
C205.2	<i>Explain</i> isothermal transformation, continuous cooling diagrams and different heat treatment processes.	K2
C205.3	<i>Clarify</i> the effect of alloying elements on ferrous and non-ferrous metals.	K2
C205.4	<i>Summarize</i> the properties and applications of polymer ceramics, composites and nano materials.	K2
C205.5	<i>Applying</i> the various testing procedures and failure mechanism in engineering field.	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
C205.1	3	-	-	-	-	-	-	-	-	-	-	1	2	1	-	-
C205.2	3	-	-	-	-	-	-	-	-	-	-	1	2	1	-	-
C205.3	3	-	-	-	-	-	-	-	-	-	-	1	2	1	-	-
C205.4	3	-	-	-	-	-	-	-	-	-	-	1	2	1	-	-
C205.5	3	1	-	-	-	1	-	-	-	-	-	1	2	1	-	-
C205	3	1	-	-	-	1	-	-	-	-	-	1	2	1	-	-

Note: 1: Slight, 2: Moderate, 3: Substantial

UNIT I CRYSTAL STRUCTURES & PHASE DIAGRAMS 9

Classification of Engineering Materials, Crystal Structure - BCC, FCC & HCP Structures - Crystallographic direction and planes, Crystal Systems, Crystal imperfections - Point, Line, Surface and Volume defects, Solid solutions - substitutional and interstitial - Hume Rothery Rules, Phase diagrams - Phase Rules - Binary Phase Diagram, Isomorphous Systems, Eutectic, eutectoid, peritectic, and peritectoid reactions, Iron – carbon equilibrium diagram, Microstructures in Iron-Carbon alloys, Classification of steel and cast Iron.

UNIT II HEAT TREATMENT 9

Importance of Heat Treatment - Annealing and types, Normalizing, Hardening of Steel, Tempering, Austempering and Martempering, TTT- Time Temperature Transformation Diagram (Isothermal Transformation diagram), CCT diagram – cooling curves superimposed on I.T. diagram, Hardenability, Jominy end quench test, Case hardening, Carburising, Nitriding, Cyaniding, Carbonitriding, Flame and Induction hardening, Precipitation / Age Hardening

UNIT III FERROUS AND NON-FERROUS METALS 9

Effect of alloying additions on steel, Classification of Steels - Plain Carbon Steels, HSLA, Maraging steels, Tool Steels, Stainless Steels - Properties & Applications, Classification of Cast Irons - White, Grey, Malleable, Spheroidal, Alloy Cast Iron - Properties & Applications, Copper and copper alloys, Aluminium and Aluminium Alloys, Bearing alloys, Mg Alloys, Ni- Based Super Alloys, Titanium Alloys, Shape Memory Alloys – Properties, Classifications and its applications.

UNIT IV INTRODUCTION TO NEW MATERIALS 9

Polymers – Properties and applications of various thermosetting and thermoplastic polymers (PP, PS, PVC, PMMA, PET, PC, PA, ABS, PI, PAI, PPO, PPS, PEEK, PTFE, Polymers – Urea and Phenol formaldehydes), Engineering Ceramics – Properties and applications (Al₂O₃, SiC, Si₃N₄, PSZ and SIALON), Composites- Classifications and Applications of Composites (Metal Matrix and FRP), Nano Materials.

UNIT V MECHANICAL PROPERTIES & TESTING 9

Mechanisms of Plastic deformations, Slip and Twinning, Types of Fracture, Ductile and Brittle fracture, Griffith's theory, Fatigue and Creep Failure Mechanisms, Testing of materials under tension, compression and shear loads, Hardness tests (Brinell, Vickers and Rockwell), Impact test- Izod and Charpy, Fracture Toughness test.

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Avner, S.H., "Introduction to Physical Metallurgy", McGraw Hill Book Company, 1997.
2. Williams D Callister, "Material Science and Engineering" Wiley India Pvt Ltd, Revised Indian Edition 2014.

REFERENCES:

1. Kenneth G. Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of India Private Limited, 2010.
2. Raghavan. V, "Materials Science and Engineering", Prentice Hall of India Pvt. Ltd., 2015.
3. U.C. Jindal, "Material Science and Metallurgy", First Edition, Dorling Kindersley, 2012
4. Upadhyay. G.S. and Anish Upadhyay, "Materials Science and Engineering", Viva Books Pvt. Ltd., New Delhi, 2006.



VEL TECH HIGH TECH

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Course code	21ME26T	Semester		II			
Category	ENGINEERING SCIENCE COURSE (ESC)			L	T	P	C
Course Title	ENGINEERING MECHANICS (Common for MECH, CIVIL)			3	1	0	4

COURSE OBJECTIVES:

- To develop capacity to predict the effect of force and motion in the course of carrying out the design functions of engineering.

PREREQUISITE:

- Engineering Physics, Mathematics

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C206.1	<i>Illustrate</i> the vectorial and scalar representation of forces and moments	K2
C206.2	<i>Analyze</i> the rigid body in equilibrium	K4
C206.3	<i>Calculate</i> dynamic forces exerted in rigid body	K4
C206.4	<i>Examine</i> the friction and the effects by the laws of friction	K4
C206.5	<i>Evaluate</i> the properties of surfaces and solids	K5

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
C206.1	3	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
C206.2	3	3	2	1	-	1	-	-	-	-	-	1	-	2	-	-
C206.3	3	3	-	-	-	1	-	-	-	-	-	1	-	2	-	-
C206.4	3	3	-	-	-	1	-	-	-	-	-	1	-	2	-	-
C206.5	3	3	2	1	-	1	-	-	-	-	-	1	-	2	-	-
C206	3	3	2	1	-	1	-	-	-	-	-	1	-	2	-	-

Note: 1: Slight, 2: Moderate, 3: Substantial

LEARNING RESOURCES:

TEXT BOOKS:

1. Beer, F.P and Johnston Jr. E.R., “Vector Mechanics for Engineers (In SI Units): Statics and Dynamics”, 8th Edition, Tata McGraw-Hill Publishing company, New Delhi, 2004.
2. Bhavikatti, S.S and Rajashekarappa, K.G., “Engineering Mechanics”, New Age International (P) Limited Publishers, 2007.

REFERENCES:

1. Vela Murali, “Engineering Mechanics”, Oxford University Press, 2010.
2. Hibbeler, R.C and Ashok Gupta, “Engineering Mechanics: Statics and Dynamics”, 11th Edition, Pearson Education 2010.
3. Irving H. Shames and Krishna Mohana Rao. G., “Engineering Mechanics – Statics and Dynamics”, 4th Edition, Pearson Education 2006.
4. Meriam J.L. and Kraige L.G., “Engineering Mechanics- Statics - Volume 1, Dynamics- Volume2”, Third Edition, John Wiley & Sons,1993.
5. Rajasekaran S and Sankara subramanian G., “Engineering Mechanics Statics and Dynamics”, 3rdEdition, Vikas Publishing House Pvt. Ltd., 2005.



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Course code	21ME27P	Semester	II				
Category	PROFESSIONAL CORE COURSE (PCC)			L	T	P	C
Course Title	PRODUCTION TECHNOLOGY-I LABORATORY			0	0	4	2

COURSE OBJECTIVES:

- To Study and practice the various operations that can be performed in lathe, shaper, drilling, milling machines etc. and to equip with the practical knowledge required in the core industries.

PREREQUISITE:

- Basic engineering knowledge

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C207.1	Demonstrate the safety precautions exercised in the mechanical workshop.	K2
C207.2	Show the workpiece as per given shape and size using Lathe.	K2
C207.3	Join two metals using arc welding.	K2
C207.4	Use sheet metal fabrication tools and make simple tray and funnel.	K2
C207.5	Use different molding tools, patterns and prepare sand molds.	K2

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
C207.1	3	-	-	-	-	2	2	-	2	1	1	2	-	-	-	-
C207.2	3	-	-	-	-	2	2	-	2	1	1	2	-	-	-	-
C207.3	3	-	-	-	-	2	2	-	2	1	1	2	-	-	-	-
C207.4	3	-	-	-	-	2	2	-	2	1	1	2	-	-	-	-
C207.5	3	-	-	-	-	2	2	-	2	1	1	2	-	-	-	-
C207	3	-	-	-	-	2	2	-	2	1	1	2	-	-	-	-

Note: 1: Slight, 2: Moderate, 3: Substantial

S.NO.	EXPERIMENT
1.	Taper Turning
2.	External Thread cutting
3.	Internal Thread Cutting
4.	Eccentric Turning
5.	Knurling
6.	Square Head Shaping
7.	Hexagonal Head Shaping
8.	Fabrication of simple structural shapes using Gas Metal Arc Welding
9.	Joining of plates and pipes using Gas Metal Arc Welding/ Arc Welding/ Submerged arc welding
10.	Preparation of green sand molds
11.	Manufacturing of simple sheet metal components using shearing and bending operations.
12.	Manufacturing of sheet metal components using metal spinning on a lathe
13.	Study of construction features and manufacturing methods – Head stock, Tail stock, Carriage, Cross slide, Compound rest, Belt, Guide ways, Feed gear box, Apron gearbox.

TOTAL: 60 PERIODS

LEARNING RESOURCES:

TEXT BOOKS:

1. Hajra Chouldhary S.K and Hajra Choudhury. AK., "Elements of workshop Technology", volume I and II, Media promoters and Publishers Private Limited, Mumbai, 2018.
2. Kalpakjian. S, "Manufacturing Engineering and Technology", Pearson Education India Edition, 2017.

REFERENCES:

1. Gowri P. Hariharan, A.Suresh Babu, "Manufacturing Technology I", Pearson Education, 2018.
2. Rao, P.N. "Manufacturing Technology Foundry, Forming and Welding", 4th Edition, TMH- 2018.
3. Roy. A. Lindberg, "Processes and Materials of Manufacture", PHI / Pearson education, 2017.
4. Sharma, P.C., "A Text book of production Technology", S.Chand and Co. Ltd., 2018.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S. NO.	NAME OF THE EQUIPMENT	Qty.
1	Centre Lathes	7 Nos.
2	Horizontal Milling Machine	1 No
3	Vertical Milling Machine	1 No
4	Shaper	1 No.
5	Arc welding transformer with cables and holders	2 Nos
6	Oxygen and acetylene gas cylinders, blow pipe and other welding outfit	1 No
7	Moulding table, Moulding equipment	2 Nos
8	Sheet metal forming tools and equipment	2 Nos.



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Course code	21EE28P	Semester	II				
Category	ENGINEERING SCIENCE COURSE (ESC)			L	T	P	C
Course Title	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY Common for (AI&DS, MECH)			0	0	4	2

COURSE OBJECTIVES:

- Provide hands on experience with generators and motors.
- Understand the working of dc/ac motors and generators
- Learn the uses of transformer
- Understand the working of transducers and amplifiers

PREREQUISITES:

- Engineering Physics and Engineering Mathematics

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C208.1	<i>Perform</i> experiments to know the working of DC motors / Generators / Transformers.	K2
C208.2	<i>Illustrate</i> the load characteristics of DC motors / Generators / Transformers.	K3
C208.3	<i>Draw</i> the characteristics of diodes and transistors for different configuration.	K2
C208.4	<i>Design</i> bridge network circuit to measure the values of passive component.	K3
C208.5	<i>Illustrate</i> the characteristics of amplifier and ADC converters.	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
C208.1	2	1	-	-	-	-	-	-	2	-	-	-
C208.2	2	1	-	-	-	-	-	-	2	-	-	-
C208.3	2	1	-	-	-	-	-	-	2	-	-	-
C208.4	2	1	-	-	-	-	-	-	2	-	-	-
C208.5	2	1	-	-	-	-	-	-	2	-	-	-
C208	2	1	-	-	-	-	-	-	2	-	-	-

Note: 1: Slight, 2: Moderate, 3: Substantial

LIST OF EXPERIMENT

1. Open circuit and load test on shunt generators
2. Load test on DC Shunt & DC Series motor
3. Speed control of DC shunt motor (Armature, Field control)
4. Load test on single phase transformer
5. Load test on single phase Induction Motor
6. Load test on three phase squirrel cage Induction motor
7. Study of DC & AC motor starters
8. VI Characteristics of Semiconductor diode and Zener diode.
9. Characteristics of a NPN Bipolar Junction Transistor under common emitter, common collector and common base configurations.
10. Measurement of passive (R, L, C) elements using Bridge Networks
11. Design and plot the characteristics of instrumentation amplifier.
12. Design and test the analog to digital converter.

TOTAL: 60 PERIODS

LEARNING RESOURCES:**TEXT BOOKS:**

1. D P Kothari and IJ Nagarath, —Basic Electrical and Electronics Engineering, McGrawHill Education(India) Private Limited, Third Reprint ,2016
2. D.V.S. Moorthy, ‘Transducers and Instrumentation’, Prentice Hall of India Pvt Ltd, 2007.

REFERENCES:

1. N K De, Dipu Sarkar, “Basic Electrical Engineering”, Universities Press (India)PrivateLimited 2016
2. David A. Bell ,”Electronic devices and circuits”, Oxford University higher education,5thedition2008.
3. Allan S Moris, “Measurement and Instrumentation Principles”, Elseveir, First IndianEdition, 2006.

21EE28P Basic Electrical and Electronics Engineering Laboratory

Requirements for a batch of 30 students

Sl. No.	Description of Equipment	Quantity required
1.	Open circuit and load test on shunt generators 1. D.C motor – Shunt Generator set 2. Ammeter (0-30 A), (0-2A) 3. Voltmeter (0-30V) 4. Rheostat 175 Ω , 250 Ω 5. Tachometer 6. Connecting Wires	1 1 1 1 1 As required
2.	Load test on DC Shunt & DC Series motor 1. Ammeter MC (0-20A) 2. Voltmeter MC (0-300)V 3. Rheostat 7.5 Ω , 10 A 4. Tachometer 5. Field Rheostat 175 Ω , 1.5 A 6. Connecting wires	1 each 1 1 1 1 As required
3.	Speed control of DC shunt motor (Armature, Field control) 1. DC shunt motor 2. Ammeter MC (0-20A) 3. Voltmeter MC (0-300)V 4. Rheostat 7.5 Ω , 10 A 5. Tachometer 6. Field Rheostat 175 Ω , 1.5 A 7. Field Rheostat 100 Ω , 2A 8. Connecting wires	1 1 1 1 1 1 1 1 As required
4.	Load test on single phase transformer 1. 1KVA transformer 2. Ammeter MI (0-10A) 3. Ammeter MI (0- 5A) 4. Voltmeter MC (0-300)V 5. Voltmeter MC (0-150)V 6. Wattmeter (300V, 10A, UPF) 7. Connecting wires	1 1 1 1 1 2 As required
5.	Load test on single phase Induction Motor 1. Single phase Induction motor 2. Ammeter MI (0-20A) 3. Voltmeter MI (0-300)V 4. Wattmeter – 300V, 30 A 5. Tachometer – Digital 6. Connecting Wires	1 1 1 1 1 As required
6.	Load test on three phase squirrel cage Induction motor 1. Three phase Squirrel Cage Induction motor	1

	2. Ammeter MI (0-20A) 3. Voltmeter MI (0-300)V 4. Wattmeter – 300V, 30 A 5. Tachometer – Digital 6. Connecting Wires	1 1 1 1 As required
7.	Study of DC & AC motor starters 1. Two-point , three point and four-point DC starters 2. DOL starter, Autotransformer starter	2 each 2 each
8.	VI Characteristics of Semiconductor diode and Zener diode. 1. PN Diode (BY127, OA79), Zener diode (6.8V, 1A) 2. Resistor 1 K Ω , 100 Ω 3. Bread Board 4. DC Regulated Power supply (0 - 30 V variable) 5. Multimeter 6. Connecting wires	1 1 1 1 1 As required
9.	Characteristics of a NPN Bipolar Junction Transistor under common emitter, common collector and common base configurations. 1. Transistor (No-BC548) 2. Resistors- 1k Ω , 470K Ω , 1M Ω 3. Bread Board 4. DC Regulated Power supply (0 - 30 V variable) 5. Multimeter 6. Connecting wires	2 1 each 1 1 1 1 As required
10.	Measurement of passive (R, L, C) elements using Bridge Networks 1. Wheat stone Bridge kit 2. Maxwell's inductance Capacitance Bridge kit 3. Patch chords 4. Multimeter	1 1 1 1
11.	Design and plot the characteristics of instrumentation amplifier. 1. Instrumentation Amplifier Kit 2. Patch chords 3. Multimeter	1 1 1
12.	Design and test the analog to digital converter. 1. Analog – Digital and Digital – Analog Converters(ADC and DACs) 2. Patch chords 3. Multimeter	1 1 1

3rd SEMESTER CURRICULUM & SYLLABI

Applicable to the students admitted to

B.E-MECHANICAL ENGINEERING

R-2021: CBCS

Academic year 2021-2022

Onwards



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B.E. – MECHANICAL ENGINEERING

R-2021: CBCS CURRICULUM

SEMESTER III										
S. No.	Course Code	Course Title	Category	CIE Marks	SEE Marks	Total marks	Credits			
							L	T	P	C
THEORY										
1	21ME31T	Engineering Thermodynamics	PCC	40	60	100	3	1	0	4
2	21ME32T	Fluid Mechanics and Machinery	PCC	40	60	100	3	0	0	3
3	21ME33T	Production Technology-II	PCC	40	60	100	3	0	0	3
4	21MA34T	Series, Transforms and Partial Differential Equations	BSC	40	60	100	3	1	0	4
5	21HE35IT	Electrical Drives and Controls	ESC	40	60	100	2	0	4	4
6	21MC01T	Constitution of India	MC	40	60	100	2	0	0	0
PRACTICAL										
7	21ME37P	Production Technology-II Laboratory	PCC	40	60	100	0	0	4	2
8	21ME38P	Computer Aided Machine Drawing Laboratory	PCC	40	60	100	0	0	4	2
TOTAL										22

Dean Academics

Principal



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Course code	21ME31T	Semester	III				
Category	PROFESSIONAL CORE COURSE (PCC)			L	T	P	C
Course Title	ENGINEERING THERMODYNAMICS			3	1	0	4

COURSE OBJECTIVES:

- To familiarize the students to understand the fundamental laws of thermodynamics and thermodynamic properties
- To impart knowledge on pure substances, Gas behavior, thermodynamic relations and Psychrometry

PREREQUISITE:

- Mathematics, Physics, Chemistry

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C301.1	<i>Explain</i> the first law of thermodynamics for simple open and closed systems under steady and unsteady conditions.	K2
C301.2	<i>Solve</i> second law of thermodynamics to open and closed systems and calculate entropy and availability.	K3
C301.3	<i>Relate</i> Rankine cycle to steam power plant and compare few cycle improvement methods	K3
C301.4	<i>Apply</i> simple thermodynamic relations for ideal and real gases	K3
C301.5	<i>Calculate</i> the properties of gas mixtures and moist air and its use in psychometric processes	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
C301.1	3	2	-	-	-	-	-	-	-	-	-	-	-	1	-
C301.2	3	2	-	-	-	-	-	-	-	-	-	1	-	1	-
C301.3	3	2	1	-	-	1	-	-	-	-	-	1	2	1	-
C301.4	3	2	-	-	-	-	-	-	-	-	-	-	1	-	-
C301.5	3	2	2	-	-	1	-	-	-	-	-	1	2	1	-

Note: 1: Slight, 2: Moderate, 3: Substantial

UNIT I BASIC CONCEPTS AND FIRST LAW**9+3**

Basic concepts - concept of continuum, comparison of microscopic and macroscopic approach. Path and point functions. Intensive and extensive, total and specific quantities. System and their types. Thermodynamic Equilibrium State, path and process. Quasi-static, reversible and irreversible processes. Heat and work transfer, definition and comparison, sign convention. Displacement work and other modes of work .P-V diagram. Zeroth law of thermodynamics – concept of temperature and thermal equilibrium– relationship between temperature scales –new temperature scales. First law of thermodynamics –application to closed and open systems – steady and unsteady flow processes.

UNIT II SECOND LAW AND AVAILABILITY ANALYSIS**9+3**

Heat Reservoir, source and sink. Heat Engine, Refrigerator, and Heat pump. Statements of second law and its corollaries. Carnot cycle Reversed Carnot cycle, Performance. Clausius inequality. Concept of entropy, T-s diagram, Tds Equations, entropy change for - pure substance, ideal gases - different processes, principle of increase in entropy. Applications of II Law. High- and low-grade energy. Available and non-available energy of a source and finite body. Energy and irreversibility. Expressions for the energy of a closed system and open systems. Energy balance and entropy generation. Irreversibility. I and II law Efficiency. Negentropy

UNIT III PROPERTIES OF PURE SUBSTANCE AND STEAM POWER CYCLE**9+3**

Formation of steam and its thermodynamic properties, p-v, p-T, T-v, T-s, h-s diagrams. p-v-T surface. Use of Steam Table and Mollier Chart. Determination of dryness fraction. Application of I and II law for pure substances. Ideal and actual Rankine cycles, Cycle Improvement Methods - Reheat and Regenerative cycles, Economiser, preheater, Binary and Combined cycles.

UNIT IV IDEAL AND REAL GASES, THERMODYNAMIC RELATIONS**9+3**

Properties of Ideal gas- Ideal and real gas comparison- Equations of state for ideal and real gases- Reduced properties. Compressibility factor-.Principle of Corresponding states. -Generalised Compressibility Chart and its use-. Maxwell relations, Tds Equations, Difference and ratio of heat capacities, Energy equation, Joule-Thomson Coefficient, Clausius Clapeyron equation, Phase Change Processes, Phase change materials and its applications. Simple Calculations.

UNIT V GAS MIXTURES AND PSYCHROMETRY**9+3**

Mole and Mass fraction, Dalton's and Amagat's Law. Properties of gas mixture – Molar mass, gas constant, density, change in internal energy, enthalpy, entropy and Gibbs function. Psychrometric properties, Psychrometric charts. Property calculations of air vapour mixtures by using chart and expressions. Psychrometric process – adiabatic saturation, sensible heating and cooling, humidification, dehumidification, evaporative cooling and adiabatic mixing. Simple Applications

Total: 60 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. P.K. Nag, "Engineering Thermodynamics", 5th Edition, Tata McGraw-Hill, New Delhi, 2013.
2. R.K.Rajput, "A Text Book of Engineering Thermodynamics", Fifth Edition, 2017.

REFERENCES:

1. Arora C.P, "Thermodynamics", Tata McGraw-Hill, New Delhi, 2003.
2. Borgnakke & Sonntag, "Fundamental of Thermodynamics", 8th Edition, 2016.
3. Chattopadhyay, P, "Engineering Thermodynamics", Oxford University Press, 2016.
4. Michael J. Moran, Howard N. Shapiro, "Fundamentals of Engineering Thermodynamics", 8th Edition
5. Yunus a. Cengel & michael a. Boles, "Thermodynamics", 8th edition 2015.



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Course code	21ME32T	Semester	III			
Category	PROFESSIONAL CORE COURSE (PCC)		L	T	P	C
Course Title	FLUID MECHANICS AND MACHINERY		3	0	0	3

COURSE OBJECTIVES:

- To inculcate the knowledge of fluids flow phenomena in various hydraulic Machines.

PREREQUISITE:

- Concepts of Engineering mechanics, basic physics and Newton's Law

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C302. 1	<i>Understand</i> the mathematical knowledge to predict the properties and characteristics of a fluid.	K2
C302. 2	<i>Solve</i> problems of major and minor losses associated with pipe flow in piping networks.	K3
C302. 3	<i>Identify and</i> mathematically predict the nature of physical quantities	K3
C302. 4	<i>Examine</i> the performance of pumps	K3
C302. 5	<i>Calculate</i> the performance of turbines	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
C302. 1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	1
C302. 2	3	2	1	-	-	-	-	-	-	-	-	1	-	-	-
C302. 3	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-
C302. 4	3	2	1	-	-	-	-	-	-	-	-	1	1	-	1
C302. 5	3	2	1	-	-	-	-	-	-	-	-	1	1	-	1

Note: 1: Slight, 2: Moderate, 3: Substantial

SYLLABUS**No. of Credits: 3****UNIT I FLUID PROPERTIES AND FLOW CHARACTERISTICS****9**

Units and dimensions- Properties of fluids- mass density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapor pressure, surface tension and capillarity. Flow characteristics – concept of control volume - application of continuity equation, energy equation and momentum equation. Manometer, Archimedes principle, Meta centre, metacentric height.

UNIT II FLOW THROUGH CIRCULAR CONDUITS**9**

Hydraulic and energy gradient - Laminar flow through circular conduits and circular annuli- Boundary layer concepts – types of boundary layer thickness – Darcy Weisbach equation –friction factor- Moody diagram- commercial pipes- minor losses – Flow through pipes in series and parallel, D Alembert’s Paradox

UNIT III DIMENSIONAL ANALYSIS**9**

Need for dimensional analysis – methods of dimensional analysis – Similitude –types of similitude - Dimensionless parameters- application of dimensionless parameters – Model analysis.

UNIT IV PUMPS**9**

Impact of jets - Euler’s equation - Theory of roto-dynamic machines – various efficiencies– velocity components at entry and exit of the rotor- velocity triangles - Centrifugal pumps– working principle- work done by the impeller - performance curves - Reciprocating pump– working principle – Rotary pumps –classification

UNIT V TURBINES**9**

Classification of turbines – heads and efficiencies – velocity triangles. Axial, radial and mixed flow turbines. Pelton wheel, Francis turbine and Kaplan turbines- working principles - work done by water on the runner – draft tube. Specific speed - unit quantities – performance curves for turbines governing of turbines.

Total: 45 Periods**LEARNING RESOURCES:****TEXT BOOKS:**

1. Modi P.N. and Seth, S.M. "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi 2013.
2. R K Bansal, “A Textbook of Fluid Mechanics and Machinery”, New Delhi

REFERENCES:

1. Graebel. W.P, "Engineering Fluid Mechanics", Taylor & Francis, Indian Reprint, 2011
2. Kumar K. L., "Engineering Fluid Mechanics", Eurasia Publishing House(p) Ltd., New Delhi 2016
3. Robert W.Fox, Alan T. McDonald, Philip J.Pritchard, “Fluid Mechanics and Machinery”, 2011.
4. Fluid Mechanics: Fundamentals and Applications Book by John Cimbala and Yungus A. Cengel, 4th Edition 28 May 2019.

WEB REFERENCES:

1. [http:// nptel.ac.in/courses/112105171/7\1](http://nptel.ac.in/courses/112105171/7\1)
2. <http:// web.mit.edu/html/ncfmf.html>



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Course code	21ME33T	Semester		III			
Category	PROFESSIONAL CORE COURSE (PCC)			L	T	P	C
Course Title	PRODUCTION TECHNOLOGY-II			3	0	0	3

COURSE OBJECTIVES:

- This course aims at providing the concept and basic mechanics of metal cutting, working of standard machine tools such as lathe, shaping and allied machines, milling, drilling and allied machines, gear making methods, grinding and allied machines and broaching.
- The course is intended to introduce the students to basic concepts of Computer Numerical Control (CNC) of machine tools and CNC Programming.
- The course will impart the students to know the basic concept of non-traditional machining processes and additive manufacturing processes to solve Engineering problems in modern industries.

PREREQUISITE:

- Production Technology I Knowledge

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C303.1	<i>Explain</i> the mechanism of material removal processes.	K2
C303.2	<i>Outline</i> the constructional and operational features of centre lathe, semiautomatic lathe and automats.	K2
C303.3	<i>Discuss</i> the CNC machining centers with its part programming fundamentals and write a simple manual part program.	K2
C303.4	<i>Describe</i> the constructional and operational features of shaper, drilling, milling, and gear manufacturing processes.	K2
C303.5	<i>Explain</i> the types of grinding and other super finishing processes apart from broaching processes.	K2
C303.6	<i>Recognize</i> the knowledge of Non-Traditional Machining Process and Additive Manufacturing process	K2

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
C303.1	2	1	-	-	-	-	-	1	-	-	-	-	2	-	-
C303.2	2	1	-	-	1	-	-	1	-	-	-	1	2	1	1
C303.3	2	1	-	-	1	-	-	1	-	-	-	1	2	1	1
C303.4	2	1	-	-	1	-	-	1	-	-	-	1	2	1	1
C303.5	2	1	-	-	1	-	-	1	-	-	-	1	2	1	1
C303.6	2	1	-	-	1	-	-	1	-	-	1	1	2	1	1

Note: 1: Slight, 2: Moderate, 3: Substantial

SYLLABUS**No. of Credits: 3****UNIT I THEORY OF METAL CUTTING****9**

Mechanics of chip formation, Types of chip - Cutting tools-Nomenclature of single point cutting tool- Forces in machining -Orthogonal metal cutting-Cutting tool materials-Thermal aspects- Tool wear-Tool life- Surface finish- Cutting fluids and Machinability.

UNIT II TURNING MACHINES WITH CENTER**9**

Centre lathe-constructural features, specification, operations - Taper turning methods, thread cutting methods-Special attachments -Machining time and power estimation - Capstan and turret lathes-tool layout - Automats-single spindle- Swiss type-automatic screw type -multi spindle-CNC- Lathe center- CNC Lathe- part programming fundamentals -part programming.

UNIT III FUNCTIONS AND STORAGE CLASSES**9**

Reciprocating machine tool : Shaper-Hole machining : Drilling, Reaming, tapping and boring- Milling: types, cutting and operations- CNC- Milling center-CNC Lathe part programming fundamentals- Part programming- Gear cutting, forming, shaping- Hobbing and generation - Concept of jigs, fixtures and its applications.

UNIT IV ABRASIVE PROCESS, BROACHING AND SUPER FINISHING PROCESSES**9**

Abrasive processes: grinding wheel, specifications and selection-types of grinding process- Pedestal grinding-cylindrical grinding- surface grinding-centerless grinding and internal grinding- Typical applications -concepts of surface integrity- broaching machines: broach construction-push, pull, surface and continuous broaching machines- Abrasive finishing processes- honing, lapping and super finishing.

UNIT V MODERN MACHINING PROCESSES**9**

Non-Traditional machining: principle, need, futures and limitations-Types: mechanical, electrical, electro chemical and thermal energy-based processes- Equipment, Advantages, Applications and Limitations. Rapid Prototyping: Stereo-lithography - Fused Deposition modelling, Selective laser sintering - 3D Printing and Rapid Tooling Techniques-Equipment, futures and limitations.

Total: 45 Periods**LEARNING RESOURCES:****TEXT BOOKS:**

1. Hajra Choudhury, "Elements of Workshop Technology", Vol.II., Media Promoters 2014
2. Rao. P.N "Manufacturing Technology - Metal Cutting and Machine Tools", 3rd Edition, Tata McGraw-Hill, New Delhi, 2013.

REFERENCES:

1. Richerd R Kibbe, John E. Neely, Roland O. Merges and Warren J.White "Machine Tool Practices", Prentice Hall of India, 1998

2. Geoffrey Boothroyd, "Fundamentals of Metal Machining and Machine Tools", Mc Graw Hill, 1984
3. HMT, "Production Technology", Tata McGraw Hill, 1998.
4. Roy. A.Lindberg, "Process and Materials of Manufacture," Fourth Edition, PHI/Pearson Education 2006
5. James Brown, —Advanced Machining Technology Handbookl, McGraw Hill Book Company, New York, 1998.
6. Ian Gibson, David W.Rosen, Brent Stucker, Additive manufacturing technologies; rapid prototyping to direct digital manufacturing, Springer,2010



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Course code	21MA34T	Semester		III			
Category	BASIC SCIENCE COURSE(BSC)			L	T	P	C
CourseTitle	SERIES,TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS (Common to Mechanical, Civil, Chemical & Biotechnology)			3	1	0	4

COURSE OBJECTIVES:

- To introduce the basic concepts of PDE for solving standard partial differential equations.
- To acquaint the student with Fourier series techniques in solving heat flow problems used in various situations.
- To develop Z transform techniques for discrete time systems.

PREREQUISITE:

- Mathematics skills at Sem-II level

COURSE OUTCOMES:

CO. No	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C304.1	<i>Understand</i> how to solve the given standard partial differential equations.	K2
C304.2	<i>Solve</i> differential equations using Fourier series analysis which plays a vital role in engineering applications.	K3
C304.3	<i>Appreciate</i> the physical significance of Fourier series techniques in solving one- and two-dimensional heat flow problems and one-dimensional wave equations.	K2
C304.4	<i>Understand</i> the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering.	K2
C304.5	<i>Use</i> the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems.	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C304.1	3	3	-	-	-	-	-	-	-	-	-	-
C304.2	3	2	-	-	-	-	-	-	-	-	-	-
C304.3	3	2	-	-	-	-	-	-	-	-	-	-
C304.4	3	2	-	-	-	-	-	-	-	-	-	-
C304.5	3	3	-	-	-	-	-	-	-	-	-	-

Note: 1: Slight, 2: Moderate, 3: Substantial

SYLLABUS**No. of Credits: 4****UNIT I PARTIAL DIFFERENTIAL EQUATIONS 12**

Introduction-Formation of partial differential equations Solutions of a partial differential equation-Linear Equations of the first order- Nonlinear equations of the first order Charpit's method Linear partial Differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.

UNIT II FOURIER SERIES 12

Introduction - Euler's Formulae - Conditions for a Fourier Expansion-Functions having points of discontinuity-Change of interval - Odd and even functions-Half range sine series-Half range cosine series-Parseval's Formula-Complex form of Fourier series-Harmonic analysis.

UNIT III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 12

Introduction - Method of separation of variables-Vibrations of a stretched string-Wave equation [Fourier Series Method Only]- One dimensional equation of heat conduction-Steady state solution of two-dimensional equation of heat conduction - Laplace's equation in polar coordinates.

UNIT IV FOURIER TRANSFORMS 12

Introduction-Statement of Fourier integral theorem-Fourier transforms - Properties of Fourier transforms-Convolution theorem-Parseval's identity for Fourier transform-Relation between Fourier and Laplace transforms.

UNIT V TRANSFORMS AND DIFFERENCE EQUATIONS 12

Introduction - Definition of Z-transforms - Some standard Z-transforms-Damping rule-Some standard results-Shifting to the right and left - Multiplication by n-Initial and Final value theorem -Inverse Z-transform (using partial fraction and residues) - Convolution theorem-Convergence of Z-transforms-Evaluation of inverse Z-transforms [using partial and residue method only]- Application of difference equations.

Total:60 Periods**LEARNING RESOURCES:****TEXT BOOKS:**

1. B. S. Grewal, Higher Engineering Mathematics, 43rd Edition, Khanna Publishers, New Delhi, 2014.
2. Narayanan S., Manicavachagom Pillay.T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students", Vol. II & III, S.Viswanathan Publishers Pvt. Ltd, Chennai, 1998.

REFERENCES:

1. Erwin Kreyszig, "Advanced Engineering Mathematics ", 10th Edition, John Wiley, India, 2016.
2. B.V.Ramana, "Higher Engineering Mathematics", McGrawHill Education Pvt. Ltd, New Delhi, 2016.
3. Wylie, R.C.and Barrett,L.C., "Advanced Engineering Mathematics", Tata McGraw Hill Education Pvt. Ltd, 6th Edition, NewDelhi, 2012.



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Course code	21HE35IT	Semester		III			
Category	ENGINEERING SCIENCE COURSE(ESC)			L	T	P	C
Course Title	ELECTRICAL DRIVES AND CONTROLS			2	0	4	4

COURSE OBJECTIVES:

- This course aims at giving adequate exposure to students about the concept of DC, Synchronous motor and induction motor drive used in automation.
- The course will enable the students to understand the concept of how to control the various types of drives.

PREREQUISITE:

- Basic Electrical, Electronics and Instrumentation Engineering

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C305.1	<i>Classify</i> types of electric drives systems based on nature of loads, control objectives, performance and reliability. Combine concepts of DC machines Control and power electronics to cater to the need of automations in industries.	K2
C305.2	<i>Combine</i> concepts of AC machines Control and power electronics to cater to the need of automations in industries.	K2
C305.3	<i>Select</i> most suitable type and specification of motor drive combination for efficient conversion and control of electric power any applications.	K2
C305.4	<i>Analyze</i> the performance of DC drives	K3
C305.5	<i>Analyze</i> the performance of AC drives	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
C305.1	3	2	1	-	-	-	-	-	-	-	-	-	2	1	-
C305.2	3	2	1	-	-	-	-	-	-	-	-	-	2	1	-
C305.3	3	2	1	-	-	-	-	-	-	-	-	-	2	1	-
C305.4	3	2	1	-	-	2	-	-	2	1	1	2	2	1	-
C305.5	3	2	1	-	-	2	-	-	2	1	1	2	2	1	-

Note: 1: Slight, 2: Moderate, 3: Substantial

SYLLABUS**No. of Credits: 4****UNIT I INTRODUCTION TO ELECTRICAL DRIVES****6**

Basic Elements of Electric Drives - Classification- Factors affecting the choice of drive: Different classes of duty cycle of motors, Selection of power rating for drive motors with regard to thermal overloading and Load variation factors.

UNIT II DRIVE MOTORS CHARACTERISTICS**6**

Mechanical characteristics- Speed- Torque characteristics of various types of load and drive motors- Braking of electrical motors- DC motors and AC motors.

UNIT III D C DRIVES**6**

Speed control of DC series and shunt motors – Armature control and Field control-Ward Leonard drives–converter fed and chopper fed Drive– Four quadrant operation– Closed loop control.

UNIT IV AC DRIVES**6**

Induction motor fundamentals– voltage control and variable frequency control (AC chopper, Inverter fed induction motor drives)– Rotor resistance control– slip power recovery scheme- Synchronous motor fundamentals– Open loop, closed loop variable frequency control– Voltage and Current source fed synchronous motor.

UNIT V APPLICATIONS**6**

Digital technique in speed control– Advantages and limitations– Microprocessor based control of drives – Selection of Motor and Drive System for Industrial Applications: Cranes and Electric Traction, Air compressors, Paper and Pulp Industry, Textile Industry, Steel Industry.

Total: 30 Periods**LAB -LIST OF EXPERIMENTS:**

1. Study of VI characteristics of SCR and MOSFET
2. Step up and Step down MOSFET based Choppers.
3. Simulation of DC-DC converters.
4. Simulation of AC to DC fully controlled converter
5. Simulation of AC voltage controller.
6. Position control of DC Motor.
7. Speed control of BLDC motor.
8. Study of Speed control of single-phase induction motor using microcontroller.
9. Speed control of Inverter fed induction motor drives.
10. Speed control of Slip ring Induction motor using rotor resistance control.
11. No load and blocked rotor test on a 3- ϕ induction motor
12. V and inverted V curve of synchronous machines.

Total: 60 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. B.L Theraja and A.K Theraja, "A Text Book of Electrical Technology", Vol.2,
2. Vedham Subramanyam, "Electric Drives Concept and Applications", 2nd Edition, Tata McGraw-Hill Publishing Company

REFERENCES:

1. S.K. Pillai, "A First Course on Electrical Drives", 2nd Edition, New Age International Publishers, 2004.
2. I.J. Nagrath and D.P. Kothari, "Electrical Machines", 3rd Edition, Tata McGraw-Hill Publishing Company, 2010.
3. G.K. Dubey, "Fundamentals of Electrical Drives", Narosa Publishing House, New Delhi, 2007.

LIST OF EQUIPMENT REQUIRED

S.No.	Description of the equipment	Quantity
1.	Device characteristics(for SCR, MOSFET, kit with built in / discrete power supply and meters)	1 No
2.	MOSFET based step up and step-down choppers(Built in/ Discrete)	1 No
3.	Position Control Systems Kit (with manual)	1 No
4.	BLDC motor with loading arrangements	1 No
5.	IGBT based three phase PWM inverter module/Discrete Component with induction motor set-up	1 No
6.	Three Phase Slip ring Induction Motor with Loading Arrangement	1 No
7.	Three Phase Induction Motor with Loading Arrangement	1 No
8.	Synchronous motor 3HP	1 No
9.	DC and AC meters of required ranges	10 No
10.	Rheostats of various ranges	3 No
11.	Tachometer – Digital /Analog	4 No
12.	Personal computers with MATLAB simulation packages	10 No



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Course code	21MC01T	Semester	III				
Category	MANDATORY COURSE (MC)			L	T	P	C
Course Title	CONSTITUTION OF INDIA			2	0	0	0

COURSE OBJECTIVES:

- To understand the importance of constitution.
- To understand the autonomous nature of constitutional bodies like Supreme Court and high court, controller and auditor general of India and election commission of India.

PREREQUISITE:

- Civic Knowledge.

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C001.1	<i>Understand</i> historical background of the constitutional making and its importance for building a democratic India, the structure of Indian government, the structure of state government, the local Administration	K2
C001.2	<i>Understand</i> the directive principle of state policy, and strengthening of the constitutional institutions.	K2
C001.3	<i>Analyze</i> the role of Governor and Chief Minister, role of state election commission, the decentralization of powers.	K2
C001.4	<i>Understand</i> the Public Election Process.	K2
C001.5	<i>Know</i> the Special Provisions for Various category of People.	K2

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C001.1	-	-	-	-	-	3	-	2	-	-	-	1	-	-	-
C001.2	-	-	-	-	-	2	-	2	-	-	-	1	-	-	-
C001.3	-	-	-	-	-	2	-	2	-	-	-	1	-	-	-
C001.4	-	-	-	-	-	1	-	2	-	-	-	1	-	-	-
C001.5	-	-	-	-	-	1	-	2	-	-	-	1	-	-	-

Note: 1: Slight, 2: Moderate, 3: Substantial

SYLLABUS**No. of Credits: 0****UNIT I INTRODUCTION TO INDIAN CONSTITUTION 6**

The Necessity of the Constitution, The Societies before and after the Constitution adoption. **Introduction to the Indian constitution**, The Making of the Constitution, The Role of the Constituent Assembly - Preamble and Salient features of the Constitution of India.

UNIT II FUNDAMENTAL RIGHTS AND DIRECTIVE PRINCIPLES 6

Fundamental Rights and its Restriction and limitations in different Complex Situations. Directive Principles of State Policy (DPSP) and its present relevance in our society with examples. Fundamental Duties and its Scope and significance in Nation building. Directive Principles of State Policy (Art. 36-51).

UNIT III UNION EXECUTIVE AND STATE EXECUTIVE 6

Parliamentary System, Federal System, Centre-State Relations. Union Executive – President, Prime Minister, Union Cabinet, Parliament - LS and RS, Parliamentary Committees, Parliamentary Terminologies. Supreme Court of India, State Executives – Governor, Chief Minister, State Cabinet, State Legislature, High Court and Subordinate Courts.

UNIT IV ELECTIONS, AMENDMENTS AND EMERGENCY PROVISIONS 6

Elections, Electoral Process, and Election Commission of India, Election Laws. Amendments Important Constitutional Amendments. Emergency Provisions, types of Emergencies and its consequences.

UNIT V DIRECTIVE PRINCIPLES & FUNDAMENTAL DUTIES 6

Fundamental Duties (Art. 51A), Basic Features of Constitution & Constitutional **special provisions**: Special Provisions for SC and ST, OBC, Women, Children and Backward Classes.

Total: 30 Periods**LEARNING RESOURCES:****TEXT BOOKS:**

1. N. Shukla, Constitution of India, Eastern Book Agency, 2014.
2. P. Jain, Indian Constitutional Law, Lexis Nexis, 2013.
3. M. Seervai, Constitutional Law of India, Universal Law Publishing Co., Reprint 2013.

REFERENCES:

1. Glanville Austin, Indian Constitution – cornerstone of the Nations, Oxford University Press, 1999.
2. M. Bakshi, The Constitution of India, Universal Law Publishing Co., 2014.
3. D. Basu, Shorter Constitution of India (14th Ed. 2008, reprint 2010).



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Course code	21ME37P	Semester	III			
Category	PROFESSIONAL CORE COURSE (PCC)		L	T	P	C
Course Title	PRODUCTION TECHNOLOGY-II LABORATORY		0	0	4	2

COURSE OBJECTIVES:

- To Study and acquire knowledge on various basic machining operations in special purpose machines and its applications in real life manufacture of components in the industry
- The lab course will impart the students to know the basic concept of additive manufacturing processes to solve Engineering problems in modern industries.

PREREQUISITE:

- Theoretical Knowledge in Production Technology II

COURSE OUTCOMES

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C307.1	<i>Use</i> dynamometer to measure cutting forces.	K3
C307.2	<i>Apply</i> milling machine to perform contour milling	
C307.3	To <i>experiment</i> with different machine tools to manufacture gears	K3
C307.4	Ability to <i>use</i> different machine tools for finishing operations	K3
C307.5	To manufacture tools by <i>employ</i> tool & cutter grinder	K3
C307.6	<i>Illustrate</i> rapid machining processes	K2
C307.7	<i>Develop</i> CNC part programming	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
C307.1	3	2	1	-	1	-	-	1	1	-	-	1	-	1	1
C307.2	3	2	1	-	1	-	-	1	1	-	-	1	-	1	-
C307.3	3	2	1	-	1	-	-	1	1	-	-	1	-	1	-
C307.4	3	2	1	-	1	-	-	1	1	-	-	1	-	1	-
C307.5	3	2	1	-	1	-	-	1	1	-	-	1	-	1	-
C307.6	2	2	1	-	1	-	-	1	1	-	-	1	2	-	-
C307.7	3	2	1	-	1	-	-	1	1	-	-	1	3	2	2

Note: 1: Slight, 2: Moderate, 3: Substantial

LIST OF EXPERIMENTS

1. Measurement of cutting forces in Milling / Turning Process
2. Contour milling using vertical milling machine
3. Spur gear cutting in milling machine
4. Helical Gear Cutting in milling machine
5. Gear generation in hobbing machine
6. Gear generation in gear shaping machine
7. Plain Surface grinding
8. Cylindrical grinding
9. Centreless Grinding
10. Tool angle grinding with tool and Cutter Grinder
11. Study of Rapid prototyping
12. CNC Part Programming

Total: 60 Periods**LEARNING RESOURCES:****TEXT BOOKS:**

1. Laboratory Manual prepared by Department of Mechanical Engineering, VTHT, Chennai.

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS

S.No.	Description of the equipment	Quantity
1.	Turret and Capstan Lathes	1 No each
2.	Horizontal Milling Machine	2 No
3.	Vertical Milling Machine	1 No
4.	Surface Grinding Machine	1 No
5.	Cylindrical Grinding Machine	1 No
6.	Radial Drilling Machine	1 No
7.	lathe Tool Dynamometer	1 No
8.	Milling Tool Dynamometer	1 No
9.	Gear Hobbing Machine	1 No
10.	Tool Makers Microscope	1 No
11.	CNC Lathe	1 No
12.	CNC Milling machine	1 No
13.	Gear Shaping machine	1 No
14.	Centreless Grinding Machine	1 No
15.	Tool and Cutter Grinder	1 No



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Course code	21ME38P	Semester	III			
Category	PROFESSIONAL CORE COURSE (PCC)		L	T	P	C
Course Title	COMPUTER AIDED MACHINE DRAWING LABORATORY		0	0	4	2

COURSE OBJECTIVES:

- To acquire the knowledge of drafting software.
- To understand Parametric Modelling Fundamentals, Procedure, and "Shape before Size" Approach
- To understanding of orthographic projections of machine parts with and without sectioning (3-D to 2-D conversion)
- To develop an ability to create 3D Modelling of machine components.

PREREQUISITE:

- Drafting and Machine Drawing skills.

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C308.1	Understand engineering drawings for the machine components as per Indian Standard Code of practice using a drafting software	K2
C308.2	Draw split muff, protected type flanged, pin type flexible, and universal couplings in 2D.	K3
C308.3	Understand the concept involved in 3D machine component drawing, assembly conditions	K3
C308.4	Ability to ensure manufacturability and proper assembly of components and assemblies.	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
C308.1	3	2	-	-	-	-	-	-	-	-	-	1	3	2	-
C308.2	3	2	-	-	-	-	-	-	-	-	-	-	2	1-	-
C308.3	2	2	2	2	2	-	-	-	1	2	2	-	3	2	-
C308.4	2	2	3	1	1	-	-	-	2	2	-	2	2	1	-

Note: 1: Slight, 2: Moderate, 3: Substantial

CYCLE I DRAWING STANDARDS & FITS AND TOLERANCES**12**

1. Code of practice for Engineering Drawing, BIS specifications –
2. Welding symbols, riveted joints, keys, fasteners –
3. Reference to hand book for the selection of standard components like bolts, nuts, screws, keys etc. –
4. Limits, Fits – Tolerance of individual dimensions – Specification of Fits –
5. Preparation of production drawings and reading of part and assembly drawings,
6. basic principles of Geometric Dimensioning & Tolerancing (GD&T)

CYCLE II INTRODUCTION TO 2D DRAFTING**16**

1. Drawing, Editing, Dimensioning, Layering, Hatching, Block, Array, Detailing, Detailed drawing.
2. Bearings - Bush bearing, Plummer block
3. Valves – Safety and non-return valves.

CYCLE III 3D GEOMETRIC MODELING AND ASSEMBLY**32**

Sketcher - Datum planes – Protrusion – Holes - Part modeling – Extrusion – Revolve – Sweep – Loft – Blend – Fillet - Pattern – Chamfer - Round - Mirror – Section - Assembly

1. Couplings – Flange, Universal, Gear couplings
2. Joints – Knuckle, Gib & cotter, sleeve & cotter joints
3. Engine parts – Piston, connecting rod, Disk Brake, stuffing box
4. valve - ball valve & butterfly valve, single-plate clutch
5. Mechanical Tools - Stillson Wrench
6. Miscellaneous machine components – Screw jack, machine vice, tail stock

Total: 60 Periods**LEARNING RESOURCES:****TEXT BOOKS:**

1. Machine Drawing by K.L.Narayan, P.Kannaiah and K.Venkata Reddy, 3rd edition, New Age publications 2006.
2. Machine Drawing with Auto CAD, (1st edition) by GowthamPohit and Goutam Ghosh, Pearson Education, Delhi, 2004.

REFERENCES:

1. Machine Drawing, by R.K.Dhawan, S.Chand Publications, New Delhi, 1996.
2. Machine Drawing by K.C.John, PHI Learning Pvt.Ltd.,New Delhi, 2009.

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS

S. No	Description of Equipment	Quantity required(R)
Hardware		
1.	Computer Server	1 No
2.	Computer nodes or systems (High end CPU with at least 1 GB main memory)	30 Nos
3.	Laser Printer	1 No
Software		
1.	Any High-end integrated CAD software (AutoCAD or SOLIDWORKS)	15 licenses
2.	Licensed operating system	Adequate

IV & V SEMESTER CURRICULUM AND SYLLABI

Applicable to the students admitted to

B.E-MECHANICAL ENGINEERING

R-2021: CBCS

Academic year 2021-2022 onwards



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B.E - Mechanical Engineering (R2021)

SEMESTER – IV										
S. No	Course code	Course Title	Category	CIE Marks	SEE Marks	Total Marks	Credits			
							L	T	P	C
THEORY										
1	21ME41T	Computer Aided Design	PCC	40	60	100	3	0	0	3
2	21ME42T	Strength of Materials	PCC	40	60	100	3	0	0	3
3	21ME43T	Kinematics of Machinery	PCC	40	60	100	3	1	0	4
4	21ME44T	Thermal Engineering	PCC	40	60	100	3	0	0	3
5	21MA45T	Statistics and Numerical Methods	BSC	40	60	100	3	0	0	3
6	21MC02T	Environmental Sciences	MC	40	60	100	2	0	0	0
PRACTICAL										
7	21ME47P	Fluid Mechanics and Machinery & Strength of Materials Laboratory	PCC	40	60	100	0	0	4	2
8	21ME48P	Thermal Engineering Laboratory	PCC	40	60	100	0	0	4	2
9	21EE01P	Mini Project – I	EEC	40	60	100	0	0	2	1
TOTAL										21



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Course code	21ME41T	Semester	IV				
Category	PROFESSIONAL CORE COURSE (PCC)			L	T	P	C
Course Title	COMPUTER AIDED DESIGN			3	0	0	3

COURSE OBJECTIVES:

- To provide an overview of how computers are being used in mechanical component design.
- To understand the application of computers in various aspects of Manufacturing viz., Design, Proper planning, Manufacturing cost, Layout & Material Handling system.

PREREQUISITE:

- Engineering Graphics

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C401.1	<i>Apply</i> the fundamental concepts of computer graphics and its tools in a generic framework.	K2
C401.2	<i>Create</i> and manipulating geometric models using curves, surfaces and solids.	K2
C401.3	<i>Apply</i> concept of CAD systems for 3D modelling and visual realism.	K2
C401.4	<i>Create</i> and add geometric tolerances in assembly modelling.	K2
C401.5	<i>Apply</i> standard CAD practices in engineering design.	K2

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
C401.1	2	1	-	-	-	-	-	-	-	-	-	1	2	1	1
C401.2	2	1	-	-	-	-	-	-	-	-	-	1	2	1	1
C401.3	2	1	-	-	-	-	-	-	-	-	-	1	2	1	1
C401.4	2	1	-	-	-	-	-	-	-	-	-	1	2	1	1
C401.5	2	1	-	-	-	-	-	-	-	-	-	1	2	1	1

Note: 1: Slight, 2: Moderate, 3: Substantial

LEARNING RESOURCES:

TEXT BOOKS:

1. Ibrahim Zeid “Mastering CAD CAM” Tata McGraw-Hill Publishing Co.2007.
2. P. N. Rao, CAD/CAM: Principles and Applications, Tata McGraw Hill, 2010.

REFERENCES:

1. Computer Aided Design and Manufacturing, NPTEL Course Contents & Videos, MHRD.
2. Groover, M. P., CAD/CAM: Computer-Aided Design and Manufacturing, Pearson Education, 2008.
3. Chris McMahan and Jimmie Browne “CAD/CAM Principles, practice and manufacturing Management “Pearson education Asia, 2001.
4. Donald Hearn and M. Pauline Baker “Computer Graphics”. Prentice Hall, Inc, 1994.
5. Foley, Wan Dam, Feiner and Hughes – “Computer graphics principles & practice”, Pearson Education - 2003.
6. William M Neumann and Robert F.Sproul “Principles of Computer Graphics”, McGraw Hill Book Co. Singapore, 1989.



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Course code	21ME42T	Semester	IV				
Category	PROFESSIONAL CORE COURSE (PCC)			L	T	P	C
Course Title	STRENGTH OF MATERIALS			3	0	0	3

COURSE OBJECTIVES:

- To understand and familiarize the mechanical behaviour of materials about the stress, Strain, shear force, bending moment, deflection and slopes in various types of beams for different loading Conditions.

PREREQUISITE:

- Engineering Mechanics

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C402.1	<i>Understand</i> the concepts of stress and strain in simple and compound bars, the importance of principal stresses and principal planes.	K2
C402.2	<i>Draw</i> the shear force & bending moment diagrams for various beams, compute bending stress, and shear stress at various points in beams.	K3
C402.3	<i>Calculate</i> the slope and deflection in beams using different methods.	K3
C402.4	<i>Apply</i> basic equation of simple torsion in designing of shafts and helical spring.	K3
C402.5	<i>Calculate</i> the stresses and strain associated with thin wall spherical & cylindrical pressure vessels.	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
C402.1	3	2	-	-	-	1	-	-	-	-	-	1	2	1	-
C402.2	3	2	-	-	-	1	-	-	-	-	-	1	2	1	-
C402.3	3	2	-	-	-	1	-	-	-	-	-	1	2	1	-
C402.4	3	2	-	-	-	1	-	-	-	-	-	1	2	1	-
C402.5	3	2	-	-	-	1	-	-	-	-	-	1	2	1	-

Note: 1: Slight, 2: Moderate, 3: Substantial

UNIT I STRESS, STRAIN AND DEFORMATION OF SOLIDS 9

Rigid bodies and deformable solids – Tension, Compression and Shear Stresses – Deformation of simple and compound bars – Elastic constants – Volumetric strains – principal stresses and principal planes – Mohr's circle of stress.

UNIT II TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAM 9

Beams – types transverse loading on beams – Shear force and bending moment in beams Cantilevers – Simply supported beams and over – hanging beams. Theory of simple bending– bending stress distribution – Load carrying capacity – Flitched beams.

UNIT III DEFLECTION OF BEAMS AND COLUMNS 10

Double Integration method – Macaulay's method – Area moment method for computation of slopes and deflections in beams - Conjugate beam and strain energy.

Columns – Theory of Columns – long column and short column – Euler's formula – Rankine's formula – Secant formula – beam column.

UNIT IV TORSION AND SPRINGS 8

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

UNIT V THIN CYLINDERS AND SPHERES 9

Stresses in thin cylindrical shell due to internal pressure circumferential and longitudinal stresses and deformation in thin cylinders – spherical shells subjected to internal pressure – Deformation in spherical shells – Lamé's theorem.

Total: 45 Periods**LEARNING RESOURCES:****TEXT BOOKS:**

1. Beer. F.P. & Johnston. E.R. "Mechanics of Materials", Tata McGraw Hill, 8th Edition, New Delhi, 2019.
2. Rajput R.K. "Strength of Materials (Mechanics of Solids)", S.Chand & company Ltd., New Delhi, 7th Edition, 2018.
3. Rattan S.S., "Strength of Materials", Tata McGraw Hill Education Pvt Ltd., New Delhi, 2017.
4. Bansal, R.K., "Strength of Materials", Laxmi Publications (P) Ltd., 2016.
5. Jindal U.C., "Strength of Materials", Asian Books Pvt. Ltd., New Delhi, 2009.

REFERENCES:

1. Strength of Materials, NPTEL Course Contents & Videos, MHRD.
2. Singh. D.K., “Strength of Materials”, Ane Books Pvt Ltd., New Delhi, 2021.
3. Egor. P.Popov “Engineering Mechanics of Solids” Prentice Hall of India, New Delhi,2015.
4. Ferdinand P. Beer, Russell Johnson, J.r. and John J. Dewole "Mechanics of Materials", Tata McGraw Hill Publishing co. Ltd., New Delhi, 2005.
5. Hibbeler, R.C., "Mechanics of Materials", Pearson Education, Low Price Edition, 2013.
6. Subramanian R., "Strength of Materials", Oxford University Press, Oxford Higher Education Series, 2010.



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Course code	21ME43T	Semester	IV			
Category	PROFESSIONAL CORE COURSE (PCC)		L	T	P	C
Course Title	KINEMATICS OF MACHINERY		3	1	0	4

COURSE OBJECTIVES:

- To understand the basic components and layout of linkages in the assembly of a system machine.
- To understand the motion resulting from a specified set of linkages, design few linkage mechanisms and cam mechanisms for specified output motions.
- To understand the basic concepts of toothed gearing, kinematics of gear trains and the effects of friction in motion transmission & in machine components.

PREREQUISITE:

- Basic Engineering knowledge and Engineering Mechanics

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C403.1	<i>Explain</i> the basics of mechanism.	K2
C403.2	<i>Understand</i> friction, belt drives in machine elements.	K2
C403.3	<i>Solve</i> velocity and acceleration in simple mechanisms.	K3
C403.4	<i>Develop</i> CAM profiles.	K3
C403.5	<i>Solve</i> problems on gears and gear train components.	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
C403.1	2	1	-	-	-	-	-	-	-	1	-	1	-	1	-
C403.2	2	1	-	-	-	-	-	-	-	1	-	1	-	1	-
C403.3	3	3	2	-	-	-	-	-	-	1	-	1	-	1	-
C403.4	3	3	2	-	-	-	-	-	-	1	-	1	-	1	-
C403.5	3	3	2	-	-	-	-	-	-	1	-	1	-	1	-

Note: 1: Slight, 2: Moderate, 3: Substantial

SYLLABUS**No. of Credits: 4****UNIT I BASICS OF MECHANISMS 9+3**

Classification of mechanisms – Basic kinematic concepts and definitions – Degree of freedom, Mobility – Kutzbach criterion, Gruebler's criterion – Grashof's Law – Kinematic inversions of four-bar chain and slider crank chains – Limit positions – Mechanical advantages – Transmission Angle – Description of some common mechanisms – Quick return mechanisms, Universal Joint–rocker mechanisms.

UNIT II KINEMATICS OF LINKAGE MECHANISMS 9+3

Displacement, velocity and acceleration analysis of simple mechanisms – Graphical method– Velocity and acceleration polygons – Velocity analysis using instantaneous centres – kinematic analysis of simple mechanisms – Coincident points – Coriolis component of Acceleration – Introduction to linkage synthesis problem.

UNIT III KINEMATICS OF CAM MECHANISMS 9+3

Classification of cams and followers – Terminology and definitions – Displacement diagrams – Uniform velocity, parabolic, simple harmonic and cycloidal motions – Derivatives of follower motions – Layout of plate cam profiles – Specified contour cams – Circular arc and tangent cams – Pressure angle and undercutting – sizing of cams.

UNIT IV GEARS AND GEAR TRAINS 9+3

Law of toothed gearing – Involute and cycloidal tooth profiles – Spur Gear terminology and definitions – Gear tooth action – contact ratio – Interference and under cutting. Helical, Bevel, Worm, Rack and Pinion gears [Basics only]. Gear trains – Speed ratio, train value – Parallel axis gear trains – Epicyclic Gear Trains.

UNIT V FRICTION IN MACHINE ELEMENTS 9+3

Surface contacts – Sliding and Rolling friction – Friction drives – Friction in screw threads – Bearings and lubrication – Friction clutches – Belt and rope drives – Friction in brakes – Band and Block brakes.

TOTAL: 60 Periods**LEARNING RESOURCES:****TEXT BOOKS:**

1. Ghosh. A and Mallick, A.K., "Theory of Mechanisms and Machines", 3rd Edition Affiliated East-West Pvt.Ltd., New Delhi, 2006.
2. Rattan, S.S, "Theory of Machines", 5th Edition, Tata McGraw-Hill, 2019.
3. Uicker J J, Pennock G.R and Shigley, J.E., "Theory of Machines and Mechanisms", Edition, Oxford university Press, 2017.
4. F.B.Sayyad, "Kinematics of Machinery", MacMillan Publishers Pvt Ltd., Tech-max Educational resources, 2011.

REFERENCES:

1. Kinematics of Machines, NPTEL Course Contents & Videos, MHRD.
2. Cleghorn.W.L, “Mechanisms of Machines”, Oxford University Press, 2014.
3. Robert L. Norton, “Kinematics and Dynamics of Machinery”, Tata McGraw-Hill, 2013.
4. Wilson and Sadler, “Kinematics and Dynamics of Machinery”, Pearson, 2008.
5. Thomas Bevan, "Theory of Machines", 3rd Edition, CBS Publishers and Distributors, 2005.
6. John Hannah and Stephens R.C., "Mechanics of Machines", Viva Low-Prices Student Edition, 1999.
7. Allen S.Hall Jr., “Kinematics and Linkage Design”, Prentice Hall,1961.



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Course code	21ME44T	Semester	IV				
Category	PROFESSIONAL CORE COURSE (PCC)			L	T	P	C
Course Title	THERMAL ENGINEERING			3	0	0	3

COURSE OBJECTIVES:

- To integrate the concepts, laws and methodologies from the first course in thermodynamics into analysis of cyclic processes.
- To apply the thermodynamic concepts into various thermal application like IC engines, Steam Turbines, Compressors and Refrigeration & Air conditioning systems.

(Use of standard refrigerant property data book, Steam Tables, Mollier diagram and Psychrometric chart permitted).

PREREQUISITE:

- Basic Engineering Skills and Engineering Thermodynamics.

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C404.1	<i>Solve</i> problems in single stage and multistage air compressors.	K3
C404.2	<i>Apply</i> thermodynamic concepts to different air standard cycles and solve problems.	K3
C404.3	<i>Identify</i> the functioning and features of IC engines, components, auxiliaries and performance calculations.	K3
C404.4	<i>Solve</i> problems in boilers, steam nozzle and steam turbines, Velocity diagram for steam turbines.	K3
C404.5	<i>Solve</i> problems using refrigerant table/ charts and psychrometric charts.	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
C404.1	3	2	1	-	-	-	-	-	-	-	-	1	-	1	-
C404.2	3	2	1	-	-	-	-	-	-	-	-	1	-	1	-
C404.3	3	2	1	-	-	-	-	-	-	-	-	1	-	1	-
C404.4	3	2	1	-	-	-	-	-	-	-	-	1	-	1	-
C404.5	3	2	1	-	-	-	-	-	-	-	-	1	-	1	-

Note: 1: Slight, 2: Moderate, 3: Substantial

SYLLABUS**No. of Credits: 3****UNIT I AIR COMPRESSOR****8**

Classification and working principle of various types of compressors, work of compression with and without clearance, Volumetric efficiency, Isothermal efficiency and Isentropic efficiency of reciprocating compressors, Multistage air compressor and inter cooling –work of multistage air compressor.

UNIT II GAS POWER CYCLES**8**

Otto, Diesel, Dual, Brayton cycles, Calculation of mean effective pressure and air standard efficiency - Comparison of cycles.

UNIT III INTERNAL COMBUSTION ENGINES**9**

Classification - components and their function. Valve timing diagram and port timing diagram - actual and theoretical p-V diagram of four stroke and two stroke engines. Simple and complete carburettor. MPFI, Diesel pump and injector system. Battery and Magneto ignition system - principles of combustion and knocking in SI and CI Engines. Lubrication and Cooling systems. Performance calculation, Sterling Engine (Description only).

UNIT IV BOILERS, STEAM NOZZLES AND TURBINES**9**

Classification and working principle of boilers – performance. Flow of steam through nozzles, shapes of nozzles, effect of friction, critical pressure ratio, super saturated flow. Impulse and Reaction principles, compounding, velocity diagram for simple and multi-stage turbines, speed regulations – Governors.

UNIT V REFRIGERATION AND AIR CONDITIONING**11**

Refrigerants - vapour compression refrigeration cycle- super heat, sub cooling – performance calculations - working principle of vapour absorption system, Ammonia –Water, Lithium bromide – water systems (Description only). Air conditioning system - processes, types and working principles. Concept of RSHF, GSHF, ESHF- cooling load calculations. Air conditioning equipment's – air cleaning and air filters – humidifiers and dehumidifiers – air washers

Total: 45 Periods**LEARNING RESOURCES:****TEXT BOOKS:**

1. Rajput. R. K., “Thermal Engineering” S.Chand Publishers, 2017.
2. Kothandaraman.C.P., Domkundwar.S, Domkundwar.A.V., “A course in thermal Engineering”, Fifth Edition, Dhanpat Rai & sons, 2016.

3. Cengel, Y and M. Boles, Thermodynamics - An Engineering Approach, Tata McGraw Hill, 8th Edition, 2015.

REFERENCES:

1. Applied Thermodynamics, Refrigeration & Air Conditioning, NPTEL Course Contents & Videos, MHRD.
2. Sarkar, B.K, "Thermal Engineering" Tata McGraw-Hill Publishers, 2007.
3. Arora.C.P, "Refrigeration and Air Conditioning", Tata McGraw-Hill Publishers, 2008.
4. Ganesan V "Internal Combustion Engines", Third Edition, Tata Mc Graw-Hill, 2012.
5. Rudra Moorthy R, "Thermal Engineering", Tata McGraw-Hill, New Delhi, 2003.
6. Ramalingam. K.K., "Thermal Engineering", SCITECH Publications (India) Pvt. Ltd., 2009.



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Course code	21MA45T	Semester	IV				
Category	BASIC SCIENCE COURSE (BSC)			L	T	P	C
Course Title	STATISTICS AND NUMERICAL METHODS			3	1	0	4

COURSE OBJECTIVES:

- To provide the necessary basic concepts of a few statistical methods.
- To understand and implement various concepts of numerical analysis.
- To identify the areas applied in numerical interpolation, differential equations and method of finding solutions.

PREREQUISITE:

- Ordinary differential equations
- Multivariable calculus

COURSE OUTCOME:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C405.1	<i>Analyze</i> the different samples of data at different level of significance using various hypothesis testing.	K2
C405.2	<i>Design</i> experiments using suitable ANOVA techniques and draw conclusions.	K2
C405.3	<i>Learn</i> how to obtain numerical solution of nonlinear equations using bisection, Newton – Raphson and fixed-point iteration methods.	K3
C405.4	<i>Use</i> interpolation methods to solve problems.	K3
C405.5	<i>Apply</i> the numerical techniques for solutions of ordinary differential equations	K4

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
C405.1	2	1	1	1	-	-	-	-	-	-	-	-	-	-
C405.2	2	1	-	1	-	-	-	-	-	-	-	-	-	-
C405.3	2	1	-	-	-	-	-	-	-	-	-	-	-	-
C405.4	2	1	-	-	-	-	-	-	-	-	-	-	-	-
C405.5	2	1	-	-	-	-	-	-	-	-	-	-	-	-

Note: - 1: Slight 2: Moderate 3: Substantial

SYLLABUS**No. of Credits: 4****UNIT I TESTING OF HYPOTHESIS****9+3**

Large sample test based on Normal distribution for single mean and difference of means – Tests based t, Chi-square and F distributions for testing means and variances – Contingency table (Test for Independency) – Goodness of fit.

UNIT II DESIGN OF EXPERIMENTS**9+3**

One way and Two way classifications - Completely randomized design – Randomized block design – Latin square design – 2^2 factorial design.

UNIT III SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS**9+3**

Newton Raphson method – Gauss elimination method – pivoting – Gauss Jordan methods – Crout's method – Iterative methods of Gauss Jacobi and Gauss Seidel – Matrix inversion by Gauss Jordan method – Eigen values of a matrix by power method, Jacobi method.

**UNIT IV INTERPOLATION, NUMERICAL DIFFERENTIATION AND
NUMERICAL INTEGRATION****9+3**

Lagrange's and Newton's divided difference interpolations – Newton's forward and backward difference interpolation – numerical integration, Newton-Cotes formulae- Numerical single and double integrations using Trapezoidal and Simpson's 1/3 rules.

UNIT V NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATION**9+3**

Taylor's series method – Euler's method – Modified Euler's method – Heun's method - Fourth order Runge-Kutta method for solving first order equations – Milne's predictor corrector methods for solving first order equations.

Total: 60 Periods**LEARNING RESOURCES:****TEXT BOOKS:**

1. Steven C Chapra and Raymond P Canale, Numerical Methods for Engineers, McGraw Hill Education, New Delhi, 2012.
2. Manish Goyal, "Statistics and Numerical methods", Lakshmi Publications, 2016.

REFERENCES:

1. Johnson R.A., and Gupta. C.B., "Miller and Freund's Probability and Statistics for Engineers", 11th Edition, Pearson Education, , Asia, 2011.
2. Walpole R.E., Myers. R.H., Myers. S.L., and Ye. K., "Probability and Statistics for Engineers and Scientists", 9th Edition, Pearson Education, Asia, 2011.
3. Jain, M. K., Iyengar, S. R. K. and Jain, R. K., Numerical Methods for Scientific and Engineering Computation, New Age International Publishers (2008).
4. Grewal. B. S., "Numerical Methods in Science and Engineering", 40th Edition, Khanna Publishers, 2007.



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Course code	21MC02T	Semester	IV				
Category	MANDATORY COURSE (MC)			L	T	P	C
Course Title	ENVIRONMENTAL SCIENCES (Common for All Branches except Chemical)			2	0	0	0

COURSE OBJECTIVES:

- To study the nature, interrelationship between living organism and environment, biodiversity, natural resources, pollution control and waste management.
- To find and implement scientific, technological, economic and political solutions to environmental problems.
- To appreciate the importance of environment by assessing its impact on the human world.

PREREQUISITE:

- Basic awareness on environment.

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C002.1	<i>Illustrate</i> the interrelationship between living organism and environment.	K2
C002.2	<i>Relate</i> Public awareness, environmental pollution and its problem.	K2
C002.3	<i>Classify</i> the dynamic processes and the features of natural resources.	K2
C002.4	<i>Measure</i> the development and improvement in standard of living.	K2
C002.5	<i>Summarize</i> the knowledge about human health and welfare.	K2

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C002.1	1	-	-	-	-	-	1	-	-	-	-	-
C002.2	2	-	-	-	-	-	1	-	-	-	-	-
C002.3	1	-	-	-	-	-	1	-	-	-	-	-
C002.4	1	-	-	-	-	-	2	1	-	-	-	1
C002.5	1	-	-	-	-	-	1	1	-	-	-	1

Note: 1: Slight, 2: Moderate, 3: Substantial

SYLLABUS**No. of Credits: 0****UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 12**

Definition, scope and importance of environment – need for public awareness – concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) –Introduction to biodiversity definition: genetic, species and ecosystem diversity –biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity –threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts –endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Field study of common plants, insects, birds, etc., Field study of simple ecosystems – pond, river, hill slopes, etc.

UNIT II NATURAL RESOURCES 10

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources. Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT III ENVIRONMENTAL POLLUTION AND DISASTER MANAGEMENT 8

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution(c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards, accidents and holocaust – solid waste management: causes, effects and control measures of municipal solid wastes- E waste and Scrap tyres – Recycling of Plastic, Glass and Paper wastes- role of an individual in prevention of pollution – pollution case studies –disaster management: floods, earthquake, cyclone and landslides- case studies. Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 8

From unsustainable to sustainable development- Equitable use of resources for sustainable lifestyles – urban problems related to energy –water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies –

role of nongovernmental organization- environmental ethics: Issues and possible solutions – principles of green chemistry–climate change, global warming, acid rain, ozone layer depletion, case studies. – wasteland reclamation – consumerism and waste products –environment protection act – Air (Prevention and Control of Pollution) act – Water(Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act – environmental impact assessment- enforcement machinery involved in environmental legislation- central and state pollution control boards- Public awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 7

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – women and child welfare – HIV/AIDS –SARS- Covid-19- role of information technology in environment and human health – Case studies.

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Benny Joseph, Environmental Science and Engineering, Tata McGraw-Hill, New Delhi, 2014.
2. Anubha Kaushik, and Kaushik, C. P., Environmental Science and Engineering, New Age International Publishers, 6thEdition, 2019.

REFERENCES:

1. Erach Bharucha, Textbook of Environmental Studies for Undergraduate Courses, 2nd Edition, University Grants Commission, Universities Press, 2013.
2. Gilbert M. Masters, Introduction to Environmental Engineering and Science, 2nd Edition, Pearson Education, 2004.
3. Tyler Miller, G., and Scott E. Spoolman, Environmental Science, Cengage Learning India Pvt, Ltd, Delhi, 2014.



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Course code	21ME47P	Semester	IV			
Category	PROFESSIONAL CORE COURSE (PCC)		L	T	P	C
Course Title	FLUID MECHANICS & MACHINERY AND STRENGTH OF MATERIALS LABORATORY		0	0	4	2

COURSE OBJECTIVES:

- To study the mechanical properties of materials when subjected to different types of loading.
- To verify the principles studied in Fluid Mechanics theory by performing experiments in lab.

PREREQUISITE:

- Fluid Mechanics and Machinery.
- Engineering Materials and Metallurgy.

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C407.1	<i>Perform</i> Tension, Torsion, Hardness, Compression, and Deformation test on Solid materials.	K3
C407.2	<i>Use</i> the measurement equipment's for flow measurement.	K3
C407.3	<i>Perform</i> test on different fluid machinery.	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
C407.1	3	2	1	-	1	-	-	1	1	1	-	1	-	2	-
C407.2	3	2	1	-	1	-	-	1	1	1	-	1	-	2	-
C407.3	3	2	1	-	1	-	-	1	1	1	-	1	-	2	-

Note: - 1: Slight, 2: Moderate, 3: Substantial.

STRENGTH OF MATERIALS LABORATORY**30 Hours****LIST OF EXPERIMENTS**

1. Tension test on a mild steel rod
2. Double shear test on Mild steel and Aluminium rods
3. Torsion test on mild steel rod
4. Impact test on metal specimen
5. Hardness test on metals - Brinnell and Rockwell Hardness Number
6. Deflection test on beams
7. Compression test on helical springs
8. Strain measurement using Rosette strain gauge
9. Effect of hardening- Improvement in hardness and impact resistance of steels.

FLUID MECHANICS & MACHINES LABORATORY**30 Hours****LIST OF EXPERIMENTS**

1. Determination of the Coefficient of discharge of given Orifice meter and Venturi meter
2. Calculation of the rate of flow using Rotameter.
3. Determination of friction factor for a given set of pipes.
4. Conducting experiments and drawing the characteristic curves of centrifugal pump/
submergible pump
5. Conducting experiments and drawing the characteristic curves of reciprocating pump.
6. Conducting experiments and drawing the characteristic curves of Gear pump.
7. Conducting experiments and drawing the characteristic curves of Pelton wheel.
8. Conducting experiments and drawing the characteristics curves of Francis turbine and
Kaplan turbine.
9. Conducting the performance analysis of a blower.

TOTAL: 60 Hours

LIST OF EQUIPMENTS FOR STRENGTH OF MATERIALS LABORATORY

S. No.	NAME OF THE EQUIPMENT	Qty.
1.	Tensile Testing machine with double 1 shear attachment – 40 Ton Capacity	1
2.	Torsion Testing Machine (60 NM Capacity)	1
3.	Impact Testing Machine (300 J Capacity)	1
4.	Brinell Hardness Testing Machine	1
5.	Rockwell Hardness Testing Machine	1
6.	Spring Testing Machine for tensile and compressive loads (2500 N)	1
7.	Muffle Furnace (800°C)	1

LIST OF EQUIPMENTS FOR FLUID MECHANICS & MACHINES LABORATORY

S. No.	NAME OF THE EQUIPMENT	Qty.
1.	Orifice meter setup	1
2.	Venturi meter setup	1
3.	Rotameter setup	1
4.	Pipe flow analysis setup	1
5.	Centrifugal pump/submersible pump setup	1
6.	Reciprocating pump setup	1
7.	Gear pump setup	1
8.	Pelton wheel setup	1
9.	Francis turbine setup	1
10.	Kaplan turbine setup	1

LEARNING RESOURCES:

REFERENCES:

1. Fluid Mechanics and Machinery & Strength of Materials Laboratory Manual, Department of Mechanical Engineering, Vel Tech High Tech Dr.Rangarajan Dr.Sakunthala Engineering College, Chennai 600 062.
2. Modi P.N. and Seth S.M., “Hydraulics and Fluid Mechanics”, Standard Book House, New Delhi, 2017.
3. Subramanya K, “Fluid Mechanics and Hydraulic Machines”, Tata McGraw Hill Edu. Pvt. Ltd., 2011



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Course code	21ME48P	Semester	IV				
Category	PROFESSIONAL CORE COURSE (PCC)			L	T	P	C
Course Title	THERMAL ENGINEERING LABORATORY			0	0	4	2

COURSE OBJECTIVES:

- To study the working principle of IC engines (both SI and CI engines), performance and characteristics.
- To analyse the modes of heat transfer.

PREREQUISITE:

- Basic knowledge on IC engines, refrigeration, psychrometry, modes of heat transfer

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C408.1	<i>Explain</i> the valve timing diagram and port timing diagram of IC Engines.	K3
C408.2	<i>Compute</i> the performance of IC engines, flash and fire points of oil.	K4
C408.3	<i>Apply</i> the heat balance test on 4 – stroke Diesel Engine.	K4
C408.4	<i>Predict</i> the performance of steam turbines and generators.	K4
C408.5	<i>Calculate</i> the COP of refrigeration unit.	K4
C408.6	<i>Calculate</i> the heat transfer coefficient in convection, conduction and radiation and correlate with theoretical values.	K4

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
C408.1	2	1	-	-	1	-	-	1	1	1	-	1	-	1	-
C408.2	3	2	1	-	1	-	-	1	1	1	-	1	-	1	-
C408.3	3	2	1	-	1	-	-	1	1	1	-	1	-	1	-
C408.4	3	2	1	-	1	-	-	1	1	1	-	1	-	1	-
C408.5	3	2	1	-	1	-	-	1	1	1	-	1	-	1	-
C408.6	3	2	1	-	1	-	-	1	1	1	-	1	-	1	-

Note: 1: Slight, 2: Moderate, 3: Substantial

I.C ENGINES LAB

1. Determination of flash point and fire point of various fuels / lubricants.
2. Determination of viscosity using redwood viscometer.
3. Valve timing and Port timing diagrams.
4. Performance test on 4 – stroke Diesel Engine.
5. Heat balance test on 4 – stroke Diesel Engine.
6. Morse test on Multi-cylinder Petrol Engine.
7. Retardation test on a Diesel Engine.

STEAM LAB

1. Study on Steam Generators and Turbines.
2. Performance and Energy Balance Test on a Steam Generator.
3. Performance and Energy Balance Test on Steam Turbine.

REFRIGERATION AND AIR CONDITIONING LAB

1. Determination of COP of a refrigeration system.
2. Experiments on Psychrometric processes.
3. Performance test on a reciprocating air compressor.
4. Performance test in a Fluidized Bed Cooling Tower.

HEAT TRANSFER LAB

1. Thermal conductivity measurement using guarded plate apparatus.
2. Thermal conductivity measurement of pipe insulation using lagged pipe apparatus.
3. Determination of heat transfer coefficient under natural convection from a vertical cylinder.
4. Determination of heat transfer coefficient under forced convection from a tube.
5. Heat transfer from pin-fin apparatus (natural & forced convection modes).
6. Determination of Stefan – Boltzmann constant.
7. Determination of emissivity of a grey surface.
8. Effectiveness of Parallel / Counter flow heat exchanger.

TOTAL: 60 Periods

LIST OF EQUIPMENTS FOR THERMAL ENGINEERING LABORATORY

S. NO.	NAME OF THE EQUIPMENT	Qty.
1.	I.C Engine – 2 stroke and 4 stroke model	1
2.	Apparatus for Flash and Fire Point	1
3.	4-stroke Diesel Engine with mechanical loading	1
4.	4-stroke Diesel Engine with hydraulic loading	1
5.	4-stroke Diesel Engine with electrical loading	1
6.	Multi-cylinder Petrol Engine	1
7.	Redwood Viscometer	1
8.	Data Acquisition system with any one of the above engines	1
9.	Steam boiler with turbine setup.	1
10.	Guarded plate apparatus	1
11.	Lagged pipe apparatus	1
12.	Natural convection-vertical cylinder apparatus	1
13.	Forced convection inside tube apparatus	1
14.	Pin-fin apparatus	1
15.	Stefan-Boltzmann apparatus	1
16.	Emissivity measurement apparatus	1
17.	Parallel/ Counter flow heat exchanger apparatus	1
18.	Single/ Two stage reciprocating air compressor	1
19.	Refrigeration test rig	1
20.	Air-conditioning test rig	1
21.	Cooling tower test rig.	1

LEARNING RESOURCES:

REFERENCES:

1. Thermal Engineering Laboratory Manual, Department of Mechanical Engineering, Vel Tech High Tech Dr.Rangarajan Dr. Sakunthala Engineering College, Chennai 600 062.
2. Arora.C.P, “Refrigeration and Air Conditioning”, Tata McGraw-Hill Publishers, 2008.
3. Ganesan V “Internal Combustion Engines”, Third Edition, Tata Mc Graw-Hill 2012.
4. Yunus A. Cengel, "Heat Transfer A Practical Approach", Tata McGraw Hill, 5th Edition, 2015.



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Course code	21EE01P	Semester	IV			
Category	EMPLOYABILITY ENHANCEMENT COURSE (EEC)		L	T	P	C
Course Title	MINI PROJECT – I		0	0	2	1

COURSE OBJECTIVES:

- To introduce real project-based learning

PREREQUISITE:

- All Core Courses

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C001.1	<i>Elaborate</i> specific problem statements in the practical world difficulties with reasonable assumptions and constraints.	K6
C001.2	<i>Organize</i> literature survey and patent search in the area of interest.	K3
C001.3	<i>Perform</i> experiments, design and error analysis.	K4
C001.4	<i>Ascertain</i> the results and arrive at scientific conclusions, products and solution.	K5
C001.5	<i>Document</i> the results in the form of technical report and presentation	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
C001.1	3	3	2	2	2	1	1	1	3	2	2	2	2	2	1
C001.2	3	3	2	2	2	1	1	1	3	2	2	2	2	2	1
C001.3	3	3	2	2	2	1	1	1	3	2	2	2	2	2	1
C001.4	3	3	2	2	2	1	1	1	3	2	2	2	2	2	1
C001.5	3	3	2	2	2	1	1	1	3	2	2	2	2	2	1

Note: 1: Slight, 2: Moderate, 3: Substantial

SYLLABUS**No. of Credits: 1**

Students are motivated and advised to carry out the projects in the following domains, but not limited with

- Mechanical Engineering Design
- Manufacturing Engineering
- Industrial Engineering
- Thermal Engineering
- Reverse Engineering
- Renewable Energy Sources
- Industrial Automation and Robotics
- Mechatronics
- Refrigeration and Air Conditioning
- Metrology and Measurements
- Composites and Nano Technology
- Emerging Technologies in Mechanical Engineering, etc.

Total: 30 Periods**LEARNING RESOURCES:****OFF-LINE RESOURCES:**

1. Journal papers in Library
2. Knowledge Resource Centre.

ONLINE RESOURCES:

1. <https://www.sciencedirect.com/>
2. <https://www.tandfonline.com/>
3. <https://link.springer.com/>
4. https://swayam.gov.in/nc_details/NPTEL
5. <https://library.annauniv.edu/>
6. <https://www.youtube.com/>
7. <https://www.ncbi.nlm.nih.gov/>
8. <https://www.ncbi.nlm.nih.gov/pmc/>
9. <https://mtccindia.res.in/>
10. <https://www.atcc.org/>



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B.E - Mechanical Engineering (R2021)

SEMESTER – V										
S. No	Course Code	Course Title	Category	CIE Marks	SEE Marks	Total Marks	Credits			
							L	T	P	C
THEORY										
1	21ME51T	Heat and Mass Transfer	PCC	40	60	100	3	0	0	3
2	21ME52T	Design of Machine Elements	PCC	40	60	100	3	1	0	4
3	21ME53T	Metrology and Measurements	PCC	40	60	100	3	0	0	3
4	21ME54T	Dynamics of Machines	PCC	40	60	100	3	0	0	3
5	-	Professional Elective – I	PEC	40	60	100	3	0	0	3
6	-	Open Elective – I	OEC	40	60	100	3	0	0	3
PRACTICAL										
7	21ME57P	Metrology and Measurements Laboratory	PCC	40	60	100	0	0	4	2
8	21ME58P	Kinematics and Dynamics Laboratory	PCC	40	60	100	0	0	4	2
9	21EE03P	Technical Seminar	EEC	100	-	100	0	0	2	1
TOTAL										24



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Course code	21ME51T	Semester		V			
Category	PROFESSIONAL CORE COURSE (PCC)			L	T	P	C
Course Title	HEAT AND MASS TRANSFER			3	0	0	3

COURSE OBJECTIVES:

- To understand the mechanisms of heat transfer under steady and transient conditions.
- To understand the concepts of heat transfer through extended surfaces.
- To learn the thermal analysis, sizing of heat exchangers and to understand the basic concepts of mass transfer.

PREREQUISITE:

- Engineering Thermodynamics and Thermal Engineering.

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C501.1	<i>Apply</i> heat conduction equations to different surface configurations under steady state & transient conditions and solve problems.	K3
C501.2	<i>Apply</i> free, forced convective heat transfer correlations to internal and external flows through/over various surface configurations and solve problems.	K3
C501.3	<i>Explain</i> the phenomena of boiling and condensation, apply LMTD and NTU methods of thermal analysis to different types of heat exchanger configurations and solve problems.	K3
C501.4	<i>Explain</i> basic laws for Radiation and apply these principles to radiative heat transfer between different types of surfaces to solve problems.	K3
C501.5	<i>Apply</i> diffusive and convective mass transfer equations and correlations to solve problems for different applications.	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
C501.1	3	2	1	-	-	-	-	-	-	-	-	1	-	2	-
C501.2	3	2	1	-	-	-	-	-	-	-	-	1	-	2	-
C501.3	3	2	1	-	-	-	-	-	-	-	-	1	-	2	-
C501.4	3	2	1	-	-	-	-	-	-	-	-	1	-	2	-
C501.5	3	2	1	-	-	-	-	-	-	-	-	1	-	2	-

Note: 1: Slight, 2: Moderate, 3: Substantial

SYLLABUS	No. of Credits: 3
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UNIT I CONDUCTION	9
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General Differential equation of Heat Conduction– Cartesian and Polar Coordinates – One Dimensional Steady State Heat Conduction — plane and composite systems – Conduction with Internal Heat Generation – Extended Surfaces – Unsteady Heat Conduction – Lumped Analysis – Semi Infinite and Infinite Solids –Use of Heisler’s charts – Applications

UNIT II CONVECTION	9
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Free and Forced Convection -Hydrodynamic and Thermal Boundary Layer. Free and Forced Convection during external flow over Plates and Cylinders and Internal flow through tubes– Applications

UNIT III PHASE CHANGE HEAT TRANSFER AND HEATEXCHANGERS	9
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Nusselt’s theory of condensation - Regimes of Pool boiling and Flow boiling. Correlations in boiling and condensation. Heat Exchanger Types - Overall Heat Transfer Coefficient – Fouling Factors - Analysis – LMTD method - NTU method–Applications

UNIT IV RADIATION	9
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Black Body Radiation – Grey body radiation - Shape Factor – Electrical Analogy – Radiation Shields. Radiation through gases. Radiation Cooling System – Applications

UNIT V MASS TRANSFER	9
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Basic Concepts – Diffusion Mass Transfer – Fick’s Law of Diffusion – Steady state Molecular Diffusion – Convective Mass Transfer – Momentum, Heat and Mass Transfer Analogy – Convective Mass Transfer Correlations – simultaneous heat and mass transfer – Applications

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Yunus A. Cengel, "Heat Transfer A Practical Approach", Tata McGraw Hill, 5th Edition, 2015.
2. Holman, J.P., "Heat and Mass Transfer", Tata McGraw Hill, 2010.

REFERENCES:

1. Introduction to Heat and Mass Transfer, NPTEL Course Contents & Videos, MHRD.
2. Frank P. Incropera and David P. Dewitt, "Fundamentals of Heat and Mass Transfer", John Wiley & sons, 2014.
3. Kothandaraman, C.P., "Fundamentals of Heat and Mass Transfer", New Age International, New Delhi, 2012.
4. R.C.Sachdeva, "Fundamentals of Engineering Heat& Mass transfer", New Age International Publishers, 2009.
5. Nag, P.K., "Heat Transfer", Tata McGraw Hill, New Delhi, 2002.
6. Ozisik, M.N., "Heat Transfer", McGraw Hill Book Co., 1994.



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Course code	21ME52T	Semester	V				
Category	PROFESSIONAL CORE COURSE (PCC)			L	T	P	C
Course Title	DESIGN OF MACHINE ELEMENTS			3	1	0	4

COURSE OBJECTIVES:

- To design shafts and couplings for various applications.
- To design bolted and welded joints for various kinds of loads.
- To design helical, leaf springs, flywheels and bearings for various applications.

PREREQUISITE:

- Strength of Materials, Material Science and Kinematics of machinery.

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C502.1	<i>Design</i> machine members subjected to static and variable loads.	K3
C502.2	<i>Design</i> shafts and couplings for various applications.	K3
C502.3	<i>Design</i> bolted and welded joints for various kinds of loads.	K3
C502.4	<i>Design</i> helical and leaf springs	K3
C502.5	<i>Select</i> sliding and rolling contact bearings.	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
C502.1	3	3	2	-	-	-	-	-	-	1	1	1	1	2	-
C502.2	3	3	2	-	-	-	-	-	-	1	1	1	1	2	-
C502.3	3	3	2	-	-	-	-	-	-	1	1	1	1	2	-
C502.4	3	3	2	-	-	-	-	-	-	1	1	1	1	2	-
C502.5	3	3	2	-	-	-	-	-	-	1	1	1	1	2	-

Note: 1: Slight, 2: Moderate, 3: Substantial

SYLLABUS**No. of Credits: 4****UNIT I FUNDAMENTAL CONCEPTS IN DESIGN 9+3**

Machine Design philosophy and Procedures –Factors influencing machine design, selection of materials based on mechanical properties – Preferred numbers– Direct, Bending and torsional loading – Factor of Safety and Factors governing selection of factor of Safety – Combined loads – Principal stresses – Creep strain and Creep Curve – Eccentric loading – curved beams – crane hook and ‘C’ frame- theories of failure – Design based on strength and stiffness – Stress Concentration Causes & Remedies - Fluctuating stresses – Endurance limit– Design for finite and infinite life under variable loading .

UNIT II SHAFTS AND COUPLINGS 9+3

Design of solid and hollow shafts - Materials for shafts; strength of shafts under torsion and bending; factor of safety in shafts: fatigue strength reduction factors, modified moments of inertia of shaft section; stiffness of shafts: factors affecting shaft deflection. Complete design calculation and checking of stress concentration- Shaft vibrations - Design of Rigid and flexible couplings.

UNIT III TEMPORARY AND PERMANENT JOINTS 9+3

Threaded fasteners - Bolted joints – Simple and eccentrically loaded bolted joints - Welded joints – Butt, Fillet and parallel transverse fillet welds – welded joints subjected to bending, torsional and eccentric loads.

UNIT IV ENERGY STORING ELEMENTS 9+3

Types of springs, design of helical and concentric springs–surge in springs, Design of laminated springs - Flywheels considering stresses in rims and arms for engines and presses - Solid and Rimmed flywheels.

UNIT V BEARINGS 9+3

Sliding contact and rolling contact bearings - Hydrodynamic journal bearings, Sommerfeld Number, Raimondi & Boyd graphs, Selection of Rolling Contact bearings - Seals and Gaskets.

TOTAL: 60 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Shigley J.E and Mischke C. R, “Mechanical Engineering Design”, Sixth Edition, Tata Mc Graw - Hill, 2010.
2. Bhandari V.B, “Design of Machine Elements”, Second Edition, Tata McGraw-Hill Book Co, 2020.

REFERENCES:

1. Design of Machine Elements, NPTEL Course Contents & Videos, MHRD.
2. Sundararaja moorthy T. V, Shanmugam N, "Machine Design", Anuradha Publications, Chennai, 2018.
3. Orthwein W, “Machine Component Design”, Jaico Publishing Co, 2013.
4. Ugural A.C, “Mechanical Design” – An Integral Approach, Mc Graw - Hill Book Co, 2015.



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Course code	21ME53T	Semester	V				
Category	PROFESSIONAL CORE COURSE (PCC)			L	T	P	C
Course Title	METROLOGY AND MEASUREMENTS			3	0	0	3

COURSE OBJECTIVES:

- To provide knowledge on various Metrological equipment available and correct procedure to be adopted to measure the dimension of the components.

PREREQUISITE:

- Scientific study of measurement.

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C503.1	<i>Describe</i> the concepts of measurements to apply in various metrological instruments.	K2
C503.2	<i>Outline</i> the principles of linear and angular measurement tools used for industrial applications.	K2
C503.3	<i>Explain</i> the procedure for conducting computer aided inspection.	K2
C503.4	<i>Demonstrate</i> the techniques of form measurement used for industrial components.	K2
C503.5	<i>Explain</i> various measuring techniques of mechanical properties in industrial applications.	K2

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
C503.1	3	2	-	-	1	-	-	-	-	-	-	1	-	1	-
C503.2	3	2	-	-	1	-	-	-	-	-	-	1	-	1	-
C503.3	3	2	-	-	1	-	-	-	-	-	-	1	-	1	-
C503.4	3	2	-	-	1	-	-	-	-	-	-	1	-	1	-
C503.5	3	2	-	-	1	-	-	-	-	-	-	1	-	1	-

Note: 1: Slight, 2: Moderate, 3: Substantial

LEARNING RESOURCES:

TEXT BOOKS:

1. Dotson Connie, “Dimensional Metrology”, Cengage Learning, First edition, 2012.
2. Mark Curtis, Francis T. Farago, “Handbook of Dimensional Measurement”, Industrial Press, Fifth edition, 2013.
3. Jain R.K. “Engineering Metrology”, Khanna Publishers, 2009.
4. Gupta. I.C., “Engineering Metrology”, Dhanpatrai Publications, 2005.

REFERENCES:

1. Engineering Metrology and Introduction on Mechanical Measurements, NPTEL Course Contents & Videos, MHRD.
2. Venkateshan, S. P., “Mechanical Measurements”, Second edition, John Wiley & Sons, 2015.
3. Beckwith, Marangoni, Lienhard, “Mechanical Measurements”, Pearson Education, 2014.
4. Raghavendra, Krishnamurthy, “Engineering Metrology & Measurements”, Oxford Univ. Press, 2013
5. AmmarGrous, J “Applied Metrology for Manufacturing Engineering”, Wiley-ISTE, 2011.
6. IdPeckman, “Industrial Instrumentation”, Wiley Eastern, 2004.
7. Charles Reginald Shotbolt, “Metrology for Engineers”, 5th edition, Cengage Learning EMEA, 1990.
8. Alan S. Morris, “The essence of Measurement”, Prentice Hall of India 1996.



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Course code	21ME54T	Semester	V				
Category	PROFESSIONAL CORE COURSE (PCC)			L	T	P	C
Course Title	DYNAMICS OF MACHINES			3	0	0	3

COURSE OBJECTIVES:

- To understand the force-motion relationship in components subjected to external forces and analysis of standard mechanisms.
- To understand the effect of Dynamics of undesirable vibrations.
- To understand the principles in mechanisms used for speed control and stability control.

PREREQUISITE:

- Engineering Mechanics and Kinematics of Machinery.

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C504.1	<i>Calculate</i> static and dynamic forces of mechanisms.	K3
C504.2	<i>Calculate</i> the balancing masses and their locations of reciprocating and rotating masses.	K3
C504.3	<i>Compute</i> the frequency of free vibration.	K3
C504.4	<i>Compute</i> the frequency of forced vibration and damping coefficient.	K3
C504.5	<i>Calculate</i> the speed, lift of the governor and estimate the gyroscopic effect on automobiles, ships and airplanes.	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
C504.1	3	3	2	1	-	-	-	1	1	-	-	1	1	2	-
C504.2	3	3	2	1	-	-	-	1	1	-	-	1	1	2	-
C504.3	3	3	2	1	-	-	-	1	1	-	-	1	1	2	-
C504.4	3	3	2	1	-	-	-	1	1	-	-	1	1	2	-
C504.5	3	3	2	1	-	-	-	1	1	-	-	1	1	2	-

Note: 1: Slight, 2: Moderate, 3: Substantial

UNIT I FORCE ANALYSIS 9

Dynamic force analysis – Inertia force and Inertia torque– D Alembert's principle –Dynamic Analysis in reciprocating engines – Gas forces – Inertia effect of connecting rod– Bearing loads – Crank shaft torque – Turning moment diagrams –Fly Wheels – Flywheels of punching presses– Dynamics of Cam- follower mechanism.

UNIT II BALANCING 9

Static and dynamic balancing – Balancing of rotating masses – Balancing a single cylinder engine – Balancing of Multi-cylinder inline, V- engines – Partial balancing in engines – Balancing of linkages – Balancing machines-Field balancing of discs and rotors.

UNIT III FREE VIBRATION 9

Basic features of vibratory systems – Degrees of freedom – single degree of freedom – Free vibration– Equations of motion – Natural frequency – Types of Damping – Damped vibration– Torsional vibration of shaft – Critical speeds of shafts – Torsional vibration – Two and three rotor torsional systems.

UNIT IV FORCED VIBRATION 9

Response of one degree freedom systems to periodic forcing – Harmonic disturbances – Disturbance caused by unbalance – Support motion – transmissibility – Vibration isolation. Vibration measurement–Vibration meter – Seismographs – Vibration Analyzer – Display and recording of signals – Cathode Ray Oscilloscope – XY Plotter – Chart Plotters – Digital data Acquisition systems.

UNIT V MECHANISM FOR CONTROL 9

Governors – Types – Centrifugal governors – Gravity controlled and spring controlled centrifugal governors – Characteristics – Effect of friction – Controlling force curves. Gyroscopes – Gyroscopic forces and torques – Gyroscopic stabilization – Gyroscopic effects in Automobiles, ships and airplanes.

TOTAL: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. S Balaguru, “Dynamics of Machines”, Cengage India, 2019.
2. Rattan, S.S, “Theory of Machines”, 4th Edition, Tata McGraw-Hill, 2014.
3. Uicker, J.J., Pennock G.R and Shigley, J.E., “Theory of Machines and Mechanisms”, 4th Edition, Oxford University Press, 2014.
4. Dr Sadhu Singh, “Dynamics of Machines”, S.K Katarina & Sons, 2011.
5. F. B. Sayyad, “Dynamics of Machinery”, McMillan Publishers India Ltd., Tech-Max Educational resources, 2011.
6. Ghosh. A and Mallick, A.K., “Theory of Mechanisms and Machines”, 3rd Edition Affiliated East-West Pvt. Ltd., New Delhi, 2006.

REFERENCES:

1. Dynamics of Machines, NPTEL Course Contents & Videos, MHRD.
2. Cleghorn. W. L, “Mechanisms of Machines”, Oxford University Press, 2014.
3. Khurmi, R.S, “Theory of Machines”, S Chand Publications, 2005.
4. Rao.J.S. and Dukkupati.R.V. "Mechanisms and Machine Theory", Wiley-Eastern Ltd., New Delhi, 1992.
5. Robert L. Norton, "Kinematics and Dynamics of Machinery", Tata McGraw-Hill, 2009.
6. V.Ramamurthi, "Mechanics of Machines", Narosa Publishing House, 2002.



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Course code	21ME551PT	Semester	V				
Category	PROFESSIONAL ELECTIVE COURSE (PEC)			L	T	P	C
Course Title	AUTOMOBILE ENGINEERING			3	0	0	3

COURSE OBJECTIVES:

- To understand the construction and working principle of various parts of an automobile.
- To understand the assembling and dismantling of engine parts and transmission system.

PREREQUISITE:

- Basic Engineering Skills and Thermal Engineering

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C5501.1	<i>Indicate</i> the various parts of the automobile and their functions and materials.	K2
C5501.2	<i>Discuss</i> the engine auxiliary systems and engine emission control.	K2
C5501.3	<i>Express</i> the working of different types of transmission systems.	K2
C5501.4	<i>Explain</i> the types and working of Steering, Brakes and Suspension Systems.	K2
C5501.5	<i>Select</i> the possible alternate sources of energy for IC Engines.	K2

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
C5501.1	3	2	-	-	-	-	-	-	-	-	-	1	-	1	-
C5501.2	3	2	-	-	-	-	1	-	-	-	-	1	-	1	-
C5501.3	3	2	-	-	-	-	-	-	-	-	-	1	-	1	-
C5501.4	3	2	-	-	-	-	-	-	-	-	-	1	-	1	-
C5501.5	3	2	-	-	-	-	-	-	-	-	-	1	-	1	-

Note: 1: Slight, 2: Moderate, 3: Substantial

UNIT I VEHICLE STRUCTURE AND ENGINES 9

Types of automobiles, vehicle construction and different layouts, chassis, frame and body, Vehicle aerodynamics (various resistances and moments involved), IC engines –components and its functions, material selection and working principle.

UNIT II ENGINE AUXILIARY SYSTEMS 9

Electronically controlled gasoline injection system for SI engines, Electronically controlled diesel injection system (Unit injector system, Rotary distributor type and common rail direct injection system), Electronic ignition system (Transistorized coil ignition system, capacitive discharge ignition system), Turbo chargers (WGT, VGT), Engine emission control by three-way catalytic converter system, Radiators and Coolant pumps.

UNIT III TRANSMISSION SYSTEMS 9

Clutch-types and construction, gear boxes- manual and automatic, gear shift mechanisms, over drive, transfer box, fluid flywheel, torque converter, propeller shaft, slip joints, universal joints, Differential and rear axle, Hotchkiss Drive and Torque Tube Drive.

UNIT IV STEERING, BRAKES AND SUSPENSION SYSTEMS 9

Steering geometry and types of steering gear box-Power Steering, Types of Front Axle, Types of Suspension Systems, Pneumatic and Hydraulic Braking Systems, Antilock Braking System (ABS), electronic brake force distribution (EBD) and Traction Control.

UNIT V ALTERNATIVE ENERGY SOURCES 9

Use of Natural Gas, Liquefied Petroleum Gas, Bio-diesel, Bio-ethanol, Gasohol and Hydrogen in Automobiles- Engine modifications required –Performance, Combustion and Emission Characteristics of SI and CI engines with these alternate fuels - Electric and Hybrid Vehicles– Types – main components – working principles – Design requirement for electric vehicles. Fuel Cell–Fuel cell Characteristics- Fuel cell types- Half reactions of fuel cell.

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Kirpal Singh, “Automobile Engineering”, Volume 1, Standard Publishers, 2020.
2. S.K. Gupta, “A Textbook of Automobile Engineering”, Second edition, S. CHAND Publishers, 2020.
3. Jain K.K. and Asthana R.B, “Automobile Engineering”, 1st edition, Tata McGraw Hill Education, 2017.
4. Joseph Heitner, “Automotive Mechanics,” Second Edition, East-West Press, 1999.

REFERENCES:

1. Fundamentals of Automotive Systems, NPTEL Course Contents & Videos, MHRD.
2. Ganesan V. “Internal Combustion Engines”, Fourth Edition, Tata McGraw-Hill, 2017.
3. William H Crouse, Donald L Anglin, Automotive Mechanics, 10th edition, McGraw – Hill, 2017.
4. Heinz Heisler, “Advanced Engine Technology,” SAE International Publications USA, 1998.
5. Martin W, Stockel and Martin T Stockle, “Automotive Mechanics Fundamentals,” The Goodheart - Will Cox Company Inc, USA,1978.
6. Newton, Steeds and Garet, “Motor Vehicles”, Butterworth Publishers, 1989.



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Course code	21ME552PT	Semester	V				
Category	PROFESSIONAL ELECTIVE COURSE (PEC)			L	T	P	C
Course Title	GAS DYNAMICS AND JET PROPULSION			3	0	0	3

COURSE OBJECTIVES:

- To understand the basic difference between incompressible and compressible flow.
- To understand the phenomenon of shock waves and its effect on flow.
- To gain basic knowledge about jet propulsion and Rocket Propulsion.

PREREQUISITE:

- Thermodynamics, Thermal Engineering

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C5502.1	<i>Discuss</i> the basic fundamentals of compressible and incompressible flow concepts	K3
C5502.2	<i>Apply</i> the effect of friction (Fanno flow) and heat transfer (Rayleigh flow) in compressible flow and solve Fanno and Rayleigh flow problems	K3
C5502.3	<i>Apply</i> the concept of shock waves and its effects	K3
C5502.4	<i>Discuss</i> the propulsive methods, concept of air-craft propulsion system	K3
C5502.5	<i>Explain</i> the propulsive methods, concept of rocket propulsion system	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
C5502.1	3	2	1	-	-	-	-	-	-	-	-	1	-	1	-
C5502.2	3	2	1	-	-	-	-	-	-	-	-	1	-	1	-
C5502.3	3	2	1	-	-	-	-	-	-	-	-	1	-	1	-
C5502.4	3	2	1	-	-	-	1	-	-	-	-	1	-	1	-
C5502.5	3	2	1	-	-	-	1	-	-	-	-	1	-	1	-

Note: 1: Slight, 2: Moderate, 3: Substantial

UNIT I BASIC CONCEPTS AND ISENTROPIC FLOWS 9

Energy and momentum equations of compressible fluid flows – Stagnation states, Mach waves and Mach cone – Effect of Mach number on compressibility – Isentropic flow through variable ducts – Nozzle and Diffusers.

UNIT II FLOW THROUGH DUCTS 9

Flows through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) – variation of flow properties. Choking. Isothermal flow with friction.

UNIT III NORMAL AND OBLIQUE SHOCKS 9

Governing equations – Variation of flow parameters across the normal and oblique shocks – Prandtl – Meyer relations – Applications – Supersonic wind tunnels.

UNIT IV JET PROPULSION 9

Theory of jet propulsion – Thrust equation – Thrust power and propulsive efficiency – Operating principle, cycle analysis and use of stagnation state performance of ram jet, turbojet, turbofan and turbo prop engines – Air craft combustors.

UNIT V SPACE PROPULSION 9

Types of rocket engines – Propellants-feeding systems – Ignition and combustion – Theory of rocket propulsion – Performance study – Staging – Terminal and characteristic velocity – Applications – space flights.

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Anderson, J.D., "Modern Compressible flow", 3rd Edition, McGraw Hill, 2012.
2. Yahya, S.M. "Fundamentals of Compressible Flow", New Age International (P) Limited, New Delhi, 2002.

REFERENCES:

1. Gas Dynamics and Air Craft Propulsion, NPTEL Course Contents & Videos, MHRD.
2. Cohen. H., G.E.C. Rogers and Saravana, "Gas Turbine Theory", Longman Group Ltd.,1980.
3. Ganesan. V., "Gas Turbines", Tata McGraw Hill Publishing Co., New Delhi, 2010.
4. Shapiro. A.H., "Dynamics and Thermodynamics of Compressible fluid Flow", John wiley, New York, 1953.
5. Sutton. G.P., "Rocket Propulsion Elements", John wiley, New York,2010.
6. Zucrow. N.J., "Principles of Jet Propulsion and Gas Turbines", John Wiley, New York, 1970.



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Course code	21ME553PT	Semester		V			
Category	PROFESSIONAL ELECTIVE COURSE (PEC)			L	T	P	C
Course Title	INTELLECTUAL PROPERTY RIGHTS			3	0	0	3

COURSE OBJECTIVES:

- To acquaint the basic concepts of Intellectual Property Rights.
- To develop expertise in IPR related issues and sensitize the learners with the emerging issues in IPR and the rationale for the protection of IPR.

PREREQUISITE:

- Professional Ethics

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C5503.1	<i>Imbibe</i> the knowledge of Intellectual Property and its protection through various laws.	K2
C5503.2	<i>Explain</i> the knowledge of IPR for professional development.	K2
C5503.3	<i>Recognize</i> a platform for protection and compliance of Intellectual Property Rights & knowledge.	K2
C5503.4	<i>Locate</i> awareness amidst academia and industry of IPR and Copyright compliance.	K2
C5503.5	<i>Deliver</i> the purpose and function of IPR and patenting.	K2

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
C5503.1	2	1	-	-	-	-	-	-	-	-	-	1	-	1	-
C5503.2	2	1	-	-	-	-	-	-	-	-	-	1	-	1	-
C5503.3	2	1	-	-	-	-	-	-	-	-	-	1	-	1	-
C5503.4	2	1	-	-	-	-	-	-	-	-	-	1	-	1	-
C5503.5	2	1	-	-	-	-	-	-	-	-	-	1	-	1	-

Note: 1: Slight, 2: Moderate, 3: Substantial

UNIT I INTRODUCTION 9

Introduction to IPRs, Basic concepts and need for Intellectual Property – Meaning and practical aspects of Patents, Copyrights, Geographical Indications, IPR in India and Abroad. Nature of Intellectual Property, Industrial Property, technological Research, Inventions and Innovations – Important examples of IPR.

UNIT II INTELLECTUAL PROPERTY RIGHTS 9

The IPR tool kit, Patents, the patenting process, Patent cooperation treaties: International Treaties and conventions on IPRs: Trade Related Aspects of Intellectual Property Rights Agreement, Patent Cooperation Treaty, Patent Act of India, Patent Amendment Act, Design Act, Trademark Act, Geographical Indication Act.

UNIT III INTELLECTUAL PROPERTY PROTECTIONS 9

PR of Living Species, protecting inventions in biotechnology, protections of traditional knowledge, biopiracy and documenting traditional knowledge, Digital Innovations and Developments as Knowledge Assets – IP Laws, Cyber Law and Digital Content Protection. Case studies: The basmati rice issue, revocations of turmeric patent, revocation of neem patent.

UNIT IV EXERCISING AND ENFORCING OF INTELLECTUAL PROPERTY RIGHTS 9

Rights of an IPR owner, licensing agreements, criteria for patent infringement. Case studies of patent infringement, IPR –contract, unfair competitions and control, provisions in TRIPS.

UNIT V ROLE OF PATENTS IN PRODUCT DEVELOPMENT COMMERCIALIZATION 9

Recent changes in IPR laws impacting patents and copy rights, intellectual cooperation in the science and allied industry. Patentable and non-patentable research. Case studies.

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. P.B. Ganguli, Intellectual Property Rights: Unleashing the Knowledge Economy. Tata McGraw Hill, 2001.
2. Prabuddha Ganguli. Intellectual Property Rights: Unleashing the Knowledge Economy. McGraw Hill Education, 2011.

REFERENCES:

1. Steve Smith, “The Quality Revolution”, 1st ed., Jaico Publishing House, 2002.
2. Kompal Bansal and Praishit Bansal. Fundamentals of IPR for Engineers, 1st Edition, BS Publications, 2012.
3. Prabhuddha Ganguli. Intellectual Property Rights. 1st Edition, TMH, 2012.
4. R Radha Krishnan & S Balasubramanian. Intellectual Property Rights. 1st Edition, Excel Books, 2012.
5. M Ashok Kumar & Mohd. Iqbal Ali. Intellectual Property Rights. 2nd Edition, Serial Publications, 2011.
6. Vinod V. Scople, Managing Intellectual Property. Prentice Hall of India Pvt Ltd, 2012.
7. Deborah E. Bouchoux. Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets. Cengage Learning, 3rd ed. Edition, 2012.
8. Edited by Derek Bosworth and Elizabeth Webster, “The Management of Intellectual Property”, Edward Elgar Publishing Ltd., 2013.
9. B.S. Patil, “Legal Aspects of Building and Engineering Contracts”, 1974.
10. Wadhwa (2004), “Intellectual Property Rights”, Universal Law Publishing Co.



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Course code	21ME554PT	Semester		V			
Category	PROFESSIONAL ELECTIVE COURSE (PEC)			L	T	P	C
Course Title	COMPOSITE MATERIALS AND NANO TECHNOLOGY			3	0	0	3

COURSE OBJECTIVES:

- Study of different composite materials and finding its mechanical strength.
- Fabrication of FRP and other composites by different manufacturing methods.
- Introduce them the various methods of developing nano materials.
- Make them understand characterization of nano materials.

PREREQUISITE:

- Engineering Materials and Metallurgy and Production Technology

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C5504.1	<i>Explain</i> the mechanical strength of the composite material.	K2
C5504.2	<i>Describe</i> the fabrication of FRP and other composites by different manufacturing methods.	K2
C5504.3	<i>Classify</i> on nano materials.	K2
C5504.4	<i>Discuss</i> on the development of a Nano material.	K2
C5504.5	<i>Illustrate</i> the characterization of Nano materials.	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
C5504.1	2	1	-	-	-	-	-	-	-	-	-	1	-	1	-
C5504.2	2	1	-	-	-	-	-	-	-	-	-	1	-	1	-
C5504.3	2	1	-	-	-	-	-	-	-	-	-	1	-	1	-
C5504.4	2	1	-	-	-	-	-	-	-	-	-	1	-	1	-
C5504.5	3	2	-	-	-	-	-	-	-	-	-	1	-	1	-

Note: 1: Slight, 2: Moderate, 3: Substantial

UNIT I INTRODUCTION TO COMPOSITE MATERIALS 9

Definition-Matrix materials – polymers – metals-ceramics - Reinforcements: Particles, whiskers, inorganic fibers, metal filaments-ceramic fibers-fiber fabrication-natural composite wood, Jute Advantages and drawbacks of composites over monolithic materials. Mechanical properties and applications of composites, Particulate-Reinforced composite materials, Dispersion-Strengthened composite, Fiber-reinforced composites Rule of mixtures-Characteristics of fiber-Reinforced composites, Manufacturing fiber and composites

UNIT II MANUFACTURING OF COMPOSITES 9

Manufacturing of Polymer Matrix Composites (PMCs)-hand lay-up, spray technique, filament winding, Pultrusion, Resin Transfer Moulding (RTM)-bag moulding, injection moulding, Sandwich Mould Composites (SMC) - Manufacturing of Metal Matrix Composites (MMCs) - solid state, liquid state, vapour state processing, manufacturing of Ceramic Matrix Composites (CMCs)-hot pressing reaction bonding process-infiltration technique, direct oxidation-interfaces

UNIT III INTRODUCTION TO NANOMATERIALS 9

Amorphous, Crystalline, microcrystalline, quasicrystalline and nanocrystalline materials- historical development of nanomaterials – Nanomaterials classification (Gleiter's Classification) – properly changes done to size effects, Hall – petch, inverse Hall- petch effects - polymeric nanostructures.

UNIT IV ZERO-DIMENSIONAL NANO MATERIALS 9

Nanoparticles – properties – processing – liquid state processing - Sol-gel process, wet chemical synthesis – vapour state processing, Aerosol processing, solid state processing – mechanical, mechanochemical synthesis – Application of nanoparticle. Quantum Dots – Quantum confinement – Pauli's exclusion principle – processing – Optical lithography – MOCVD – Droplet epitaxy - Applications.

UNIT V CHARACTERIZATION OF NANOMATERIALS 9

Nano indentation – types of nano indenter – force actuation- displacement measurement- factors affecting nano indentation- Atomic Force Microscope (AFM) – Scanning Tunneling Microscope (STM) – Electrostatic Force Mode (EFM) – Magnetic Force Mode (MFM) – Scanning Electron Microscope (SEM) – Transmission Electron Microscope (TEM).

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Gibson RF, Principles of Composite Material Mechanics, CRC press,4th Edition,2015.
2. Carl C. Koch (ed.), "Nanostructured Materials", Processing, Properties and Potential Applications, Noyes Publications, Norwich, New York, U.S.A.

REFERENCES:

1. Introduction to Composites and Nanomaterials, NPTEL Course Contents & Videos, MHRD.
2. Issac M Daniel and OriIshai, "Engineering Mechanics of Composite Materials", Oxford University Press - 2006, First Indian Edition-2007
3. Mallick PK, Fiber – Reinforced Composites: Materials, Manufacturing and Design, CRC Press, 3rd Edition,2007.
4. Mark Ratner and Daniel Ratner, "Nano Technology", Pearson Education, New Delhi, 2003.
5. Charles P. Poole Jr., Frank J. Ownes, "Introduction to Nanotechnology", Wiley Inter science, 2003.



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Course Code	21ME555PT	Semester	V			
Category	PROFESSIONAL ELECTIVE COURSE (PEC)		L	T	P	C
Course Title	HYDRAULICS AND PNEUMATICS		3	0	0	3

COURSE OBJECTIVES

- To provide knowledge on the application of fluid power in process, construction and manufacturing Industries.
- To understand the fluid and components utilized in modern industrial fluid power system.
- To develop a measurable degree of competence in the design, construction and operation of fluid power circuits.

PREREQUISITE

- Fluid Mechanics

COURSE OUTCOMES

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C5505.1	<i>Summarize</i> the features and functions of Hydraulic motors, actuators and Flow control valves.	K2
C5505.2	<i>Apply</i> different theories related to Fluid power and operation of different types of pumps.	K3
C5505.3	Experiment with different types of Hydraulic circuits and systems	K3
C5505.4	Build the working of different pneumatic circuits and systems	K3
C5505.5	<i>Utilize</i> the various trouble shooting methods and applications of hydraulic and pneumatic systems.	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
C5505.1	3	2	1	-	1	-	-	-	-	-	-	1	1	1	-
C5505.2	3	2	1	-	1	-	-	-	-	-	-	1	1	1	-
C5505.3	3	2	1	-	1	-	-	-	-	-	-	1	1	1	-
C5505.4	3	2	1	-	1	-	-	-	-	-	-	1	1	1	-
C5505.5	3	2	1	-	1	-	-	-	-	-	-	1	1	1	-

Note: 1: Slight, 2: Moderate, 3: Substantial

UNIT I FLUID POWER PRINCIPLES AND HYDRAULIC PUMPS 9

Introduction to Fluid power – Advantages and Applications – Fluid power systems – Types of fluids - Properties of fluids and selection – Basics of Hydraulics – Pascal’s Law – Principles of flow - Friction loss – Work, Power and Torque Problems, Sources of Hydraulic power: Pumping Theory – Pump Classification – Construction, Working, Design, Advantages, Disadvantages, Performance, Selection criteria of Linear and Rotary – Fixed and Variable displacement pumps – Problems.

UNIT II HYDRAULIC ACTUATORS AND CONTROL COMPONENTS 9

Hydraulic Actuators: Cylinders – Types and construction, Application, Hydraulic cushioning – Hydraulic motors - Control Components: Direction Control, Flow control and pressure control valves – Types, Construction and Operation – Servo and Proportional valves – Applications – Accessories: Reservoirs, Pressure Switches – Applications – Fluid Power ANSI Symbols – Problems.

UNIT III HYDRAULIC CIRCUITS AND SYSTEMS 9

Accumulators, Intensifiers, Industrial hydraulic circuits – Regenerative, Pump Unloading, Double-Pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-Safe, Speed Control, Hydrostatic transmission, Electro hydraulic circuits, Mechanical hydraulic servo systems.

UNIT IV PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS 9

Properties of air – Perfect Gas Laws – Compressor – Filters, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust Valves, Pneumatic actuators, Design of Pneumatic circuit – Cascade method – Electro Pneumatic System – Elements – Ladder diagram – Problems, Introduction to fluidics and pneumatic logic circuits.

UNIT V TROUBLE SHOOTING AND APPLICATIONS 9

Installation, Selection, Maintenance, Trouble Shooting and Remedies in Hydraulic and Pneumatic systems, Design of hydraulic circuits for Drilling, Planning, Shaping, Surface grinding, Press and Forklift applications. Design of Pneumatic circuits for Pick and Place applications and tool handling in CNC Machine tools – Low cost Automation – Hydraulic and Pneumatic power packs.

TOTAL: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Jagadeesha. T., “Pneumatics Concepts, Design and Applications “, Universities Press, 2015.
2. Anthony Esposito, “Fluid Power with Applications”, Pearson Education 2009.
3. Srinivasan.R., “Hydraulic and Pneumatic Controls”, Vijay Nicole Imprints, 2008.
4. Majumdar S.R., “Oil Hydraulics Systems- Principles and Maintenance”, Tata McGraw-Hill, 2001.
5. Vickers, Industrial Hydraulics Manual, 1992.

REFERENCES:

1. Hydraulics and Pneumatics, NPTEL Course Contents & Videos, MHRD.
2. Anthony Lal, “Oil hydraulics in the service of industry”, Allied publishers, 1982.
3. Dudelyt, A. Pease and John T. Pippenger, “Basic Fluid Power”, Prentice Hall, 1987.
4. Majumdar S.R., “Pneumatic systems – Principles and maintenance”, Tata McGraw Hill, 1995.
5. Michael J, Prinches and Ashby J. G, “Power Hydraulics”, Prentice Hall, 1989.
6. Shanmugasundaram.K, “Hydraulic and Pneumatic controls”, Chand & Co, 2006.



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Course code	21ME01OT	Semester	V				
Category	OPEN ELECTIVE COURSE (OEC)			L	T	P	C
Course Title	INDUSTRY 4.0			3	0	0	3

COURSE OBJECTIVES:

- To introduce and realize students with Industry 4.0, components involved in Industry 4.0 and their support system.
- To understand the concept of cloud manufacturing and open manufacturing framework.
- To learn about recent trends in automated manufacturing, machine vision and IoT in various domains.

PREREQUISITE:

- Basic knowledge of different domains of industrial skills

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C001.1	<i>Realize</i> the need for Industry 4.0 and its challenges in Industry	K2
C001.2	<i>Discuss</i> various components and support system involved in the Industry 4.0	K2
C001.3	<i>Summarize</i> cloud manufacturing and open manufacturing framework for Industry 4.0	K2
C001.4	<i>Familiar</i> the automated manufacturing system and machine vision system	K3
C001.5	<i>Discuss</i> the applications of IoT in various domain	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
C001.1	3	2	-	-	-	-	-	-	-	-	1	1	-	2	-
C001.2	2	2	-	-	-	-	-	-	-	-	1	1	-	2	-
C001.3	2	2	-	-	-	-	-	-	-	-	1	1	-	2	-
C001.4	3	2	1	-	-	-	-	-	-	-	1	1	-	2	-
C001.5	2	2	1	-	-	-	-	-	-	-	1	1	-	2	-

Note: 1: Slight, 2: Moderate, 3: Substantial

UNIT I INTRODUCTION 9

Introduction – need - various Industrial Revolutions - Challenges and Applications in Manufacturing Industries. Current Standard of Industry 4.0 in India.

UNIT II COMPONENTS OF INDUSTRY 4.0 9

Internet of Things (IoT) - Industrial Internet of Things (IIoT) - Internet of Services- Smart Devices - Cyber Physical Systems. Robotic Automation and Support System for Industry 4.0. Introduction to Mobile Computing - Augmented Reality and Virtual Reality, Artificial Intelligence – Data collection from sensors - Big Data and Advanced Analysis – case studies.

UNIT III INDUSTRY 4.0 AND CLOUD MANUFACTURING 9

Cyber-physical production systems - Control System as a Service (CSaaS) – Additive Manufacturing for industry 4.0 - Open manufacturing cloud platform for future manufacturing business - Cloud-based decision making in complex engineering environments such as product configuration for manufacturing, process planning, product planning, resource allocation, production planning and Scheduling-examples and case studies.

UNIT IV AUTOMATED MANUFACTURING AND MACHINE VISION 9

Introduction to IT-enabled Smart factories - Smart / intelligent Manufacturing, Overview of CIM, significance of rapid prototyping- - Introduction to Machine Vision - Components-Machine Learning and Applications of Machine Vision in manufacturing/process industries.

UNIT V INDUSTRIAL IoT APPLICATIONS 9

Industrial IoT- Application Domains: Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security (Including AR and VR safety applications), Facility Management. Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries Case studies.

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Carlos Toro, Wei Wang, Humza Akhtar, Implementing Industry 4.0: The Model Factory as the Key Enabler for the Future of Manufacturing, Springer, 2021.
2. Anand Nayyar, Akshi Kumar, A Roadmap to Industry 4.0: Smart Production, Sharp Business and Sustainable Development, Springer, 2020.
3. Carolina Machado, J. Paulo Davim, Industry 4.0-Challenges, Trends, and Solutions in Management and Engineering, CRC press, 2020.

REFERENCES:

1. Boris Sokolov, Dmitry Ivanov, Alexandre Dolgui, Scheduling in Industry 4.0 and Cloud Manufacturing, Springer, 2020.
2. Elena G. Popkova, Yulia V. Ragulina, Aleksei V. Bogoviz, Industry 4.0: Industrial Revolution of the 21st Century, Springer, 2019.
3. Mohammad Dastbaz, Peter Cochrane, Industry 4.0 and Engineering for a Sustainable Future, Springer, 2019.
4. Kaushik Kumar, Divya Zindani, J. Paulo Davim, Industry 4.0: Developments towards the Fourth Industrial Revolution, Springer-Singapore, 2019.
5. Max Hoffmann, Smart Agents for the Industry 4.0: Enabling Machine Learning in Industrial Production, Springer Fachmedien Wiesbaden; Springer, 2019
6. Kaushik Kumar, Divya Zindani, J. Paulo Davim, Digital Manufacturing and Assembly Systems in Industry 4.0, CRC Press, 2019.
7. Le, Chung Van; Le, Dac-Nhuong; Nguyen, Nhu Gia; Tromp, Jolanda G, Emerging technologies for health and medicine: virtual reality, augmented reality, artificial intelligence, internet of things, robotics, industry 4.0, John Wiley & Sons, 2018.
8. Alasdair Gilchrist, Industry 4.0: The Industrial Internet of Things, Apress, 2016.



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Course code	21ME02OT	Semester		V			
Category	OPEN ELECTIVE COURSE (OEC)			L	T	P	C
Course Title	ROBOTICS AND INDUSTRIAL AUTOMATION			3	0	0	3

COURSE OBJECTIVES:

- To understand the functions of the basic components and accessories of a Robot.
- To impart knowledge on Robot Kinematics and Programming.
- To learn Robot safety issues and economics.

PREREQUISITE:

- Electrical Drives & Control, Mechatronics and Kinematics of machinery.

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C002.1	Implement the concepts of a productive system in automation	K2
C002.2	Apply the knowledge of automated flow lines for industrial applications.	K3
C002.3	Classify different drives systems, End Effectors and robot sensors.	K3
C002.4	Compute forward and inverse kinematics of robots and trajectory plan.	K3
C002.5	Program robot to perform typical tasks including Pick and Place in material handling systems.	K2

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
C002.1	3	2	2	1	1	-	-	-	-	-	1	1	3	2	3
C002.2	3	3	3	2	1	2	1	-	1	-	1	1	3	2	3
C002.3	3	3	3	2	1	1	1	-	1	-	1	1	3	2	3
C002.4	2	2	2	2	1	1	1	2	1	1	1	1	3	2	3
C002.5	3	3	3	2	1	1	1	2	1	1	1	1	3	2	3

Note: 1: Slight, 2: Moderate, 3: Substantial

SYLLABUS		No. of Credits: 3
UNIT I	INTRODUCTION TO AUTOMATION	9
<p>Need, Types, Basic elements of an automated system, Manufacturing Industries, Types of production, Functions in manufacturing, Organization and information processing in manufacturing, Automation strategies and levels of automation, Hardware components for automation and process control, mechanical feeders, hoppers, orienters, high speed automatic insertion devices.</p>		
UNIT II	AUTOMATED FLOW LINES	9
<p>Part transfer methods and mechanisms, types of Flow lines, flow line with/without buffer storage, Quantitative analysis of flow lines. Assembly line balancing: Assembly process and systems assembly line, line balancing methods, ways of improving line balance, flexible assembly lines.</p>		
UNIT III	INTRODUCTION TO INDUSTRIAL ROBOTICS	9
<p>Classification of Robot Configurations, functional line diagram, degrees of freedom. Components common types of arms, joints grippers, factors to be considered in the design of grippers. Robot actuators and Feedback components: Actuators, Pneumatic, Hydraulic actuators, Electric & Stepper motors, comparison. Position sensors - potentiometers, resolvers, encoders - velocity sensors, Tactile sensors, Proximity sensors.</p>		
UNIT IV	MANIPULATOR KINEMATICS, MANIPULATOR DYNAMICS	9
<p>Homogenous transformations as applicable to rotation and translation - D-H notation, Forward inverse kinematics. Manipulator Dynamics: Differential transformations, Jacobians, Lagrange - Euler and Newton – Euler formations. Trajectory Planning: Trajectory Planning and avoidance of obstacles path planning, skew motion, joint integrated motion - straight line motion.</p>		
UNIT V	ROBOT PROGRAMMING, APPLICATION IN MANUFACTURING	9
<p>Robot Programming: Methods of programming - requirements and features of programming languages, software packages. Problems with programming languages. Robot Application in Manufacturing: Material Transfer - Material handling, loading and unloading - Process - spot and continuous arc welding & spray painting - Assembly and Inspection.</p>		

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Automation, Production Systems and Computer Integrated Manufacturing, Groover M.P, Prentice – Hall Ltd., 1997.
2. Groover M.P., “Industrial Robotics -Technology Programming and Applications”, McGraw Hill, 2001.
3. Klafter R.D., Chmielewski T.A and Negin M., “Robotic Engineering - An Integrated Approach”, Prentice Hall, 2003.

REFERENCES:

1. Robotics and Industrial Automation, NPTEL Course Contents & Videos, MHRD.
2. Craig J.J., “Introduction to Robotics Mechanics and Control”, Pearson Education, 2008.
3. Deb S.R., “Robotics Technology and Flexible Automation” Tata McGraw Hill Book Co., 1994.
4. Koren Y., “Robotics for Engineers”, Mc Graw Hill Book Co., 1992.
5. Fu.K.S., Gonzalz R.C. and Lee C.S.G., “Robotics Control, Sensing, Vision and Intelligence”, McGraw Hill Book Co., 1987.
6. Janakiraman P.A., “Robotics and Image Processing”, Tata McGraw Hill, 1995.
7. Rajput R.K., “Robotics and Industrial Automation”, S.Chand and Company, 2008.
8. Surender Kumar, “Industrial Robots and Computer Integrated Manufacturing”, Oxford and IBH Publishing Co. Pvt. Ltd., 1991.
9. Computer Control of Manufacturing Systems Yoram Koren, Tata McGraw-Hill Edition 2005.



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Course code	21ME03OT	Semester	V				
Category	OPEN ELECTIVE COURSE (OEC)			L	T	P	C
Course Title	3D PRINTING			3	0	0	3

COURSE OBJECTIVES:

- To discuss basics of 3D printing, inkjet technology, laser technology and its application.

PREREQUISITE:

- Computer Aided Design and Material Science.

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C003.1	<i>Understand</i> the basic concepts of 3D printing technology.	K2
C003.2	<i>Outline</i> the 3D printing workflow.	K2
C003.3	<i>Explain</i> the concepts of 3D printing using inkjet technique.	K3
C003.4	<i>Explain</i> the concepts of 3D printing using laser technique.	K3
C003.5	<i>Explain</i> various methods for designing and modelling for industrial applications.	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
C003.1	3	2	-	-	1	-	-	-	-	-	-	1	2	2	-
C003.2	3	2	-	-	1	-	-	-	-	-	-	1	2	2	-
C003.3	3	2	1	1	1	-	-	-	-	-	-	1	2	2	-
C003.4	3	2	1	1	1	-	-	-	-	-	-	1	2	2	-
C003.5	3	2	1	1	1	-	-	-	-	-	-	1	2	2	-

Note: 1: Slight, 2: Moderate, 3: Substantial

UNIT I INTRODUCTION 9

Introduction; Design considerations – Material, Size, Resolution, Process; Modelling and viewing - 3D; Scanning; Model preparation – Digital; Slicing; Software; File format.

UNIT II PRINCIPLE 9

Processes – Extrusion, Wire, Granular, Lamination, Photo polymerisation; Materials - Paper, Plastics, Metals, Ceramics, Glass, Wood, Fibre, Sand, Hydro gels, Graphene; Material Selection - Processes, applications, limitations.

UNIT III INKJET TECHNOLOGY 9

Printer - Working Principle, Positioning System, Print head, Print bed, Frames, Motion control; Print head Considerations – Continuous Inkjet, Thermal Inkjet, Piezoelectric Drop-On-Demand; Material Formulation for jetting; Liquid based fabrication – Continuous jet, Multi jet; Powder based fabrication – Colour jet.

UNIT IV LASER TECHNOLOGY 9

Light Sources – Types, Characteristics; Optics – Deflection, Modulation; Material feeding and flow – Liquid, powder; Printing machines – Types, Working Principle, Build Platform, Print bed Movement, Support structures.

UNIT V INDUSTRIAL APPLICATIONS 9

Product Models, manufacturing – Printed electronics, Biopolymers, Packaging, Healthcare, Food, Medical, Displays; Future trends.

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Christopher Barnatt, 3D Printing: The Next Industrial Revolution, Create Space Independent Publishing Platform, 2013.
2. Ian M. Hutchings, Graham D. Martin, Inkjet Technology for Digital Fabrication, John Wiley & Sons, 2013.

REFERENCES:

1. Rapid Prototyping, NPTEL Course Contents & Videos, MHRD.
2. Chua, C.K., Leong K.F. and Lim C.S., Rapid prototyping: Principles and applications, second edition, World Scientific Publishers, 2010.
3. Ibrahim Zeid, Mastering CAD CAM Tata McGraw-Hill Publishing Co., 2007.
4. Joan Horvath, Mastering 3D Printing, A Press, 2014.



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Course code	21ME040T	Semester	V				
Category	OPEN ELECTIVE COURSE (OEC)			L	T	P	C
Course Title	FUNDAMENTALS OF ELECTRIC AND HYBRID VEHICLES			3	0	0	3

COURSE OBJECTIVES:

- To study the general aspects of Electric and Hybrid Vehicles (EHV) including architectures, modeling, sizing, sub system design and hybrid vehicle control.
- To understand the design requirements and energy storage requirements for electric and hybrid propulsion systems.

PREREQUISITE:

- Thermodynamics, Electrical Drives & Control and Automobile Engineering.

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C004.1	<i>Summarize</i> the electric and hybrid vehicle architectures and operation.	K2
C004.2	<i>Select</i> the design requirements for electric and hybrid vehicles.	K3
C004.3	<i>Discuss</i> the energy requirements and energy storage device for electric and hybrid vehicles.	K2
C004.4	<i>Explain</i> the controllers needed to operate electric and hybrid vehicles.	K3
C004.5	<i>Classify</i> the different subsystems of electric and hybrid vehicles.	K2

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
C004.1	3	2	-	-	-	1	-	-	-	-	-	1	-	1	-
C004.2	3	2	-	-	-	1	-	-	-	-	-	1	-	1	-
C004.3	3	2	-	-	-	1	-	-	-	-	-	1	-	1	-
C004.4	3	2	-	-	-	1	-	-	-	-	-	1	-	1	-
C004.5	3	2	-	-	-	1	-	-	-	-	-	1	-	1	-

Note: 1: Slight, 2: Moderate, 3: Substantial

LEARNING RESOURCES:

TEXT BOOKS:

1. A K Babu, “Electric and Hybrid Vehicles”, Second edition, Khanna Publishing, 2022.
2. Iqbal Husain, “Electric and Hybrid Vehicles-Design Fundamentals”, 3rd edition, CRC Press, 2021.
3. Mehrdad Ehsani, “Modern Electric, Hybrid Electric and Fuel Cell Vehicles”, Third edition, CRC Press, 2018.

REFERENCES:

1. Introduction to Hybrid and Electric Vehicles, NPTEL Course Contents, MHRD.
2. Lino Guzzella, “Vehicle Propulsion System”, Springer Publications, 2005.
3. Ron Hod Kinson, “Light Weight Electric/Hybrid Vehicle Design”, Butterworth Heinemann Publication, 2005.
4. James Larminie and John Lowry, “Electric Vehicle Technology Explained”, John Wiley & Sons, 2003.
5. Rand D.A.J, Woods, R & Dell RM, “Batteries for Electric vehicles”, John Wiley & Sons, 1998.



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Course code	21ME57P	Semester	V				
Category	PROFESSIONAL CORE COURSE (PCC)			L	T	P	C
Course Title	METROLOGY AND MEASUREMENTS LABORATORY			0	0	4	2

COURSE OBJECTIVES:

- To familiar with different measurement equipment's and to make effective use of the same in industries for quality inspection.

PREREQUISITE:

- Scientific study of measurement.

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C507.1	<i>Calibrate</i> the Vernier, micrometer using slip gauges, other linear measurements and setting up the comparator for the inspection.	K3
C507.2	<i>Measure</i> the angular measurements using angular instruments.	K3
C507.3	<i>Measure</i> the gear tooth profile and screw thread parameters using Contact and non- contact instruments.	K3
C507.4	<i>Measure</i> the force, torque, and temperature using thermocouple.	K3
C507.5	<i>Measure</i> prismatic components using Coordinate Measuring Machine	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
C507.1	3	2	1	-	1	-	-	-	-	-	1	1	1	2	-
C507.2	3	2	1	-	1	-	-	-	-	-	1	1	1	2	-
C507.3	3	2	1	-	1	-	-	-	-	-	1	1	1	2	-
C507.4	3	2	1	-	1	-	-	-	-	-	1	1	1	2	-
C507.5	3	2	1	-	1	-	-	-	-	-	1	1	1	2	-

Note: 1: Slight, 2: Moderate, 3: Substantial

List of Experiments**No. of Credits: 2**

1. Calibration and use of measuring instruments – Vernier caliper, micrometer, Vernier height gauge – using gauge blocks
2. Calibration of depth micrometer
3. Calibration of plug gauge using laser micrometer
4. Calibration of LVDT for displacement measurement
5. Measurement of angles using bevel protractor, sine bar and sine center
6. Measurement of gear parameters by gear tooth Vernier caliper
7. Measurement of bore diameter using bore gauge and telescopic gauge
8. Measurement of linear dimensions using Comparators (Mechanical, Electrical, Pneumatic)
9. Measurement of screw thread parameters using Floating Carriage Micrometer
10. Measurement of force
11. Measurement of torque
12. Measurement of temperature
13. Measurement of features in a prismatic component using Coordinate Measuring Machine (CMM)
14. Non-contact (Optical) measurement using Toolmaker's microscope / Profile projector
15. Measurement of Surface finish in components manufactured using various processes (turning, milling, grinding, etc.,) using stylus-based instruments.
16. Testing of straightness of a machine tool guide way using Autocollimator.

Total: 60 Periods

LIST OF EQUIPMENTS FOR METROLOGY AND MEASUREMENTS LABORATORY

S. No.	NAME OF THE EQUIPMENT	Qty.
1	Micrometer	5
2	Vernier Caliper	5
3	Vernier Height Gauge	2
4	Vernier depth Gauge	2
5	Slip Gauge Set	1
6	Gear Tooth Vernier	1
7	Sine Bar	1
8	Sine Center	1
9	Floating Carriage Micrometer	1
10	Profile Projector / Tool Makers Microscope	1
11	Mechanical, Electrical, Pneumatic Comparator	1
12	Autocollimator	1
13	Temperature Measuring Setup	1
14	Force Measuring Setup	1
15	Torque Measuring Setup	1
16	Depth micrometer	1
17	LVDT	1
18	Laser micrometer	1

LEARNING RESOURCES:

TEXT BOOKS:

1. Gupta. I.C., “Engineering Metrology”, Dhanpatrai Publications, 2005.
2. Jain R.K. “Engineering Metrology”, Khanna Publishers, 2009.

REFERENCES:

1. Alan S. Morris, “The essence of Measurement”, Prentice Hall of India, 1996.
2. Beckwith, Marangoni, Lienhard, “Mechanical Measurements”, Pearson Education, 2014.
3. Charles Reginald Shotbolt, “Metrology for Engineers”, 5th edition, Cengage Learning EMEA, 1990.
4. Donald Peckman, “Industrial Instrumentation”, Wiley Eastern, 2004.
5. Raghavendra, Krishnamurthy “Engineering Metrology & Measurements”, Oxford Univ. Press.



VEL TECH HIGH TECH

Dr. RANGARAJAN Dr. SAKUNTHALA ENGINEERING COLLEGE

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Accredited by NBA, New Delhi & Accredited by NAAC with "A" Grade & CGPA of 3.27

Course code	21ME58P	Semester	V			
Category	PROFESSIONAL CORE COURSE (PCC)		L	T	P	C
Course Title	KINEMATICS AND DYNAMICS LABORATORY		0	0	4	2

COURSE OBJECTIVES:

- To supplement the principles learnt in kinematics and Dynamics of Machinery.
- To understand how certain measuring devices are used for dynamic testing.

PREREQUISITE:

- Kinematics of Machinery

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C508.1	<i>Explain</i> gear parameters, kinematics of mechanisms, gyroscopic effect and working of lab equipment's.	K2
C508.2	<i>Develop</i> a model of a mechanical system using a free body diagram.	K3
C508.3	<i>Determine</i> mass moment of inertia of mechanical element	K3
C508.4	<i>Develop</i> equations of motion for translational and rotational mechanical systems.	K3
C508.5	<i>Calculate</i> the frequency of the shafts, balancing masses and the concept governor effort.	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
C508.1	3	2	2	1	1	-	-	1	1	1	-	-	-	1	-
C508.2	3	2	2	1	1	-	-	1	1	1	-	-	-	1	-
C508.3	3	2	2	1	1	-	-	1	1	1	-	-	-	1	-
C508.4	3	2	2	1	1	-	-	1	1	1	-	-	-	1	-
C508.5	3	2	2	1	1	-	-	1	1	1	-	-	-	1	-

Note: 1: Slight, 2: Moderate, 3: Substantial

List of Experiments**No. of Credits: 2**

1. a) Study of gear parameters.
b) Experimental study of velocity ratios of simple, compound, Epicyclic and differential gear trains.
2. a) Kinematics of Four Bar, Slider Crank, Crank Rocker, Double crank, Double rocker, Oscillating cylinder Mechanisms.
b) Kinematics of single and double universal joints.
3. a) Determination of Mass moment of inertia of Fly wheel and Axle system.
b) Determination of Mass Moment of Inertia of axisymmetric bodies using Turn Table apparatus.
c) Determination of Mass Moment of Inertia using bifilar suspension and compound pendulum.
4. Motorized gyroscope – Study of gyroscopic effect and couple.
5. Governor - Determination of range sensitivity, effort etc., for Watts, Porter, Proell, and Hartnell Governors.
6. Cams – Cam profile drawing, Motion curves and study of jump phenomenon
7. a) Single degree of freedom Spring Mass System – Determination of natural Frequency and verification of Laws of springs – Damping coefficient determination.
b) Multi degree freedom suspension system – Determination of influence coefficient.
8. a) Determination of torsional natural frequency of single and Double Rotor systems.
b) Undamped and Damped Natural frequencies.
9. Vibration Absorber – Tuned vibration absorber.
10. Vibration of Equivalent Spring mass system – Undamped and damped vibration.
11. Whirling of shafts – Determination of critical speeds of shafts with concentrated loads.
12. a) Balancing of rotating masses.
b) Balancing of reciprocating masses.
13. a) Transverse vibration of Free-Free beam – with and without concentrated masses.
b) Forced Vibration of Cantilever beam – Mode shapes and natural frequencies.
c) Determination of transmissibility ratio using vibrating table.

Total: 60 Periods

LIST OF THE EQUIPMENTS FOR KINEMATICS AND DYNAMICS LABORATORY

S. No.	NAME OF THE EQUIPMENT	Qty.
1	Cam follower setup.	1
2	Motorised gyroscope.	1
3	Governor apparatus - Watt, Porter, Proell and Hartnell governors.	1
4	Whirling of shaft apparatus.	1
5	Dynamic balancing machine.	1
6	Two rotor vibration setup.	1
7	Spring mass vibration system.	1
8	Torsional Vibration of single rotor system setup.	1
9	Gear Models.	1
10	Kinematic Models to study various mechanisms.	1
11	Turn table apparatus.	1
12	Transverse vibration setup of cantilever.	1

LEARNING RESOURCES:

TEXT BOOKS:

1. F. B. Sayyad, "Dynamics of Machinery", McMillan Publishers India Ltd., Tech-Max Educational resources, 2011.
2. Rattan, S.S, "Theory of Machines", 4th Edition, Tata McGraw-Hill, 2014.
3. Uicker, J.J., Pennock G.R and Shigley, J.E., "Theory of Machines and Mechanisms", 4th Edition, Oxford University Press, 2014.

REFERENCES:

1. Cleghorn. W. L, "Mechanisms of Machines", Oxford University Press, 2014.
2. Ghosh. A and Mallick, A.K., "Theory of Mechanisms and Machines", 3rd Edition Affiliated East-West Pvt. Ltd., New Delhi, 2006.
3. Khurmi, R.S "Theory of Machines", 14 Edition, S Chand Publications, 2005.
4. Rao. J.S. and Duggipati. R.V. "Mechanisms and Machine Theory", Wiley-Eastern Ltd., New Delhi, 1992.
5. Robert L. Norton, "Kinematics and Dynamics of Machinery", Tata McGraw-Hill, 2009.
6. V. Ramamurthi, "Mechanics of Machines", Narosa Publishing House, 2002.



VEL TECH HIGH TECH

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Course code	21EE03P	Semester	V			
Category	EMPLOYABILITY ENHANCEMENT COURSE (EEC)		L	T	P	C
Course Title	TECHNICAL SEMINAR		0	0	2	1

COURSE OBJECTIVES:

- To inculcate the habit of critical thinking
- To emphasise the importance of reading and effective writing
- To expose meta-disciplinary research works
- To cultivate a scholarly habit

PREREQUISITE:

- Professional Communication Skill and Technical Writing Skill

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C003.1	<i>Define</i> a compelling and viable problem, question, or project by exploring the purpose and philosophy on topics in technology	K2
C003.2	<i>Learn</i> to infuse material from primary and secondary sources with their own ideas in research papers	K2
C003.3	<i>Understand</i> the stages of writing process which strengthens the technical and workplace writing tasks	K2
C003.4	<i>Demonstrate</i> an ability to synthesize and assess arguments in scholarly articles and monographs professionally	K3
C003.5	<i>Develop</i> Presentation and Communication skills.	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
C003.1	2	2	-	-	-	-	-	-	3	2	-	2	2	2	2
C003.2	2	2	-	-	-	-	-	-	3	2	-	2	2	2	2
C003.3	2	2	-	-	-	-	-	-	3	2	-	2	2	2	2
C003.4	2	2	-	-	-	-	-	-	3	2	-	2	2	2	2
C003.5	2	2	-	-	-	-	-	-	3	2	-	2	2	2	2

Note: 1: Slight, 2: Moderate, 3: Substantial

SYLLABUS**No. of Credits: 1**

Students are advised to prepare and present Seminar in the following domains, but not limited with

- Mechanical Engineering Design
- Manufacturing Engineering
- Industrial Engineering
- Thermal Engineering
- Reverse Engineering
- Renewable Energy Sources
- Industrial Automation and Robotics
- Mechatronics
- Refrigeration and Air Conditioning
- Metrology and Measurements
- Composites and Nano Technology
- Emerging Technologies in Mechanical Engineering, etc.

Total: 30 Periods**LEARNING RESOURCES:****OFF-LINE RESOURCES:**

1. Journal papers in Library
2. Knowledge Resource Centre.

ONLINE RESOURCES:

1. <https://www.sciencedirect.com/>
2. <https://www.tandfonline.com/>
3. <https://link.springer.com/>
4. https://swayam.gov.in/nc_details/NPTEL
5. <https://library.annauniv.edu/>
6. <https://www.youtube.com/>
7. <https://www.ncbi.nlm.nih.gov/>
8. <https://www.ncbi.nlm.nih.gov/pmc/>
9. <https://mtccindia.res.in/>
10. <https://www.atcc.org/>

LIST OF PROFESSIONAL ELECTIVE COURSES

Sl. No.	COURSE CODE	COURSE TITLE
Professional Elective I (V SEM)		
1.	21ME551PT	Automobile Engineering
2.	21ME552PT	Gas Dynamics and Jet Propulsion
3.	21ME553PT	Intellectual Property Rights
4.	21ME554PT	Composite materials and Nano Technology
5.	21ME555PT	Hydraulics and Pneumatics
Professional Elective II (VI SEM)		
6.	21ME641PT	Professional Ethics in Engineering
7.	21ME642PT	Artificial Intelligence
8.	21ME643PT	Renewable Energy Sources
9.	21ME644PT	Computational Fluid Dynamics
10.	21ME645PT	Unconventional Machining Processes
Professional Elective III (VII SEM)		
11.	21ME751PT	Data Science
12.	21ME752PT	Refrigeration and Air conditioning
13.	21ME753PT	Computer Integrated Manufacturing
14.	21ME754PT	Industrial Corrosion and Tribology
15.	21ME755PT	Maintenance Engineering
Professional Elective IV (VIII SEM)		
16.	21ME811PT	Non Destructive Testing and Evaluation
17.	21ME812PT	Total Quality Management
18.	21ME813PT	Industrial Robotics
19.	21ME814PT	New product Development
20.	21ME815PT	Theory of Metal Cutting and Joining
Professional Elective V (VIII SEM)		
21.	21ME821PT	Power Plant Engineering
22.	21ME822PT	Micro Electro Mechanical Systems
23.	21ME823PT	Production Planning and Control
24.	21ME824PT	Advanced Manufacturing Management
25.	21ME825PT	Lean Manufacturing

LIST OF OPEN ELECTIVE COURSES

S. No.	COURSE CODE	NAME OF THE COURSE
1	21ME01OT	Industry 4.0
2	21ME02OT	Robotics and Industrial Automation
3	21ME03OT	3D Printing
4	21ME04OT	Fundamentals of Electric and Hybrid Vehicles