



SIDDHARTHA
ACADEMY OF HIGHER EDUCATION

An Institution **DEEMED TO BE UNIVERSITY**

(Under Section 3 of UGC Act, 1956)

(Sponsored by Siddhartha Academy of General & Technical Education), Vijayawada, A.P.

VELAGAPUDI RAMAKRISHNA SIDDHARTHA SCHOOL OF ENGINEERING

DEPARTMENT OF MECHANICAL ENGINEERING

VR-23

SCHEME OF INSTRUCTIONS [B. Tech]

B.Tech. Degree Programs for students admitted from the
Academic Year 2023-24

Structure for 1st, 2nd, 3rd and 4th Years

Dr.N.Ravi Kumar
Professor & HOD
Department of ME

B.Tech. Course Structure (w.e.f A.Y 2023-24)**MECHANICAL ENGINEERING****B.Tech. – I Year I Semester**

S.No.	Code	Category	Title	L	T	P	Credits
1	23BS1101	BS&H	Linear Algebra & Calculus	3	0	0	3
2	23BS1102A	BS & H	Engineering Chemistry	3	0	0	3
3	23ES1103B	Engineering Science	Basic Electrical & Electronics Engineering	3	0	0	3
4	23ES1104	Engineering Science	Introduction to Programming	3	0	0	3
5	23ES1105	Engineering Science	Engineering Graphics	1	0	4	3
6	23MC1106	Mandatory Course	Induction Program	2	0	0	-
7	23BS1151A	BS&H	Engineering Chemistry Lab	0	0	2	1
8	23ES1152	Engineering Science	Computer Programming Lab	0	0	3	1.5
9	23ES1153	Engineering Science	Basic Electrical & Electronics Workshop	0	0	3	1.5
10	23BS1154B	BS&H	Health and wellness, Yoga and Sports	-	-	1	0.5
Total				15	0	13	19.5

B.Tech. – I Year II Semester

S.No.	Code	Category	Title	L	T	P	Credits
1	23BS2101	BS & H	Differential Equations & Vector Calculus	3	0	0	3
2	23BS2102	BS&H	Engineering Physics	3	0	0	3
3	23ES2103A	Engineering Science	Basic Civil & Mechanical Engineering	3	0	0	3
4	23PC2104B	Professional Core	Engineering Mechanics	3	0	0	3
5	23HS2105	BS&H	Communicative English	2	0	0	2
6	23MC2106	Engineering Science	Design Thinking	2	0	0	-

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7	23BS2151	BS&H	Engineering Physics Lab	0	0	2	1
8	23PC2152E	Professional Core	Engineering Mechanics Lab	0	0	3	1.5
9	23HS2153	BS&H	Communicative English Lab	0	0	2	1
10	23ES2154	Engineering Science	Engineering Workshop	0	0	3	1.5
11	23ES2155	Professional Core	IT Workshop Lab	0	0	3	1.5
12	23BS2156	BS&H	NSS/NCC/Scouts & Guides/Community Service	-	-	1	-
Total				14	0	14	20.5

B.Tech. – II Year I Semester

S.No.	Course Code	Course Category	Course Name	L	T	P	Credits
1	23BS 3101E	Basic Sciences & Humanities	Mathematics for Mechanical Engineers	3	0	0	3
2	23HS 3102	Basic Sciences & Humanities	Universal Human Values 2 – Understanding Harmony	2	1	0	3
3	23ES 3103G	Engineering Science	Basic Thermodynamics	3	0	0	3
4	23ME3304	Professional Core	Mechanics of Materials	3	0	0	3
5	23ME 3305	Professional Core	Kinematics of Machines	3	0	0	3
6	23TP 3106	Soft Skills- I	Logic and Reasoning	0	0	2	1
7	23MC3107	Audit Course	Environmental Science	2	0	0	-
8	23ME3651	Skill oriented Course	Programmable logic controllers Lab	0	0	2	1
9	23ME3352	Professional Core	Solid Modeling Laboratory	0	0	3	1.5
10	23ME3353	Professional Core	Computational Methods Lab	0	0	3	1.5
Total				15	1	10	20

B.Tech. – II Year II Semester

S.No	Code	Category	Title	L	T	P	Credits
1	23 HS 4101	Management Course	Engineering Economics and management	2	0	0	2
2	23ES 4102D	Engineering Science	Engineering Metallurgy	3	0	0	3
3	23ME4303	Professional Core	Manufacturing Processes	3	0	0	3
4	23ME4304	Professional Core	Fluid Mechanics and Hydraulic Machines	3	0	0	3
5	23ME4305	Professional Core	Machine Dynamics	3	0	0	3
6	23TP4106	Soft skills -2	English for Professionals	0	0	2	1
7	23ES4651	Skill oriented course	Python Programming Lab	0	0	2	1
8	23ES4152	Engineering Science	Design Thinking & Innovation	1	0	2	2
9	23ME4353	Professional Core	SM & FM Laboratory	0	0	3	1.5
10	23ME4354	Professional Core	Manufacturing Process Lab	0	0	3	1.5
Total				15	0	12	21

B.Tech. – III Year I Semester

S.No.	Code	Category	Title	L	T	P	Credit
1	23ME5301	Professional Core	Machine Tools and Metal Cutting	3	0	0	3
2	23ME5302	Professional Core	Applied Thermodynamics	3	0	0	3
3	23ME5303	Professional Core	Design of Machine Elements	3	0	0	3
4	23ME5404 A,B,C	Professional Elective - I	A. IC Engines & Gas Turbines B. Refrigeration and Air Conditioning C. Automobile Engineering	3	0	0	3
5	23ME5205 A,B	Open Elective - I	A. Mechatronics, B. Additive Manufacturing	3	0	0	3
6	23ME5351	Professional Core	Fuels and IC Engines Laboratory	0	0	3	1.5
7	23ME5352	Professional Core	Machine Tools Laboratory	0	0	3	1.5

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8	23ME5653	Soft Skills -3	Personality Development	0	0	2	1
9	23ME5554	Skill Enhancement course	Mechatronics and Automation Lab	0	0	2	1
10	23TP5106	EPICS	Evaluation of Community Service Internship	-	-	-	2
11	23MC5107 B	Humanities and Social Sciences Elective (Audit Course)	A. Foreign Language German B. Biology for Engineers C. Psychology D. Law for Engineers	2	0	0	-
		Total		17	0	10	22

B.Tech. – III Year II Semester

S.No.	Category	Title	L	T	P	Credits
1	Professional Core 23ME6301	Heat Transfer	3	0	0	3
2	Professional Core 23ME6302	Robotics	3	0	0	3
3	Professional Core 23ME6303	Design of Transmission Systems	3	0	0	3
4	Professional Elective – II 23ME6404 A,B,C	A. Finite Element Method B. Mechanical Vibrations C. Advanced Mechanics of Materials	3	0	0	3
5	Professional Elective – III 23ME6405 A,B,C	A. Metrology B. Theory of Metal Cutting C. Metal Forming	3	0	0	3
6	Open Elective – II (NPTEL) 23ME6206 A,B,C,D,E,F,G	A. Solar Energy Engineering & Technology B. Sustainable Energy Technology C. Fundamentals of Artificial Intelligence D. Artificial Intelligence & Machine Learning in Materials Engineering. E. Renewable Energy Engineering: Solar, Wind and Biomass Energy Systems F. Introduction to Industry 4.0 and Industrial Internet of Things G. Non-conventional energy Resources	3	0	0	3
7	Professional Core 23ME6351	Heat Transfer Lab	0	0	3	1.5
8	Professional Core 23ME6352	Simulation and Analysis Lab	0	0	3	1.5
9	Soft Skills – 4 23TP6107	Quantitative Aptitude	0	0	2	1
10	Humanities and Social Sciences 23HS6153	Advanced Communication Skills Lab	0	0	2	1
11	Audit Course 23MC6108	Technical Paper Writing & IPR	2	0	0	-
Total			20	0	10	23
Mandatory Industry Internship of 08 weeks duration during summer vacation						

B.Tech. – IV Year I Semester

S.No.	Category	Title	L	T	P	Credits
1	Professional Core	Computer Aided Manufacturing	3	0	0	3
2	Professional Elective - IV	A. Operations Research B. Manufacturing Management C. Flexible Manufacturing Systems & Group Technology	3	0	0	3
3	Professional Elective - V	A. Computational Fluid Dynamics B. Energy Resource Utilization C. Jet & Rocket Propulsion	3	0	0	3
4	Open Elective - III	A. Artificial Intelligence and Machine Learning B. Electric & Hybrid Vehicles C. Renewable Energy Sources	3	0	0	3
5	Open Elective – IV (NPTEL/Self Learning)	A. Project Management B. Statistical Quality Control C. Operations Management D. Principles of industrial Engineering	3	0	0	3
6	Professional Core	Design and Metrology Lab	0	0	3	1.5
7	Professional Core	CAM Lab	0	0	3	1.5
8	Advanced Skill Enhancement Course	Fluid flows simulation Lab	1	0	2	2
9	Audit Course	Indian Constitution / German / Psychology	2	0	0	-
10	Internship	Evaluation of Industry Internship	-	-	-	2
Total			18	0	08	22

B.Tech. – IV Year II Semester

S.No.	Category	Title	L	T	P	Credits
1	Internship & Project Work	Full semester Internship & Project Work	0	0	24	12

Open Elective -II is Mandatory MOOCS/NPTEL Course

Open Elective -IV is Self-learning Course

FIRST YEAR

23BS1101
LINEAR ALGEBRA & CALCULUS

Course Category:	Basic Science	Credits:	3
Course Type:	Theory	Lecture -Tutorial-Practice:	3 - 0- 0
Prerequisites:	10+2 level Mathematics	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

COURSE OUTCOMES

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

CO1	Solve the system of homogeneous and non-homogeneous linear equations
CO2	Examine the nature of a quadratic form by transforming into a canonical form
CO3	Determine maxima and minima of multivariable functions
CO4	Evaluate areas and volumes using double, triple integrals

**Contribution of Course Outcomes towards achievement of Program Outcomes
(L – Low, M - Medium, H – High)**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	H	M			L							
CO2	H	M			L							
CO3	H	M			L							
CO4	H	M			L							

COURSE CONTENT

UNIT I Matrices

Rank of a matrix by Echelon form, Normal form, Cauchy–Binet formulae (without proof), Inverse of Non-singular matrices by Gauss-Jordan method, System of linear equations: Solving system of Homogeneous and Non-Homogeneous equations by Gauss elimination method, Jacobi and Gauss-Seidel Iteration Methods.

UNIT II Eigenvalues, Eigenvectors and Orthogonal Transformation

Eigenvalues, Eigenvectors and their properties, Diagonalization of a matrix, Cayley-Hamilton Theorem (without proof), Finding inverse and power of a matrix by Cayley-Hamilton Theorem, Quadratic forms and Nature of the Quadratic forms, Reduction of Quadratic form to Canonical forms by Orthogonal Transformation.

UNIT III Differential Calculus

Mean Value Theorems: Rolle's theorem, Lagrange's mean value theorem with their geometrical interpretation, Cauchy's mean value theorem, Taylor's and Maclaurin's theorems with remainders (without proof), Problems and applications on the above theorems.

Functions of Several Variables: Continuity and Differentiability, Partial derivatives, Total derivatives, Chain rule, Directional derivative, Taylor's and Maclaurin's series expansion of functions of two variables, Jacobians, Functional dependence, Maxima and Minima of functions of two variables, Method of Lagrange multipliers.

UNIT IV Multiple Integrals (Multivariable Calculus)

Double integrals, Triple integrals, Change of order of integration, Change of variables to polar, cylindrical and spherical coordinates, Finding areas (by double integrals) and volumes (by double integrals and triple integrals).

TEXT BOOKS

- [1]. Higher Engineering Mathematics, B. S. Grewal, Khanna Publishers, 2017, 44th Edition

REFERENCE BOOKS

- [1]. Advanced Engineering Mathematics, Erwin Kreyszig, John Wiley & Sons, 2018, 10th Edition
 [2]. Thomas Calculus, George B. Thomas, Maurice D. Weir and Joel Hass, Pearson Publishers, 2018, 14th Edition
 [3]. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Alpha Science International Ltd., 2021 5th Edition (9th reprint)
 [4]. Advanced Modern Engineering Mathematics, Glyn James, Pearson publishers, 2018, 5th Edition
 [5]. Advanced Engineering Mathematics, Micheael Greenberg, , Pearson publishers, 9th Edition
 [6]. Higher Engineering Mathematics, H. K Das, Er. Rajnish Verma, S. Chand Publications, 2014, 3rd Edition (Reprint 2021)

E-RESOURCES AND OTHER DIGITAL MATERIAL

- [1]. Prof. S. K. Gupta & Prof. Sanjeev Kumar, IIT Roorkee, Matrix Analysis with Applications [English], Available: https://onlinecourses.nptel.ac.in/noc19_ma28/preview
 [2]. Prof. Jitendra Kumar, IIT Kharagpur, Engineering Mathematics – I [English], Available: https://onlinecourses.nptel.ac.in/noc20_ma37/preview
 [3]. Prof. Jitendra Kumar & Prof. Somesh Kumar, IIT Kharagpur, Advanced Calculus For Engineers [English], Available: https://onlinecourses.nptel.ac.in/noc22_ma75/preview
 [4]. Prof. Denis Auroux, Massachusetts Institute of Technology: MIT Open Courseware, Multivariable Calculus, Available: <https://ocw.mit.edu>.

23BS1102A ENGINEERING CHEMISTRY

Course Category:	Basic Science	Credits:	3
Course Type:	Theory	Lecture -Tutorial-Practice:	3 - 0 - 0
Prerequisites:	10 + 2 level Chemistry	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

COURSE OUTCOMES

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

CO1	Analyse various water treatment methods and boiler troubles.
CO2	Apply the knowledge of basic electrochemistry principles for electrochemical energy systems and corrosion.
CO3	Compare mechanistic aspects of polymerisation, and different polymers and conventional fuels for their effective utilisation.
CO4	Evaluate various modern engineering materials for their applications in engineering and other fields.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	M	M					L					
CO2	M	M										
CO3	M		M				L					
CO4	M		M									

COURSE CONTENT

UNIT – I :

Water Technology-I (Domestic water): Specifications for drinking water - World Health Organization (WHO) standards, domestic water treatment – sedimentation, coagulation, disinfection by chlorination – breakpoint chlorination, desalination of brackish water – electrodialysis and reverse osmosis (RO).

Water Technology-II (Industrial water): Hardness of water, Estimation of hardness of water by EDTA Method, Estimation of dissolved oxygen – Boiler troubles – scales, caustic embrittlement – reasons, disadvantages and control methods – conditioning, Industrial water treatment – Ion-exchange method, concept of adsorption and its applications.

UNIT – II :

Electrochemistry: Electrodes, electrochemical cell, Nernst equation, cell potential calculations, Primary cells – zinc-air battery, Secondary cells –lithium ion batteries- working principle of the batteries including cell reactions; Fuel cells – working principle of a fuel cell and working of hydrogen-oxygen fuel cell.

Corrosion: Introduction, electrochemical corrosion – hydrogen evolution and oxygen absorption corrosion, differential aeration corrosion, galvanic corrosion, factors affecting the corrosion, cathodic protection, copper electroplating and copper electroless plating.

UNIT – III :

Polymer Chemistry: Introduction, functionality of monomers, mechanism of chain growth, step growth polymerization, thermoplastics and thermosetting plastics: Preparation, properties and applications of PVC, polystyrene, Nylon 6,6 and Bakelite. Elastomers – Preparation, properties and applications of Buna S and Buna N.

Fuel Chemistry: Fuels- classification, calorific value of fuels, numerical problems based on calorific value; Analysis of coal (proximate and ultimate analysis), Liquid fuels -refining of petroleum, concept of knocking, octane and cetane number, alternative fuels –biomass, biogas, biodiesel.

UNIT – IV :

Modern Engineering Materials-I: Composites: classification – particle, fibre and layered reinforced composites, properties and engineering applications. **Lubricants:** classification, mechanisms, properties of lubricating oils-viscosity, viscosity Index, flash point, fire point, and applications.

Modern Engineering Materials-II: Building materials: Portland cement, constituents, setting and hardening of cement, refractories – classification and properties –refractoriness, RUL test, porosity, and applications. **Nanomaterials:** classification, properties and applications.

TEXT BOOKS

- [1]. Engineering Chemistry, Jain and Jain, 17th Edition, Dhanpat Rai, 2018.
- [2]. Engineering Chemistry, Prasantha Rath & S. Aruna Kumari, Cengage Publishers, 2023.

REFERENCE BOOKS

- [1]. Peter Atkins, Julio de Paula and James Keeler, Atkins' Physical Chemistry, 10/e, Oxford University Press, 2010.
- [2]. H.F.W. Taylor, Cement Chemistry, 2/e, Thomas Telford Publications, 1997.
- [3]. Textbook of polymer Science, Fred W. Billmeyer Jr, 3rd Edition.

E-RESOURCES AND OTHER DIGITAL MATERIAL

1. https://onlinecourses.swayam2.ac.in/cec24_cy02/preview
2. https://www.youtube.com/watch?v=LMSTMBX_2F4
3. <https://www.corrosion-doctors.org/>
4. <https://www.watertechonline.com/videos>

23BS1103B
BASIC ELECTRICAL & ELECTRONICS ENGINEERING

Course Category:	Engineering Science	Credits:	3
Course Type:	Theory	Lecture -Tutorial-Practice:	3 - 0 - 0
Prerequisites:	Basic Electrical and Electronics Engineering	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

COURSE OUTCOMES

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

CO1	Apply different techniques to solve DC circuits.
CO2	Understand the magnetic circuit concepts.
CO3	Analyze the steady-state response, series, parallel AC circuits, mesh & nodal analysis, and resonance.
CO4	Apply network theorems for AC & DC circuits.
CO5	Demonstrate the working principles of basic Electronic devices, circuits and instrumentation System .
CO6	Implementation of simple Combinational and Sequential circuits using Logic gates.

Contribution of Course Outcomes towards achievement of Program Outcomes
(L – Low, M - Medium, H – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	H											
CO2	H											
CO3	M											
CO4	M											
CO5	M		M									
CO6	M		M									

COURSE CONTENT

UNIT I DC & AC Circuits

DC Circuits: Electrical circuit elements (R, L and C), Ohm's Law and its limitations, KCL & KVL,

series, parallel, series-parallel circuits, Super Position theorem, Simple numerical problems.

AC Circuits: A.C. Fundamentals: Equation of AC Voltage and current, waveform, time period, frequency, amplitude, phase, phase difference, average value, RMS value, form factor, peak factor, Voltage and current relationship with phasor diagrams in R, L, and C circuits, Concept of Impedance, Active power, reactive power and apparent power, Concept of power factor (Simple Numerical problems).

Equipment Safety Measures: Working principle of Fuse and Miniature circuit breaker (MCB), merits and demerits. Personal safety measures: Electric Shock, Earthing phenomenon, Safety Precautions to avoid shock.

UNIT II Machines and Measuring Instruments

Machines: Construction, principle and operation of (i) DC Motor, (ii) DC Generator, (iii) Single Phase Transformer, (iv) Three Phase Induction Motor and (v) Alternator, Applications of electrical machines.

Measuring Instruments: Construction and working principle of Voltage, Current, temperature sensors, basic block diagram of multimeter.

Electricity bill: Power rating of household appliances including air conditioners, PCs, Laptops, Printers, etc. Definition of “unit” used for consumption of electrical energy, calculation of electricity bill for domestic consumers.

UNIT – III : SEMICONDUCTOR DEVICES

Introduction - Evolution of electronics – Vacuum tubes to nano electronics – Characteristics of PN Junction Diode — Zener Effect — Zener Diode and its Characteristics. Bipolar Junction Transistor — CB, CE, CC Configurations and Characteristics — Elementary Treatment of Small Signal CE Amplifier.

Rectifiers and power supplies: Block diagram description of a dc power supply, working of a full wave bridge rectifier, capacitor filter (no analysis), working of simple zener voltage regulator.

Amplifiers: Block diagram of Public Address system, Circuit diagram.

Electronic Instrumentation: Block diagram of an electronic instrumentation system.

UNIT – IV : DIGITAL ELECTRONICS

Overview of Number Systems, Logic gates including Universal Gates, BCD codes, Excess-3 code, Gray code, Hamming code. Boolean Algebra, Basic Theorems and properties of Boolean Algebra, Truth Tables and Functionality of Logic Gates – NOT, OR, AND, NOR, NAND, XOR and XNOR. Simple combinational circuits–Half and Full Adders. Introduction to Flip flops, Registers and counters (Elementary Treatment only)

TEXT BOOKS (for UNITS I & II)

1. Basic Electrical Engineering, D. P. Kothari and I. J. Nagrath, Mc Graw Hill, 2019, Fourth Edition
2. Principles of Power Systems, V.K. Mehtha, S.Chand Technical Publishers, 2020
3. Basic Electrical Engineering, T. K. Nagsarkar and M. S. Sukhija, Oxford University Press, 2017
4. Basic Electrical and Electronics Engineering, S. K. Bhattacharya, Person Publications, 2018, Second Edition.

REFERENCE BOOKS (for UNITS I & II)

1. Basic Electrical Engineering, D. P. Kothari and I. J. Nagrath, Mc Graw Hill, 2019, Fourth Edition
2. Principles of Power Systems, V.K. Mehtha, S.Chand Technical Publishers, 2020
3. Basic Electrical Engineering, T. K. Nagsarkar and M. S. Sukhija, Oxford University Press, 2017
4. Basic Electrical and Electronics Engineering, S. K. Bhattacharya, Person Publications, 2018, Second Edition.

E-RESOURCES AND OTHER DIGITAL MATERIAL (for UNITS I & II)

1. <https://nptel.ac.in/courses/108105053>
2. <https://nptel.ac.in/courses/10810807>

TEXT BOOKS (for UNITS III & IV)

- [1].R. L. Boylestad & Louis Nashlesky, Electronic Devices & Circuit Theory, Pearson Education, 2021.
- [2]. P. Jain, Modern Digital Electronics, 4th Edition, Tata Mc Graw Hill, 2009. Resnick, Halliday and Krane, “Physics”, 5th edition, Wiley India Pvt. Ltd, New Delhi, 2016.

REFERENCE BOOKS (for UNITS III & IV)

- [1]. R. S. Sedha, A Textbook of Electronic Devices and Circuits, S. Chand & Co, 2010.
- [2]. Santiram Kal, Basic Electronics- Devices, Circuits and IT Fundamentals, Prentice Hall, India, 2002.
- [3]. R. T. Paynter, Introductory Electronic Devices & Circuits – Conventional Flow Version, Pearson Education, 2009.

E-RESOURCES AND OTHER DIGITAL MATERIAL (for UNITS III & IV)

- [1] <https://embeddedengineers.files.wordpress.com/2015/09/electronic-devices-and-circuits-by-salivahanan.pdf>
- [2]. <http://www.nptelvideos.in/2012/12/basic-electronics-drchitralekha-mahanta.html>
- [3] https://en.wikipedia.org/wiki/Digital_electronics

23ES1104 INTRODUCTION TO PROGRAMMING

Course Category:	Engineering Science	Credits:	3
Course Type:	Theory	Lecture -Tutorial-Practice:	3 - 0 - 0
Prerequisites:	--	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

COURSE OUTCOMES

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

CO1	To introduce students to the fundamentals of computer programming.
CO2	To provide hands-on experience with coding and debugging on control structures and arrays.
CO3	To foster logical thinking and problem-solving skills on strings and pointers.
CO4	To familiarize students with programming concepts such as functions, structures and files.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	H				M							
CO2			H		M							
CO3			H		M							
CO4			H		M							

COURSE CONTENT

UNIT – I : Introduction to Programming and Problem Solving

History of Computers, Basic organization of a computer: ALU, input-output units, memory, program counter, Introduction to Programming Languages, Basics of a Computer Program- Algorithms, flowcharts (Using Dia Tool), pseudo code. Introduction to Compilation and Execution, Primitive Data Types, Variables, and Constants, Basic Input and Output, Operations, Type Conversion, and Casting.

Problem solving techniques: Algorithmic approach, characteristics of algorithm, Problem solving strategies: Top-down approach, Bottom-up approach, Time and space complexities of algorithms.

UNIT – II : Control Structures and Arrays

Simple sequential programs Conditional Statements (if, if-else, switch), Loops (for, while, do-while) Break and Continue, Arrays indexing, memory model, programs with array of integers, two dimensional arrays

UNIT – III : Strings and pointers

Introduction to Strings. Pointers, dereferencing and address operators, pointer and address arithmetic, array manipulation using pointers.

UNIT – IV : Functions, User Defined Data types and File Handling

Introduction to Functions, Function Declaration and Definition, Function call Return Types and Arguments, modifying parameters inside functions using pointers, arrays as parameters. Scope and Lifetime of Variables, User-defined data types-Structures and Unions, Basics of File Handling

TEXT BOOKS

- [1]. "The C Programming Language", Brian W. Kernighan and Dennis M. Ritchie, Prentice- Hall, 1988.
- [2]. Schaum's Outline of Programming with C, Byron S Gottfried, McGraw-Hill Education, 1996

REFERENCE BOOKS

- [1]. Computing fundamentals and C Programming, Balagurusamy, E., McGraw-Hill Education, 2008. W. H. Hayt and J. A. Buck, "Engineering Electromagnetics", 7th edition, Tata McGraw Hill, New Delhi, 2006
- [2]. Programming in C, Rema Theraja, Oxford, 2016, 2nd edition
- [3]. C Programming, A Problem Solving Approach, Forouzan, Gilberg, Prasad, CENGAGE, 3rd edition.

E-RESOURCES AND OTHER DIGITAL MATERIAL

- 1. <http://nptel.iitm.ac.in/video.php?subjectId=10810607>
- 2. <http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT-%20Guwahati/em/index.htm>
- 3. <http://www.mike-willis.com/Tutorial/PF2.htm>

23ES1105 ENGINEERING GRAPHICS

Course Category:	Engineering Science	Credits:	3
Course Type:	Theory & Practice	Lecture -Tutorial-Practice:	1 - 0 - 4
Prerequisites:	NIL	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

COURSE OUTCOMES

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

CO1	Understand the principles of engineering drawing, including engineering curves and scales.
CO2	Draw and interpret orthographic projections of points, lines and planes in front, top and side views.
CO3	Understand and draw projection of solids in various positions in first quadrant and Explain principles behind development of surfaces.
CO4	Explain principles behind the Sections of solids, Prepare isometric views and conversion of simple solids.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	H		H							H		
CO2	H		H							H		
CO3	M		M							M		
CO4	L		L							L		

COURSE CONTENT

UNIT I

Introduction: Lines, Lettering and Dimensioning, Geometrical Constructions of regular polygons by general methods.

Curves: Construction of ellipse, parabola and hyperbola by general method and Involute. Draw normal and tangent to Curves.

Scales: Plain scales and diagonal scales.

UNIT II

Orthographic Projections: Reference plane, importance of reference lines or Plane, **Projections of a point** situated in first quadrant only.

Projections of Straight Lines: Projections of straight lines parallel to both reference planes, perpendicular to one reference plane and parallel to other reference plane, inclined to one reference plane and parallel to the other reference plane. Projections of Straight Line Inclined to both the reference planes.

Projections of Planes: Regular planes Perpendicular to both reference planes, parallel to one reference plane and inclined to the other reference plane; plane inclined to both the reference planes.

UNIT III

Projections of Solids: Projections of solids(Prisms and Pyramids only) in simple positions: Axis perpendicular to horizontal plane, Axis perpendicular to vertical plane and Projection of Solids with axis inclined to one reference plane and parallel to another plane.

Development of Surfaces: Methods of Development: Parallel line development and radial line development. Development of a cube, prism, cylinder, pyramid and cone.

Computer graphics: Creating 2D & 3D drawings of objects including PCB and Transformations using Auto CAD (*Not for end examination*).

UNIT IV

Sections of Solids: Section planes perpendicular to VP and inclined to HP only, Sectional views (Front View and Top View only) and Sections of solids in simple position only.

Isometric Views: Draw an Isometric views of Simple solids

Conversion of Views: Conversion of isometric views to orthographic views of Simple solids.

TEXT BOOKS

1. N. D. Bhatt, Engineering Drawing, Charotar Publishing House, 2016.

REFERENCE BOOKS

1. Engineering Drawing, Basant Agrawal and C M Agrawal, Tata McGraw Hill, 2009.
2. Engineering Drawing, K.L. Narayana and P. Kanniah, Tata McGraw Hill, 2013.
3. Engineering Drawing, M.B.Shah and B.C. Rana, Pearson Education Inc, 2009.
4. Engineering Drawing with an Introduction to Auto CAD, Dhananjay Jolhe, Tata McGraw Hill, 2017.

23BS1151A ENGINEERING CHEMISTRY LAB

Course Category:	Basic Science	Credits:	1
Course Type:	Laboratory	Lecture -Tutorial-Practice:	0 - 0 - 2
Prerequisites:	Knowledge of chemistry practicals at Intermediate level	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

COURSE OUTCOMES

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

CO1	Analyze water samples and various commercial samples of acids, cement, coal, lubricants, etc. for their purity and quality.
CO2	Analyze samples of water and cement through various instrumental methods like colorimetry, and pH metry.
CO3	Apply standard procedures for preparation of nanomaterials, polymers and blueprinting, as well as study the adsorption process.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1				M								
CO2				M								
CO3				M								

COURSE CONTENT

List of Experiments

1. Determination of hardness of a groundwater sample
2. Determination of strength of an acid in Lead-acid battery
3. Determination of calcium in Portland cement
4. Determination of strength of a base using pH metric titration
5. Determination of percentage of iron in cement sample by colorimetry
6. Chemistry of blueprinting
7. Preparation of a polymer – Urea-formaldehyde resin

8. Preparation of nanomaterials by precipitation method
9. Adsorption of acetic acid by charcoal
10. Determination of percentage moisture content in a coal sample
11. Determination of viscosity of lubricating oil by Redwood viscometer
12. Determination of calorific value of gases by Junker's gas calorimeter

REFERENCE BOOKS

- [1]. "Vogel's quantitative chemical analysis", 6th Edition, by J. Mendham, R.C. Denney, J.D. Barnes and B. Sivasankar, Pearson Publications.

23ES1152
COMPUTER PROGRAMMING LAB

Course Category:	Engineering Science	Credits:	1.5
Course Type:	Lab	Lecture -Tutorial-Practice:	0 - 0 - 3
Prerequisites:		Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

COURSE OUTCOMES

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

CO1	Read, understand, and trace the execution of programs written in C language.
CO2	Select the right control structure for solving the problem.
CO3	Develop C programs which utilize memory efficiently using programming constructs like pointers.
CO4	Develop, Debug and Execute programs to demonstrate the applications of arrays, functions, basic concepts of pointers in C.

**Contribution of Course Outcomes towards achievement of Program Outcomes
(L – Low, M - Medium, H – High)**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	H	L			M							
CO2		M	H		M							
CO3	M	M	H		M							
CO4		M	H		M							

COURSE CONTENT

WEEK 1

Objective: Getting familiar with the programming environment on the computer and writing the first program.

Suggested Experiments/Activities:

Tutorial 1: Problem-solving using Computers.

Lab1: Familiarization with programming environment

i) Basic Linux environment and its editors like Vi, Vim & Emacs etc.

ii) Exposure to Turbo C, gcc

iii) Writing simple programs using printf(), scanf()

WEEK 2

Objective: Getting familiar with how to formally describe a solution to a problem in a series of finite steps both using textual notation and graphic notation.

Suggested Experiments /Activities:

Tutorial 2: Problem-solving using Algorithms and Flow charts.

Lab 1: Converting algorithms/flow charts into C Source code.

Developing the algorithms/flowcharts for the following sample programs

- i) Sum and average of 3 numbers
- ii) Conversion of Fahrenheit to Celsius and vice versa
- iii) Simple interest calculation

WEEK 3

Objective: Learn how to define variables with the desired data-type, initialize them with appropriate values and how arithmetic operators can be used with variables and constants.

Suggested Experiments/Activities:

Tutorial 3: Variable types and type conversions:

Lab 3: Simple computational problems using arithmetic expressions.

- i) Finding the square root of a given number
- ii) Finding compound interest
- iii) Area of a triangle using heron's formulae
- iv) Distance travelled by an object

UNIT II WEEK 4

Objective: Explore the full scope of expressions, type-compatibility of variables & constants and operators used in the expression and how operator precedence works.

Suggested Experiments/Activities:

Tutorial4: Operators and the precedence and as associativity:

Lab4: Simple computational problems using the operator' precedence and associativity

- i) Evaluate the following expressions.
 - a. $A+B*C+(D*E) + F*G$
 - b. $A/B*C-B+A*D/3$
 - c. $A+++B---A$
 - d. $J= (i++) + (++i)$
- ii) Find the maximum of three numbers using conditional operator
- iii) Take marks of 5 subjects in integers, and find the total, average in float

WEEK 5

Objective: Explore the full scope of different variants of “if construct” namely if-else, null- else, if-else if*-else, switch and nested-if including in what scenario each one of them can be used and how to use them. Explore all relational and logical operators while writing conditionals for “if construct”.

Suggested Experiments/Activities:

Tutorial 5: Branching and logical expressions:

Lab 5: Problems involving if-then-else structures.

- i) Write a C program to find the max and min of four numbers using if-else.
- ii) Write a C program to generate electricity bill.
- iii) Find the roots of the quadratic equation.
- iv) Write a C program to simulate a calculator using switch case.
- v) Write a C program to find the given year is a leap year or not.

WEEK 6

Objective: Explore the full scope of iterative constructs namely while loop, do-while loop and loop in addition to structured jump constructs like break and continue including when each of these statements is more appropriate to use.

Suggested Experiments/Activities:

Tutorial 6: Loops, while and for loops

Lab 6: Iterative problems e.g., the sum of series

- i) Find the factorial of given number using any loop.
- ii) Find the given number is a prime or not.
- iii) Compute sine and cos series
- iv) Checking a number palindrome
- v) Construct a pyramid of numbers.

UNIT III WEEK 7:

Objective: Explore the full scope of Arrays construct namely defining and initializing 1-D and 2-D and more generically n-D arrays and referencing individual array elements from the defined array. Using integer 1-D arrays, explore search solution linear search.

Suggested Experiments/Activities:

Tutorial 7: 1 D Arrays: searching.

Lab 7: 1D Array manipulation, linear search

- i) Find the min and max of a 1-D integer array.
- ii) Perform linear search on 1D array.
- iii) The reverse of a 1D integer array
- iv) Find 2's complement of the given binary number.
- v) Eliminate duplicate elements in an array.

WEEK 8:

Objective: Explore the difference between other arrays and character arrays that can be used as Strings by using null character and get comfortable with string by doing experiments that will reverse a string and concatenate two strings. Explore sorting solution bubble sort using integer arrays.

Suggested Experiments/Activities:

Tutorial 8: 2 D arrays, sorting and Strings.

Lab 8: Matrix problems, String operations, Bubble sort

- i) Addition of two matrices
- ii) Multiplication two matrices
- iii) Sort array elements using bubble sort
- iv) Concatenate two strings without built-in functions
- v) Reverse a string using built-in and without built-in string functions

UNIT IV WEEK 9:

Objective: Explore pointers to manage a dynamic array of integers, including memory allocation & value initialization, resizing changing and reordering the contents of an array memory de-allocation using malloc (), calloc (), realloc () and free () functions. Gain experience processing command-line arguments received by C

Suggested Experiments/Activities:

Tutorial 9: Pointers, structures and dynamic memory allocation

Lab 9: Pointers and structures, memory dereference.

- i) Write a C program to find the sum of a 1D array using malloc()
- ii) Write a C program to find the total, average of n students using structures
- iii) Enter n students data using calloc() and display failed students list
- iv) Read student name and marks from the command line and display the student details along with the total.
- v) Write a C program to implement realloc()

WEEK 10:

Objective: Experiment with C Structures, Unions, bit fields and self-referential structures (Singly linked lists) and nested structures

Suggested Experiments/Activities:

Tutorial 10: Bitfields, Self-Referential Structures, Linked lists

Lab10 : Bitfields, linked lists

Read and print a date using dd/mm/yyyy format using bit-fields and differentiate the same without using bit-fields

- i) Create and display a singly linked list using self-referential structure.
- ii) Demonstrate the differences between structures and unions using a C program.
- iii) Write a C program to shift/rotate using bitfields.
- iv) Write a C program to copy one structure variable to another structure of the same type.

UNIT V WEEK 11:

Objective: Explore the Functions, sub-routines, scope and extent of variables, doing some experiments by parameter passing using call by value. Basic methods of numerical integration

Suggested Experiments/Activities:

Tutorial 11: Functions, call by value, scope and extent,

Lab 11: Simple functions using call by value, solving differential equations using Eulers theorem.

- i) Write a C function to calculate NCR value.
- ii) Write a C function to find the length of a string.
- iii) Write a C function to transpose of a matrix.
- iv) Write a C function to demonstrate numerical integration of differential equations using Euler's method

WEEK 12:

Objective: Explore how recursive solutions can be programmed by writing recursive functions that can be invoked from the main by programming at-least five distinct problems that have naturally recursive solutions.

Suggested Experiments/Activities:

Tutorial 12: Recursion, the structure of recursive calls

Lab 12: Recursive functions

- i) Write a recursive function to generate Fibonacci series.
- ii) Write a recursive function to find the lcm of two numbers.
- iii) Write a recursive function to find the factorial of a number.
- iv) Write a C Program to implement Ackermann function using recursion.
- v) Write a recursive function to find the sum of series.

WEEK 13:

Objective: Explore the basic difference between normal and pointer variables, Arithmetic operations using pointers and passing variables to functions using pointers

Suggested Experiments/Activities:

Tutorial 13: Call by reference, dangling pointers

Lab 13: Simple functions using Call by reference, Dangling pointers.

- i) Write a C program to swap two numbers using call by reference.
- ii) Demonstrate Dangling pointer problem using a C program.
- iii) Write a C program to copy one string into another using pointer.
- iv) Write a C program to find no of lowercase, uppercase, digits and other characters using pointers.

WEEK14:

Objective: To understand data files and file handling with various file I/O functions. Explore the differences between text and binary files.

Suggested Experiments/Activities:

Tutorial 14: File handling

Lab 14: File operations

- i) Write a C program to write and read text into a file.
- ii) Write a C program to write and read text into a binary file using fread() and fwrite()
- iii) Copy the contents of one file to another file.
- iv) Write a C program to merge two files into the third file using command-line arguments.
- v) Find no. of lines, words and characters in a file
- vi) Write a C program to print last n characters of a given file.

TEXT BOOKS

- [1] Ajay Mittal, Programming in C: A practical approach, Pearson.
- [2] Byron Gottfried, Schaum's Outline of Programming with C, McGraw Hill

E-RESOURCES

- 1] Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice- Hall of India
- [2] C Programming, A Problem-Solving Approach, Forouzan, Gilberg, Prasad, CENGAGE

23ES1153
BASIC ELECTRICAL & ELECTRONICS WORKSHOP

Course Category:	Engineering Science	Credits:	1.5
Course Type:	Practice	Lecture-Tutorial-Practice:	0-0-3
Prerequisites:	Engineering Physics	Continuous Evaluation:	30M
		Semester End Evaluation:	70M
		Total Marks:	100M

Course outcomes

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

Part A: Electrical Lab

CO1	Measure voltage, current and power in an electrical circuit
CO2	Measure of Resistance using Wheat stone bridge.
CO3	Discover critical field resistance and critical speed of DC shunt generators
CO4	Investigate the effect of reactive power and power factor in electrical loads

**Contribution of Course Outcomes towards achievement of Program Outcomes
(L - Low, M - Medium, H - High)**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1			M	H										
CO2			M	H										
CO3			H	M										
CO4			H	M										

PART A: ELECTRICAL ENGINEERING LAB:

List of experiments:

1. Verification of KCL and KVL
2. Verification of Superposition theorem
3. Measurement of Resistance using Wheat stone bridge
4. Magnetization Characteristics of DC shunt Generator
5. Measurement of Power and Power factor using Single-phase wattmeter
6. Measurement of Earth Resistance using Megger.
7. Calculation of Electrical Energy for Domestic Premises.

PART B: ELECTRONICS ENGINEERING LAB

CO1	Identify & testing of various electronic components.
CO2	Understand the usage of electronic measuring instruments.

CO3 Plot and discuss the characteristics of various electron devices.

CO4 Explain the operation of a digital circuit.

**Contribution of Course Outcomes towards achievement of Program Outcomes
(L – Low, M – Medium, H – High)**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1			M	H										
CO2			M	H										
CO3			H	M										
CO4			H	M										

Course Content

PART B: ELECTRONICS ENGINEERING LAB:

List of Experiments:

1. Plot V-I characteristics of PN Junction diode A) Forward bias B) Reverse bias.
2. Plot V – I characteristics of Zener Diode and its application as voltage Regulator.
3. Implementation of half wave and full wave rectifiers
4. Plot Input & Output characteristics of BJT in CE and CB configurations
5. Frequency response of CE amplifier.
6. Simulation of RC coupled amplifier with the design supplied
7. Verification of Truth Table of AND, OR, NOT, NAND, NOR, Ex-OR, Ex-NOR gates using ICs.
8. Verification of Truth Tables of S-R, J-K& D flip flops using respective ICs.

Reference Books:

1. Basic Electrical Engineering, D. C. Kulshreshtha, Tata McGraw Hill, 2019, 1st edition
2. Power System Engineering, P.V. Gupta, M.L. Soni, U.S. Bhatnagar and A. Chakrabarti, Dhanpat Rai & Co, 2013
3. Fundamentals of Electrical Engineering, Rajendra Prasad, PHI publishers, 2014, 3rd edition.
4. R. L. Boylestad & Louis Nashlesky, Electronic Devices & Circuit Theory, Pearson Education, 2021.
5. R. P. Jain, Modern Digital Electronics, 4th Edition, Tata Mc Graw Hill, 2009
6. R. T. Paynter, Introductory Electronic Devices & Circuits – Conventional Flow Version, Pearson Education, 2009.

1. A minimum of 6 experiments from each Part- A and Part-B are to be completed.
2. Students are encouraged to do experiments with virtual labs.

23BS1154B
HEALTH AND WELLNESS, YOGA AND SPORTS

Course Category:	Basic Science	Credits:	0.5
Course Type:	Lab (Activity Based Course)	Lecture -Tutorial-Practice:	0 - 0 - 1
Prerequisites:	-	Continuous Evaluation: Max.Activities:6 Viva: Total Marks:	Activity based course 6 x 15 = 90 10 100

COURSE OBJECTIVES

The main objective of introducing this course is to make the students maintain their mental and physical wellness by balancing emotions in their life. It mainly enhances the essential traits required for the development of the personality.

COURSE OUTCOMES

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

CO1	Understand the importance of yoga and sports for Physical fitness and sound health
CO2	Demonstrate an understanding of health-related fitness components
CO3	Compare and contrast various activities that help enhance their health.
CO4	Assess current personal fitness levels.
CO5	Develop Positive Personality

COURSE CONTENT

UNIT – I :

Concept of health and fitness, Nutrition and Balanced diet, basic concept of immunity Relationship between diet and fitness, Globalization and its impact on health, Body Mass Index(BMI) of all age groups.

Activities:

- i) Organizing health awareness programmes in community
- ii) Preparation of health profile
- iii) Preparation of chart for balance diet for all age groups

UNIT II

Concept of yoga, need for and importance of yoga, origin and history of yoga in Indian context, classification of yoga, Physiological effects of Asanas- Pranayama and meditation, stress management and yoga, Mental health and yoga practice.

Activities:

Yoga practices – Asana, Kriya, Mudra, Bandha, Dhyana, Surya Namaskar

UNIT III

Concept of Sports and fitness, importance, fitness components, history of sports, Ancient and Modern Olympics, Asian games and Commonwealth games.

Activities:

- i) Participation in one major game and one individual sport viz., Athletics, Volleyball, Basketball, Handball, Football, Badminton, Kabaddi, Kho-kho, Table tennis, Cricket etc.
Practicing general and specific warm up, aerobics
- ii) Practicing cardiorespiratory fitness, treadmill, run test, 9 min walk, skipping and running.

REFERENCE BOOKS

- [1]. Gordon Edlin, Eric Golanty. Health and Wellness, 14th Edn. Jones & Bartlett Learning, 2022
- [2]. T.K.V.Desikachar. The Heart of Yoga: Developing a Personal Practice
- [3]. Archie J.Bahm. Yoga Sutras of Patanjali, Jain Publishing Company, 1993
- [4]. Wiseman, John Lofty, SAS Survival Handbook: The Ultimate Guide to Surviving Any where
Third Edition, William Morrow Paperbacks, 2014
- [5]. The Sports Rules Book/ Human Kinetics with Thomas Hanlon. -- 3rd ed. Human Kinetics, Inc. 2014

23BS2101
DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS

Course Category:	Basic Science	Credits:	3
Course Type:	Theory	Lecture -Tutorial-Practice:	3 - 0- 0
Prerequisites:	23BS1101 LinearAlgebra & Calculus	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

COURSE OUTCOMES

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

CO1	Solve first order linear differential equations
CO2	Solve higher order linear differential equations with constant coefficients
CO3	Solve Partial differential equations
CO4	Evaluate the work done against field, circulation and flux using vector calculus

Contribution of Course Outcomes towards achievement of Program Outcomes
(L – Low, M - Medium, H – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	H	M			L							
CO2	H	M			L							
CO3	H	M			L							
CO4	H	M			L							

COURSE CONTENT

UNIT I Differential equations of first order and first degree

Linear differential equations – Bernoulli's equations- Exact equations and equations reducible to exact form, Applications: Newton's Law of cooling – Law of natural growth and decay- Electrical circuits.

UNIT II Linear differential equations of higher order (Constant Coefficients)

Definitions, homogenous and non-homogenous, complimentary function, general solution, particular integral, Wronskian, Method of variation of parameters, Simultaneous linear equations, Applications to L-C-R Circuit problems and Simple Harmonic motion.

UNIT III Partial Differential Equations

Introduction and formation of Partial Differential Equations by elimination of arbitrary constants and arbitrary functions, solutions of first order linear equations using Lagrange's method, Homogeneous Linear Partial differential equations with constant coefficients.

UNIT IV Vector Calculus

Scalar and vector point functions, vector operator Del, Del applies to scalar point functions- Gradient, Directional derivative, del applied to vector point functions-Divergence and Curl, vector identities.

Line integral-circulation-work done, surface integral-flux, Green's theorem in the plane (without proof), Stoke's theorem (without proof), volume integral, Divergence theorem (without proof) and related problems.

TEXT BOOKS

[1]. Higher Engineering Mathematics, B. S. Grewal, Khanna Publishers, 2017, 44th Edition

REFERENCE BOOKS

[1]. Advanced Engineering Mathematics, Erwin Kreyszig, John Wiley & Sons, 2018, 10th Edition.

[2]. Thomas Calculus, George B. Thomas, Maurice D. Weir and Joel Hass, Pearson Publishers, 2018, 14th Edition.

[3]. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Alpha Science International Ltd., 2021 5th Edition(9th reprint).

[4]. Advanced Modern Engineering Mathematics, Glyn James, Pearson publishers, 2018, 5th Edition.

[5]. Advanced Engineering Mathematics, Micheael Greenberg, Pearson publishers, 9th Edition.

[6]. Higher Engineering Mathematics, H. K Das, Er. Rajnish Verma, S. Chand Publications, 2014, 3rd Edition (Reprint 2021).

E-RESOURCES AND OTHER DIGITAL MATERIAL

1]. Prof. Srinivas Rao Manam, IIT Madras, Differential equations for engineers[English], Available: https://onlinecourses.nptel.ac.in/noc22_ma72/preview

[2]. Prof. Jitendra Kumar , IIT Kharagpur, Engineering Mathematics – I[English], Available:https://onlinecourses.nptel.ac.in/noc20_ma37/preview

[3]. Prof. Jitendra Kumar , IIT Kharagpur, Engineering Mathematics – II[English], Available: https://onlinecourses.nptel.ac.in/noc22_ma08/preview

[4]. Prof. Jitendra Kumar & Prof. Somesh Kumar, IIT Kharagpur, Advanced Calculus For Engineers[English], Available:https://onlinecourses.nptel.ac.in/noc22_ma75/preview

[5]. Prof. Denis Auroux, Massachusetts Institute of Technology: MIT Open Courseware, Multivariable Calculus, Available:<https://ocw.mit.edu>.

23BS2102
ENGINEERING PHYSICS

Course Category:	Basic Science	Credits:	3
Course Type:	Theory	Lecture -Tutorial-Practice:	3 - 0 - 0
Prerequisites:		Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course Objectives:

To bridge the gap between the Physics in school at 10+2 level and UG level engineering courses by identifying the importance of the modern optical devices such as Lasers and optical fibers, enlightening the periodic arrangement of atoms in crystalline solids and concepts of quantum mechanics, introduce novel concepts of dielectric and magnetic materials, physics of semiconductors.

COURSE OUTCOMES

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

CO1	Elaborate different types of lasers, optical fibers and their applications.
CO2	Familiarize with the basics of crystals and their structures.
CO3	Summarize various types of polarization of dielectrics and classify the magnetic materials.
CO4	Explain the basic concepts of Quantum Mechanics and types of semiconductors using Hall Effect.

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 – Low, 2 - Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	H	L										
CO2	H	M										
CO3	H	L										
CO4	H	L										

COURSE CONTENT

UNIT I Lasers and Fiber Optics

(10 periods)

Lasers: Introduction, Characteristics of laser, Basic Principles of lasers (absorption, spontaneous emission and stimulated emission), Requirements of lasers (pumping, population inversion and cavity resonance), Einstein's coefficients, different types of lasers: solid-state lasers (Ruby), gas lasers, (He-Ne), Semiconductor laser, applications of lasers in science, engineering and medicine.

Fibre Optics: Introduction, Fundamentals of optic fibre, Propagation of light through optical fiber, Types of optical fibers, Numerical aperture, Fractional Refractive Index change, Fiber optics in communication and its advantages.

UNIT II Crystallography and X-ray diffraction

(10 periods)

Crystallography: Space lattice, Basis, Unit Cell and lattice parameters – Bravais Lattices – crystal systems (3D) – coordination number - packing fraction of SC, BCC & FCC - Miller indices – separation between successive (hkl) planes.

X-ray diffraction: Bragg's law - X-ray Diffractometer – crystal structure determination by Laue's and powder methods.

UNIT III Dielectric and Magnetic Materials

(12 periods)

Dielectric Materials: Introduction - Dielectric polarization - Dielectric polarizability, Susceptibility, Dielectric constant and Displacement Vector – Relation between the electric vectors - Types of polarizations- Electronic (Quantitative), Ionic (Quantitative) and Orientation polarizations (Qualitative) - Lorentz internal field - Clausius- Mossotti equation - Frequency dependence of polarization – complex dielectric constant (Qualitative) – dielectric loss (Qualitative).

Magnetic Materials: Introduction - Magnetic dipole moment - Magnetization-Magnetic susceptibility and permeability – Atomic origin of magnetism - Classification of magnetic materials: Dia, Para and Ferro magnetic materials - Domain concept for Ferromagnetism & Domain walls (Qualitative) - Hysteresis - soft and hard magnetic materials.

UNIT IV Quantum Mechanics and Semiconductors

(12 periods)

Quantum Mechanics: Dual nature of light, Matter waves, Properties and Debroglie's hypothesis, G.P.Thomson experiment, Heisenberg's Uncertainty Principle and its applications (Non existence of electron in nucleus) and properties of wave function – Schrodinger's time independent and dependent wave equations– Particle in a one-dimensional infinite potential well.

Semiconductors: Formation of energy bands – classification of crystalline solids - Intrinsic semiconductors- Fermi level-Extrinsic semiconductors-Fermi level - Drift and diffusion currents – Einstein's equation – Hall effect and its applications, Photodiode, Light Emitting Diode, Solar cell and its applications.

Textbooks:

1. A Text book of Engineering Physics, M. N. Avadhanulu, P.G.Kshirsagar & TVS Arun Murthy, S. Chand Publications, 11th Edition 2019.
2. Engineering Physics - D.K.Bhattacharya and Poonam Tandon, Oxford press (2015)

Reference Books:

1. Engineering Physics - B.K. Pandey and S. Chaturvedi, Cengage Learning 2021.
2. Engineering Physics - Shatendra Sharma, Jyotsna Sharma, Pearson Education, 2018.
3. Engineering Physics - Sanjay D. Jain, D. Sahasrabudhe and Girish, University Press. 2010
4. Engineering Physics - M.R. Srinivasan, New Age international publishers (2009).

Web Resources: <https://www.loc.gov/rr/scitech/selected-internet/physics.html>

23ES2103A
BASIC CIVIL & MECHANICAL ENGINEERING

Course Category:	Engineering Science	Credits:	3
Course Type:	Theory	Lecture -Tutorial-Practice:	3- 0 - 0
Prerequisites:	10 + 2	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

COURSE OUTCOMES

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

CO1	Understand various Civil Engineering sub-divisions thereby appreciate their role in ensuring a better society and understand the basic building components along with attaining knowledge of Civil Engineering Materials and prefabricated technology.
CO2	Know the basic concepts, uses and classification of surveying and realize the importance of Transportation in the nation's economy and the engineering measures related to Transportation and understand the importance of Water Storage and Conveyance Structures so that the social responsibilities of water conservation will be appreciated
CO3	Understand the scope of Mechanical Engineering in different sectors and industries and know about different manufacturing processes.
CO4	Explain the basics of thermal engineering, Power plants , power transmission and robotics.

Contribution of Course Outcomes towards achievement of Program Outcomes
(L – Low, M - Medium, H – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	M					H	M					
CO2	L					M	H					
CO3	M					M	H					
CO4	M					M	H					

COURSE CONTENT

UNIT I

Basics of Civil Engineering: Role of Civil Engineers in Society- Various Disciplines of Civil Engineering- Structural Engineering- Geo-technical Engineering- Transportation Engineering - Hydraulics and Water Resources Engineering - Environmental Engineering-Scope of each discipline - Building Construction and Planning- Construction Materials-Cement - Aggregate - Bricks- Cement concrete- Steel-Introduction to Prefabricated Construction Techniques

UNIT II

Surveying and Transportation Engineering: Objectives of Surveying- Principles of Surveying- Classification based on function and instruments, Importance of Transportation in Nation's Economic Development- Basics components of Road-Classification of Highways.

Water Resources and Environmental Engineering: Introduction, Sources of water- Quality of water- Specifications- Simple introduction to Dams and Reservoirs.

UNIT III

Introduction to Mechanical Engineering: Role of Mechanical Engineering in Industries and Society- Technologies in different sectors such as Energy, Manufacturing, Automotive, Aerospace, and Marine sectors. Engineering Materials - Metals-Ferrous and Non-ferrous, Ceramics, Composites, Smart materials. Manufacturing Processes: Principles of Casting, joining processes,

Machining, Introduction to CNC machines, 3D printing, and Smart manufacturing.

UNIT IV

Thermal Engineering: –IC engines, 2-Stroke and 4-Stroke engines, SI/CI Engines, Otto cycle, Diesel cycle, Components of Electric and Hybrid Vehicles., Refrigeration and air conditioning Working principle of Boilers: classification of Boilers Power plants – Working principle of Steam, Nuclear power plants. Mechanical Power Transmission - Belt and Gear Drives, Introduction to Robotics

TEXT BOOKS (for UNITS I & II)

- [1].Basic Civil Engineering, M.S.Palanisamy, , Tata Mcgraw Hill publications (India) Pvt. Ltd. Fourth Edition.
- [2].Introduction to Civil Engineering, S.S. Bhavikatti, New Age International Publishers. 2022. First Edition.
- [3].Basic Civil Engineering, Satheesh Gopi, Pearson Publications, 2009, First Edition.

REFERENCE BOOKS (for UNITS I & II)

- [1].Surveying, Vol- I and Vol-II, S.K. Duggal, Tata McGraw Hill Publishers 2019. Fifth Edition.
- [2].Hydrology and Water Resources Engineering, Santosh Kumar Garg, Khanna Publishers, Delhi. 2016
- [3].Irrigation Engineering and Hydraulic Structures - Santosh Kumar Garg, Khanna Publishers, Delhi 2023. 38th Edition.
- [4].Highway Engineering, S.K.Khanna, C.E.G. Justo and Veeraraghavan, Nemchand and Brothers Publications 2019. 10th Edition.
- [5].Indian Standard DRINKING WATER — SPECIFICATION IS 10500-2012
- [6].Advances in Civil Engineering (Volume - 5), S. Sathish, AkiNik Publications, 2021
- [7].Advances in Civil Engineering (Volume - 5), S. Sathish, AkiNik Publications, 2021.

E-RESOURCES AND OTHER DIGITAL MATERIAL (for UNITS I & II)

- 1. <http://nptel.iitm.ac.in/video.php?subjectId=10810607>
- 2. <http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT-%20Guwahati/em/index.htm>
- 3. <http://www.mike-willis.com/Tutorial/PF2.htm>

TEXT BOOKS (for UNITS III & IV)

- [1].Internal Combustion Engines by V.Ganesan, By Tata McGraw Hill publications (India) Pvt. Ltd.
- [2].A text book of Theory of Machines by S.S. Rattan, Tata McGraw Hill Publications, (India) Pvt. Ltd.
- [3].An introduction to Mechanical Engg by Jonathan Wicker and Kemper Lewis, Cengage learning India Pvt. Ltd.

REFERENCE BOOKS (for UNITS III & IV)

- [1].G. Shanmugam and M.S.Palanisamy, Basic Civil and the Mechanical Engineering, Tata McGraw Hill publications (India) Pvt. Ltd.
- [2].Thermal Engineering by Mahesh M Rathore Tata McGraw Hill publications (India) Pvt. Ltd.
- [3].3D printing & Additive Manufacturing Technology- L. Jyothish Kumar, Pulak M Pandey, Springer publications
- [4].Appuu Kuttan KK, Robotics, I.K. International Publishing House Pvt. Ltd. Volume-I

E-RESOURCES AND OTHER DIGITAL MATERIAL (for UNITS III & IV)

- 1. <https://www.scribd.com/document/680441639/Basic-Civil-and-Mechanical-Engineering>
- 2. <https://www.imeche.org/careers-education/careers-information/what-is-mechanical-engineering/where-do-mechanical-engineers-work>

23PC2104B ENGINEERING MECHANICS

Course Category:	Professional Core	Credits:	3
Course Type:	Theory	Lecture -Tutorial-Practice:	3 - 0 - 0
Prerequisites:	Basic Mathematics, Physics at (10 + 2) level	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

COURSE OUTCOMES

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

CO1	Analyze coplanar concurrent , parallel forces and evaluate centroid for plane figures
CO2	Analyze coplanar general case forces and evaluate moment of inertia for plane figures
CO3	Analyze rectilinear and curvilinear motion of particles
CO4	Evaluate the moment of inertia of material bodies and analyze the fixed axis rotation of rigid bodies.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	H	M	M									
CO2	H	M	M									
CO3	H	M	M									
CO4	H	M	M									

COURSE CONTENT

UNIT – I

Equilibrium of Systems of Concurrent Forces: Composition and resolution of forces – Constraint, Action and Reaction, Types of supports and support reactions, Free body diagram, Equilibrium of concurrent forces in a plane – Method of Projections, Method of moments.

Equilibrium of Systems of Parallel Forces: Introduction, Types of parallel forces, Resultant, Couple, Resolution of Force into force and a couple, General case of parallel forces in a plane.

Centroid: Centroids of standard figures, Centroids of Composite Figures.

UNIT – II

Friction: Introduction, limiting friction and impending motion, Coulomb's laws of dry friction, coefficient of friction, Cone of static friction, Numerical problems.

Coplanar General case of force system: Equilibrium of forces in plane-Analysis of plane trusses: Method of joints.

Area Moments of Inertia: Definition– Polar Moment of Inertia, Transfer Theorem, Moments of Inertia of Composite Figures

UNIT – III

Kinematics of Rectilinear motion: Displacement, Velocity and acceleration, Motion of Uniform and Variable acceleration.

Kinetics of Rectilinear motion: D'Alembert's Principle (**Other principles not included**)

Kinematics of Curvilinear motion: Rectangular components of velocity and acceleration, Normal and tangential acceleration, Motion of projectiles.

Kinetics of Curvilinear motion: D'Alembert's Principle. (**Theory only**)

UNIT – IV

Mass Moment of Inertia: Moment of Inertia of Masses, Transfer Formula for Mass Moments of Inertia, Mass moment of inertia of slender rod, Circular disc. Mass Moment of Inertia of 3D bodies– Cone, Solid cylinder & Sphere (**Derivations only**).

Rigid body Motion: Kinematics of rotation: Linear & angular velocity, Linear & angular acceleration in uniformly accelerated motion.

Kinetics of a rigid body in rotation of about a fixed axis: Equation of motion for a rigid body rotating about a fixed axis- Rotation under the action of constant moment.

Kinematics of Rigid body: Plane motion: Method of Instantaneous center of rotation (**Theory only**)

TEXT BOOKS

- [1]. Engineering Mechanics by S. Timoshenko & D. H. Young, 4th Edition, 2007, McGraw Hill International Edition. (For Concepts and symbolic Problems).
- [2]. Engineering Mechanics Statics and dynamics by A. K. Tayal, 13th Edition, 2006, Umesh Publication, Delhi, (For numerical Problems using S.I. System of Units).
- [3]. A Textbook of Engineering Mechanics, S.S Bhavikatti. New age international publications 2018

REFERENCE BOOKS

- [1] Engineering Mechanics, P.C.Dumir- S.Sengupta and Srinivas V Veeravalli , University press. 2020. First Edition.
- [2] Engineering Mechanics, Statics and Dynamics, I.H. Shames., PHI, 2002. 4th Edition.
- [3] Engineering Mechanics, Volume-I: Statics, Volume-II: Dynamics, J. L. Meriam and L. G. Kraige., John Wiley, 2008. 6th Edition

E-RESOURCES AND OTHER DIGITAL MATERIAL

- [1] <http://emweb.unl.edu/>
- [2] <https://nptel.ac.in/courses/122/104/122104015/>
- [3] Prof. U.S. Dixit, , IIT Guwahati, Engineering Mechanics [English], Web available: <https://nptel.ac.in/courses/112103109>
- [4] Prop. K.Ramesh, IIT Madras, Engineering Mechanics, , [English], Web available: <https://nptel.ac.in/courses/112106286>

23HS2105 COMMUNICATIVE ENGLISH

Course Category:	Basic Science	Credits:	3
Course Type:	Theory	Lecture -Tutorial-Practice:	3 - 0- 0
Prerequisites:	Basic understanding of the language skills viz Listening, Speaking, Reading and Writing, including Sentence construction abilities	Continuous Evaluation: Semester end Evaluation: Total Marks:	30 70 100

COURSE OUTCOMES

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

CO1	Understand the context, topic, and pieces of specific information from social or Transactional dialogues
CO2	Apply grammatical structures to formulate sentences and correct word forms.
CO3	Analyze discourse markers to speak clearly on a specific topic in informal discussions.
CO4	Evaluate reading texts / listening to write summaries based on global comprehension and create a coherent paragraph, essay and résumé

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1										H		M
CO2										H		M
CO3										H		M
CO4										H		M

COURSE CONTENT

UNIT I

Lesson: HUMAN VALUES: Gift of Magi (Short Story)

Listening: Identifying the topic, the context and specific pieces of information by listening to short audio texts and answering a series of questions.

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

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

Writing: Mechanics of Writing-Capitalization, Spellings, Punctuation-Parts of Sentences.

Grammar: Parts of Speech, Basic Sentence Structures-forming questions

Vocabulary: Synonyms, Antonyms, Affixes (Prefixes/Suffixes), Root words.

UNIT II

Lesson: NATURE: The Brook by Alfred Tennyson (Poem)

Listening: Answering a series of questions about main ideas and supporting ideas after listening to audio texts.

Speaking: Discussion in pairs/small groups on specific topics followed by short structured talks.

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

Writing: Structure of a paragraph - Paragraph writing (specific topics) **Grammar:** Cohesive devices - linkers, use of articles and zero article; prepositions. **Vocabulary:** Homonyms, Homophones, Homographs.

UNIT III

Lesson: BIOGRAPHY: Elon Musk

Listening: Listening for global comprehension and summarizing what is listened to.

Speaking: Discussing specific topics in pairs or small groups and reporting what is discussed

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

Writing: Summarizing, Note-making, paraphrasing, Essay Writing, (The Power of Intrapersonal Communication) **Grammar:** Verbs - tenses; subject-verb agreement; Compound words, Collocations

Vocabulary: Compound words, Collocations

UNIT IV

Lesson: INSPIRATION: The Toys of Peace by Saki

Listening: Making predictions while listening to conversations/ transactional dialogues without video; listening with video.

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

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

Writing: Letter Writing: Official Letters, Resumes & Report Writing

Grammar: Reporting verbs, Direct & Indirect speech, Active & Passive Voice

Vocabulary: Words often confused, Jargons & Technical Jargons

TEXT BOOKS

1. Pathfinder: Communicative English for Undergraduate Students, 1st Edition, Orient Black Swan, 2023 (Units 1,2 & 3)
2. Empowering with Language by Cengage Publications, 2023 (Units 4 & 5)

3. English: Language, Context and Culture, 1st Edition, Orient Black Swan, 2023 (Units 5)

REFERENCE BOOKS

1. Dubey, Sham Ji & Co. English for Engineers, Vikas Publishers, 2020
2. Bailey, Stephen. Academic writing: A Handbook for International Students. Routledge, 2014.
3. Murphy, Raymond. English Grammar in Use, Fourth Edition, Cambridge University Press, 2019.
4. Lewis, Norman. Word Power Made Easy- The Complete Handbook for Building a Superior Vocabulary. Anchor, 2014.

E-RESOURCES AND OTHER DIGITAL MATERIAL

Web Resources:

GRAMMAR:

1. www.bbc.co.uk/learningenglish
2. <https://dictionary.cambridge.org/grammar/british-grammar/>
3. www.eslpod.com/index.html
4. <https://www.learngrammar.net/>
5. <https://english4today.com/english-grammar-online-with-quizzes/>
6. <https://www.talkenglish.com/grammar/grammar.aspx>

VOCABULARY

1. <https://www.youtube.com/c/DailyVideoVocabulary/videos>
2. https://www.youtube.com/channel/UC4cmBAit8i_NJZE8qK8sfpA

23BS2151
ENGINEERING PHYSICS LAB

Course Category:	Basic Science	Credits:	1
Course Type:	Lab	Lecture -Tutorial-Practice:	0 - 0 - 2
Prerequisites:		Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

COURSE OUTCOMES

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

CO1	Test optical components using principles of interference and diffraction of light
CO2	Use spectrometer, travelling microscope and function generator in various experiments
CO3	Determine the V-I characteristics of photo cells and appreciate the accuracy in measurements

Contribution of Course Outcomes towards achievement of Program Outcomes
(L – Low, M - Medium, H – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1				H								
CO2				H	M							
CO3	M			H								

COURSE CONTENT

1. Determination of radius of curvature of a given Plano-convex lens by Newton's rings.
2. Study the variation of B versus H by magnetizing the magnetic material (B-H curve).
3. Determination of wavelength of Laser light using diffraction grating.
4. Estimation of stopping potential and work function of a photo material using photoelectric effect.
5. Magnetic field along the axis of a current carrying circular coil by Stewart Gee's Method.
6. Determination of Hall voltage and Hall coefficient of a given semiconductor using Hall Effect.
7. Determination of Acceleration due to Gravity and radius of Gyration by using a compound pendulum.
8. Sonometer: Verification of laws of stretched string.
9. Determination of Dielectric constant of different solid materials.

10. Determination of Numerical Aperture of a given optical fiber.
11. Determination of Frequency of electrically maintained tuning fork by Melde's experiment.
12. Determination of Rigidity Modulus of the material of the given wire using Torsional pendulum.
13. Determination of wavelengths of different spectral lines in mercury spectrum using diffraction grating in normal incidence configuration.
14. Determination of Energy Gap of a semiconductor using p-n junction diode.
15. Determination of thickness of a thin foil by Wedge Method.
16. Estimation of Fill Factor of a given Solar Cell.
17. Study the frequency response and determination of resonating frequency of LCR Circuit.
18. Determination of Figure of merit of a Galvanometer.

Note: Any TEN of the listed experiments are to be conducted. Out of which any TWO experiments may be conducted in virtual mode.

TEXT BOOKS

- [1] Madhusudhan Rao, "Engineering Physics Lab Manual", Ist ed., Scitech Publications, 2015
- [2] Ramarao Sri, Choudary Nityanand and Prasad Daruka, "Lab Manual of Engineering Physics", Vth ed., Excell Books, 2010

E-RESOURCES

- [1] <http://plato.stanford.edu/entries/physics-experiment>
- [2] <http://www.physicsclassroom.com/The-Laboratory>
- [3] <http://facstaff.cbu.edu/~jvarrian/physlabs.html>

VIRTUAL LAB REFERENCES

- [1] <http://vlab.amrita.edu/?sub=1&brch=201&sim=366&cnt=1>
- [2] <http://vlab.amrita.edu/?sub=1&brch=195&sim=840&cnt=1>
- [3] <http://vlab.amrita.edu/?sub=1&brch=282&sim=879&cnt=1>

23PC2152E ENGINEERING MECHANICS LAB

Course Category:	Professional Core	Credits:	1.5
Course Type:	Theory	Lecture -Tutorial-Practice:	0 - 0 - 3
Prerequisites:	10 + 2 level Physics	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

COURSE OUTCOMES

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

CO1	Evaluate the coefficient of friction between two different surfaces and between the inclined plane and the roller.
CO2	Verify Law of Polygon of forces and Law of Moment using force polygon and bell crank lever.
CO3	Determine the Centre of gravity and Moment of Inertia of different configurations. CO4: Verify the equilibrium conditions of a rigid body under the action of different force systems.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	H	M										
CO2	H	M										
CO3	H											

COURSE CONTENT:

1. Verification of Law of Parallelogram of Forces.
2. Verification of Law of Triangle of Forces.
3. Verification of the Law of polygon for coplanar-concurrent forces acting on a particle in equilibrium and to find the value of unknown forces considering particle to be in equilibrium using universal force table.
4. Determination of coefficient of Static and Rolling Frictions
5. Determination of Centre of Gravity of different shaped Plane Lamina.
6. Verification of the conditions of equilibrium of a rigid body under the action of coplanar non-concurrent, parallel force system with the help of a simply supported beam.
7. Study of the systems of pulleys and draw the free body diagram of the system.

8. Determine the acceleration due to gravity using a compound pendulum.
9. Determine the Moment of Inertia of the compound pendulum about an axis perpendicular to the plane of oscillation and passing through its centre of mass.
10. Determine the Moment of Inertia of a Flywheel.
11. Verification of Law of Moment using Rotation Disc Apparatus and Bell Crank Lever.

REFERENCE BOOKS

- [1]. S. Timoshenko, D. H. Young, J.V. Rao, S. Pati., Engineering Mechanics, 5th Edition, McGraw Hill Education.
- [2]. Hibbeler R.C., Engineering Mechanics: Statics and Dynamics, 14th Edition, Pearson Education, Inc., New Delhi, 2022

23HS2153 COMMUNICATIVE ENGLISH LAB

Course Category:	Basic Science	Credits:	1
Course Type:	Practical	Lecture -Tutorial-Practice:	0 - 0 - 2
Prerequisites:	Basic understanding of the language skills viz Listening, Speaking, Reading and Writing, including Sentence construction abilities	Continuous Evaluation: Semester end Evaluation: Total Marks:	30 70 100

COURSE OUTCOMES

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

CO1	Understand the different aspects of the English language proficiency with emphasis on LSRW skills.
CO2	Apply communication skills through various language learning activities.
CO3	Analyze the English speech sounds, stress, rhythm, intonation and syllable division for better listening and speaking comprehension.
CO4	Evaluate and exhibit professionalism in participating in debates and group discussions.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1		M								H		M
CO2										H		M
CO3										H		M
CO4										H		M

COURSE CONTENT

List of Topics

1. Vowels and Consonants
2. Neutralization/Accent Rules
3. Communication Skills & JAM
4. Role Play or Conversational Practice
5. E-mail Writing

6. Resume Writing, Cover Letter, SOP
7. Group Discussions-methods & practice
8. Debates – Methods & Practice
9. PPT Presentations/Poster Presentations
10. Interview Skills

SUGGESTED SOFTWARE

1. WALDEN
2. SOFTX
3. VISIONET

23ES2154 ENGINEERING WORKSHOP

Course Category:	Engineering Science	Credits:	1.5
Course Type:	Laboratory	Lecture -Tutorial-Practice:	0 - 0 - 3
Prerequisites:		Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

COURSE OUTCOMES

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

CO1	Understand the basic joints using wood and familiarize with various fundamental aspects of house wiring, fitting and foundry.
CO2	Prepare basic models using sheet metal and practice joining of metals using various types of welding.
CO3	Familiarize with various advanced manufacturing processes such as injection moulding and 3D printing.
CO4	Understand the preparation of PCB and simple IOT applications using Arduino

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1			M		H							
CO2			M		H							
CO3			M		H							
CO4			M		L							

COURSE CONTENT

PART-A

- Demonstration:** Safety practices and precautions to be observed in workshop.
- Wood Working:** Familiarity with different types of woods and tools used in wood working and make following joints.
 - Half – Lap joint
 - Bridle joint
 - Demonstration of power tools. **(2 classes)**
- Sheet Metal Working:** Familiarity with different types of tools used in sheet metal working,

developmentsof following sheet metal job from GI sheets.

a) Tapered tray b) Conical funnel **(2 classes)**

4. **Fitting:** Familiarity with different types of tools used in fitting and do the following fitting exercises.

a) V-fit b) Semi-circular fit c) Bicycle tire puncture and change of two-wheeler tyre **(2 classes)**

5. **Electrical Wiring:** Familiarity with different types of basic electrical circuits and make the following connections.

a) Parallel and series b) Two-way switch c) Godown lighting d) Tube light **(1 class)**

6. **Foundry Trade:** Demonstration and practice on Moulding tools and processes, Preparation of Green Sandmoulds for given Patterns. **(1 class)**

7. **Welding Shop:** Demonstration and practice on Arc Welding and Gas welding. Preparation of Lap joint and Butt joint. **(1 class)**

8. **Advanced manufacturing processes:** Demonstration of injection moulding and 3 D printing processes.**(1 class)**

9. **Electronic Circuits:** Demonstration of preparation of simple electronic circuit (PCB) and testing its operation. **(1 class)**

10. **Basic IOT:** Demonstration of different components & pin configuration of Arduino board

a) Measure Temperature & Humidity b) Measure Distance **(1 class)**

PART-B

GROUP ACTIVITY (2 classes)

- Students must prepare a Working model / Assembly using the knowledge gained from the above trades.

TEXT BOOKS

[1] Basic Workshop Technology: Manufacturing Process, Felix W.; Independently Published,2019.
Workshop Processes, Practices and Materials; Bruce J. Black, Routledge publishers, 5th Edn. 2015.

[2] A Course in Workshop Technology Vol I. & II, B.S. Raghuwanshi, DhanpathRai& Co., 2015 & 2017.

REFERENCE BOOKS

[1] Elements of Workshop Technology, Vol. I by S. K. Hajra Choudhury & Others, Media Promoters and Publishers, Mumbai. 2007, 14th edition.

[2] Workshop Practice by H. S. Bawa, Tata-McGraw Hill, 2004.

[3] Wiring Estimating, Costing and Contracting; Soni P.M. & Upadhyay P.A.; AtulPrakashan, 2021-22.

E-RESOURCES AND OTHER DIGITAL MATERIAL

1. <https://dsceme.files.wordpress.com/2016/08/workshop-practice-manual-2016-17-1.pdf>
2. <https://www.protosystech.com/rapid-prototyping.htm>
3. <https://www.arduino.cc/en/Tutorial/Foundations> 4. <https://www.tutorialspoint.com/arduino/>

23ES2155 IT WORKSHOP

Course Category:	Engineering Science	Credits:	1
Course Type:	Lab	Lecture -Tutorial-Practice:	0 - 0 - 2
Prerequisites:		Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

COURSE OBJECTIVES

- To introduce the internal parts of a computer, peripherals, I/O ports, connecting cables
- To demonstrate configuring the system as Dual boot both Windows and other Operating Systems Viz. Linux, BOSS
- To teach basic command line interface commands on Linux.
- To teach the usage of Internet for productivity and self-paced life-long learning
- To introduce Compression, Multimedia and Antivirus tools and Office Tools such as Word processors, Spread sheets and Presentation tools.

COURSE OUTCOMES

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

CO1	Perform Hardware troubleshooting.
CO2	Understand Hardware components and inter dependencies.
CO3	Safeguard computer systems from viruses/worms
CO4	Document/ Presentation preparation.
CO5	Perform calculations using spreadsheets.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	L	L										
CO2	M	L										
CO3	L	L										
CO4	L	L										

COURSE CONTENT

PC Hardware & Software Installation

Task 1: Identify the peripherals of a computer, components in a CPU and its functions. Draw the block diagram of the CPU along with the configuration of each peripheral and submit to your instructor.

Task 2: Every student should disassemble and assemble the PC back to working condition. Lab instructors

should verify the work and follow it up with a Viva. Also students need to go through the video which shows the process of assembling a PC. A video would be given as part of the course content.

Task 3: Every student should individually install MS windows on the personal computer. Lab instructor should verify the installation and follow it up with a Viva.

Task 4: Every student should install Linux on the computer. This computer should have windows installed. The system should be configured as dual boot (VMWare) with both Windows and Linux. Lab instructors should verify the installation and follow it up with a Viva

Task 5: Every student should install BOSS on the computer. The system should be configured as dual boot (VMWare) with both Windows and BOSS. Lab instructors should verify the installation and follow it up with a Viva

Internet & World Wide Web

Task1: Orientation & Connectivity Boot Camp: Students should get connected to their Local Area Network and access the Internet. In the process they configure the TCP/IP setting. Finally students should demonstrate, to the instructor, how to access the websites and email.

If there is no internet connectivity preparations need to be made by the instructors to simulate the WWW on the LAN.

Task 2: Web Browsers, Surfing the Web: Students customize their web browsers with the LAN proxy settings, bookmarks, search toolbars and pop up blockers. Also, plug-ins like Macromedia Flash and JRE for applets should be configured.

Task 3: Search Engines & Netiquette: Students should know what search engines are and how to use the search engines. A few topics would be given to the students for which they need to search on Google. This should be demonstrated to the instructors by the student.

Task 4: Cyber Hygiene: Students would be exposed to the various threats on the internet and would be asked to configure their computer to be safe on the internet. They need to customize their browsers to block pop ups, block active x downloads to avoid viruses and/or worms.

LaTeX and WORD

Task 1 – Word Orientation: The mentor needs to give an overview of La TeX and Microsoft (MS) office or equivalent (FOSS) tool word: Importance of La TeX and MS office or equivalent (FOSS) tool Word as word Processors, Details of the four tasks and features that would be covered in each, Using La TeXand word – Accessing, overview of toolbars, saving files, Using help and resources, rulers, format painter in word.

Task 2: Using La TeX and Word to create a project certificate. Features to be covered:- Formatting Fonts in word, Drop Cap in word, Applying Text effects, Using Character Spacing, Borders and Colors, Inserting Header and Footer, Using Date and Time option in both La TeX and Word.

Task 3: Creating project abstract Features to be covered:-Formatting Styles, Inserting table, Bullets and Numbering, Changing Text Direction, Cell alignment, Footnote, Hyperlink, Symbols, Spell Check, Track Changes.

Task 4: Creating a Newsletter: Features to be covered:- Table of Content, Newspaper columns, Images from files and clipart, Drawing toolbar and Word Art, Formatting Images, Textboxes, Paragraphs and Mail Merge in word.

EXCEL

Excel Orientation: The mentor needs to tell the importance of MS office or equivalent (FOSS) tool Excel as a Spreadsheet tool, give the details of the four tasks and features that would be covered in each. Using Excel – Accessing, overview of toolbars, saving excel files, Using help and resources.

Task 1: Creating a Scheduler - Features to be covered: Gridlines, Format Cells, Summation, auto fill, Formatting Text

Task 2: Calculating GPA -. Features to be covered:- Cell Referencing, Formulae in excel – average, std. deviation, Charts, Renaming and Inserting worksheets, Hyper linking, Count function.

LOOKUP/VLOOKUP

Task 3: Split cells, freeze panes, group and outline, Sorting, Boolean and logical operators, Conditional formatting

POWER POINT

Task 1: Students will be working on basic power point utilities and tools which help them create basic power point presentations. PPT Orientation, Slide Layouts, Inserting Text, Word Art, Formatting Text, Bullets and Numbering, Auto Shapes, Lines and Arrows in PowerPoint.

Task 2: Interactive presentations - Hyperlinks, Inserting –Images, Clip Art, Audio, Video, Objects, Tables and Charts.

Task 3: Master Layouts (slide, template, and notes), Types of views (basic, presentation, slide slotter, notes etc), and Inserting – Background, textures, Design Templates, Hidden slides.

AI TOOLS – ChatGPT

Task 1: Prompt Engineering: Experiment with different types of prompts to see how the model responds. Try asking questions, starting conversations, or even providing incomplete sentences to see how the model completes them.

- Ex: Prompt: "You are a knowledgeable AI. Please answer the following question:What is the capital of France?"

Task 2: Creative Writing: Use the model as a writing assistant. Provide the beginning of a story or a description of a scene, and let the model generate the rest of the content. This can be a fun way to brainstorm creative ideas

- Ex: Prompt: "In a world where gravity suddenly stopped working, people started floating upwards. Write a story about how society adapted to this new reality."

Task 3: Language Translation: Experiment with translation tasks by providing a sentence in one language and asking the model to translate it into another language. Compare the output to see how accurate and fluent the translations are.

- Ex:Prompt: "Translate the following English sentence to French: 'Hello, how are you doing today?'"

REFERENCE BOOKS

- [1]. Comdex Information Technology course tool kit, Vikas Gupta, WILEY Dream tech, 2003
- [2]. The Complete Computer upgrade and repair book, Cheryl A Schmidt, WILEY Dream tech,2013, 3rd edition

- [3]. Introduction to Information Technology, ITL Education Solutions limited, Pearson Education, 2012, 2nd edition
- [4]. PC Hardware - A Handbook, Kate J. Chase, PHI (Microsoft)
- [5]. LaTeX Companion, Leslie Lamport, PHI/Pearson.
- [6]. IT Essentials PC Hardware and Software Companion Guide, David Anfins on and Ken Quamme. – CISCO Press, Pearson Education, 3rd edition
- [7]. IT Essentials PC Hardware and Software Labs and Study Guide, Patrick Regan– CISCO Press, Pearson Education, 3rd edition

23BS2156
NSS/NCC/ COMMUNITY SERVICE

Course Category:	Basic Science	Credits:	0.5
Course Type:	Lab (Activity Based Course)	Lecture -Tutorial-Practice:	0 - 0 - 1
Prerequisites:	-	Continuous Evaluation: Max.Activities:6 Viva: Total Marks:	Activity based course 6 x 15 = 90 10 100

COURSE OBJECTIVES

The objective of introducing this course is to impart discipline, character, fraternity, teamwork, social consciousness among the students and engaging them in selfless service.

COURSE OUTCOMES

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

CO1	Understand the importance of discipline, character and service motto.
CO2	Solve some societal issues by applying acquired knowledge, facts, and techniques.
CO3	Explore human relationships by analyzing social problems.
CO4	Determine to extend their help for the fellow beings and downtrodden people.
CO5	Develop leadership skills and civic responsibilities.

Contribution of Course Outcomes towards achievement of Program Outcomes
(L – Low, M - Medium, H – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1								M	L			
CO2								M	L			
CO3								M	L			
CO4								M	L			
CO5								M	L			

COURSE CONTENT

UNIT I Orientation

General Orientation on NSS/NCC/ Scouts & Guides/Community Service activities, careerguidance.

Activities:

- i) Conducting – ice breaking sessions - expectations from the course-knowing personal talents and skills
- ii) Conducting orientations programs for the students –future plans-activities-releasing road map etc.
- iii) Displaying success stories-motivational biopics- award winning movies on societal issues etc.
- iv) Conducting talent show in singing patriotic songs-paintings- any other contribution.

UNIT II Nature & Care Activities:

- i) Best out of waste competition.
- ii) Poster and signs making competition to spread environmental awareness.
- iii) Recycling and environmental pollution article writing competition.
- iv) Organising Zero-waste day.
- v) Digital Environmental awareness activity via various social media platforms.
- vi) Virtual demonstration of different eco-friendly approaches for sustainable living.
- vii) Write a summary on any book related to environmental issues.

UNIT III Community Service Activities:

- i) Conducting One Day Special Camp in a village contacting village-area leaders- Survey in the village, identification of problems- helping them to solve via media- authorities-experts-etc.
- ii) Conducting awareness programs on Health-related issues such as General Health, Mental health, Spiritual Health, HIV/AIDS,
- iii) Conducting consumer Awareness. Explaining various legal provisions etc.
- iv) Women Empowerment Programmes- Sexual Abuse, Adolescent Health and Population Education.
- v) Any other programmes in collaboration with local charities, NGOs etc.

REFERENCE BOOKS

1. Nirmalya Kumar Sinha & Surajit Majumder, *A Text Book of National Service Scheme* Vol.;I, Vidya Kutir Publication, 2021 (ISBN 978-81-952368-8-6)
2. *Red Book - National Cadet Corps* – Standing Instructions Vol I & II, Directorate General of NCC, Ministry of Defence, New Delhi
3. Davis M. L. and Cornwell D. A., “Introduction to Environmental Engineering”, McGraw Hill, New York 4/e 2008
4. Masters G. M., Joseph K. and Nagendran R. “Introduction to Environmental Engineering and Science”, Pearson Education, New Delhi. 2/e 2007
5. Ram Ahuja. *Social Problems in India*, Rawat Publications, New Delhi.

SECOND YEAR

23BS3101E

MATHEMATICS FOR MECHANICAL ENGINEERS

Course Category:	Basic Sciences & Humanities	Credits:	3
Course Type:	Theory	Lecture -Tutorial-Practice:	3 - 0 - 0
Prerequisites:	23BS1101-Linear Algebra and Calculus 23BS2101- Differential equations & Vector Calculus	Continuous Evaluation: Semester end Evaluation: Total Marks:	30 70 100

COURSE OUTCOMES

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

CO1	Determine analytic, non-analytic functions and evaluate complex integrals
CO2	Analyze Taylor, Laurent series and apply residue theorem for computing real definite integrals.
CO3	Solve Algebraic and transcendental, system of equations and interpret the concept of polynomial interpolation
CO4	Find the probabilities using distributions and to estimate correlation, regression coefficients

Contribution of Course Outcomes towards achievement of Program Outcomes (L-Low, M-Medium, H- High)

	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
CO1	H	M		L									L	L
CO2	H	M		L									L	M
CO3	H	M		L	L								M	M
CO4	H	M		M	L								M	M

COURSE CONTENT**UNIT I****COMPLEX ANALYSIS:**

Introduction, Continuity, Cauchy-Riemann equations, Analytic functions, Harmonic functions, Orthogonal systems, Applications to flow problems, Complex integration, Cauchy's integral theorem, Cauchy's integral formula

UNIT II

Taylor's series, Laurent's series, Zeros and Singularities of an analytic function, Residue theorem, Calculation of Residues, Evaluation of real definite integrals: (i) Integration around the unit circle (ii) Integration around a small semi-circle, Bilinear transformation.

UNIT III**NUMERICAL METHODS:**

Solution of Algebraic and Transcendental equations with Newton - Raphson method, Solution of Simultaneous linear equations with Gauss - Seidel iterative method

INTERPOLATION: Introduction, Finite Differences-Forward, Backward and Central differences, Symbolic Relations, Newton's interpolation formulae-forward and backward differences, Central difference interpolation formulae-Gauss's formulae, Interpolation with unequal intervals - Lagrange's and Newton's divided difference formulae.

UNIT IV

PROBABILITY DENSITIES: Continuous random variables – Normal distribution.

SAMPLING DISTRIBUTIONS: Populations and Samples – Sampling distribution of the mean (SD known) – Sampling distribution of the mean (SD unknown) – Sampling distribution of the variance.

STATISTICS: Method of Least Squares – Correlation – Regression.

TEXT BOOKS

- [1] B. S. Grewal, "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, 2019.
- [2] Richard A. Johnson, "Probability and Statistics for Engineers", 8th Edition, Prentice Hall of India, 2011.

REFERENCE BOOKS

- [1] Erwin Kreyzig, "Advanced Engineering Mathematics", 10th Edition, John Wiley & Sons, 2015.
- [2] R. K. Jain, S. R. K. Iyengar, "Advanced Engineering Mathematics", 5th Edition, Narosa Publishers, 2016.
- [3] N. P. Bali, Manish Goyal, "A Text book of Engineering Mathematics", 9th Edition, Lakshmi Publications (P) Limited, 2016.
- [4] H. K. Das, Er. Rajnish Verma, "Higher Engineering Mathematics", 3rd Revised Edition, S. Chand & Co., 2014.
- [5] Rukmangadachari E, "Probability and Statistics", Pearson, 2012

E-RESOURCES AND OTHER DIGITAL MATERIAL

- [1] Prof. Pranav Haridas, Kerala School of Mathematics, Complex Analysis, [English],
Web Available: https://onlinecourses.nptel.ac.in/noc21_ma39/preview
- [2] Prof. Ameeya Kumar Nayak, Prof. Sanjeev Kumar, IIT Roorkee, Numerical methods, [English],
Web Available: https://onlinecourses.nptel.ac.in/noc21_ma45/preview
- [3] Jeremy Orloff, Massachusetts Institute of Technology: MIT OpenCourseWare, Complex Variables with Applications, [English], Web Available: <https://ocw.mit.edu>.
- [4] Henrik Schmidt, Massachusetts Institute of Technology: MIT OpenCourseWare, Introduction to Numerical Analysis for Engineering, [English], Web Available: <https://ocw.mit.edu>.
- [5] Prof. A. Kannan, IIT Madras, Statistics for Experimentalists, [English],
Web Available: <https://freevidelectures.com/course/3467/statistics-for-experimentalists/2>

23HS3102

UNIVERSAL HUMAN VALUES 2- UNDERSTANDING HARMONY

Course Category: Basic Sciences & Humanities

Course Type : Mandatory course

Prerequisites : -

Credits: 3

Lecture/Tutorial/Practice: 2/1/0

Continuous Evaluation: 30

Semester end Evaluation: 70

COURSE OUTCOMES

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

CO1	Understand and aware of themselves and their surroundings (family, society and nature).
CO2	Handle problems with sustainable solutions, while keeping human relationships and human nature in mind.
CO3	Exhibit critical ability and become sensitive to their commitment towards their understanding of human values, human relationship and human society.
CO4	Apply what they have learnt to their own self in different day-to-day settings in real life.

Contribution of Course Outcomes towards achievement of Program Outcomes (L-Low, M-Medium, H- High)

	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
CO1						L								
CO2						L								
CO3						L								
CO4						L								

Course Content: UNIT – I:

Course introduction, need, basic guidelines, content and process for value education:

Part-1: Purpose and motivation for the course, recapitulation from UHV-I, Self-exploration: what is it?, its content and process, 'Natural acceptance' and experiential validation- as the process for self-exploration. Continuous Happiness and Prosperity – A look at basic Human Aspirations.

Part-2: Right understanding, Relationship and Physical Facility – the basic requirements for fulfillment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly – A critical appraisal of the current scenario, Method to fulfill the above human aspirations: understanding and living in harmony at various levels. (Practice sessions are to be included to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence)

rather than as arbitrariness in choice based on liking-disliking).

UNIT – II: Understanding Harmony in the Human Being – Harmony in Myself:

Part-1: Understanding human being as a co-existence of the sentient 'I' and the material 'Body'. Understanding the needs of Self ('I') and 'Body' – happiness and physical facility, Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer).

Part-2: Understanding the characteristics and activities of 'I' and harmony in 'I'. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Health.

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

UNIT – III: Understanding Harmony in the Family and Society – Harmony in Human- Human Relationship:

Part-1: Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfillment to ensure mutual happiness; Trust and Respect as the foundational values of relationship, Understanding the meaning of Trust; Difference between intention and competence, Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship.

Part-2: Understanding the harmony in the society (society being an extension of family); Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals, Visualizing a universal harmonious order in society–Undivided Society, Universal Order–from family to world family.

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

UNIT – IV:

Part-1: Understanding Harmony in Nature & Existence – Whole existence as Coexistence:

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

Part-2: Implications of the above Holistic Understanding of Harmony on Professional Ethics:

Natural acceptance of human values, Definitiveness of ethical human conduct, Basis for humanistic education, humanistic constitution and humanistic universal order, Competence in professional ethics: a) ability to utilize the professional competence for augmenting universal human order, b) ability to identify the scope and characteristics of people-friendly and eco- friendly production systems, c) ability to identify and develop appropriate technologies and management patterns for above production systems, Case studies of typical holistic technologies, management models and production systems, Strategy for transition from the present state to Universal Human Order: a) at the level of individual: as

socially and ecologically responsible engineers, technologists and managers, b) at the level of society: as mutually enriching institutions and organizations.

(Part-1: Practice sessions are to be included to discuss human being as cause of imbalance in nature (film “Home” can be used), pollution, depletion of resources and role of technology, etc. Part-2: Practice exercises and case studies are to be taken up in practice (tutorial) sessions eg. to discuss the conduct as an engineer or scientist, etc.)

Text Book:

1. Human values and professional ethics, R. R. Gaur, R. Sangal and G. P. Bagaria, Excel Books Private Limited, New Delhi (2010).

Reference books:

1. Jeevan Vidya: Ek Parichaya, A. Nagaraj, Jeevan Vidya Prakashan, Amarkantak (1999).
2. Human Values, A. N. Tripathi, New Age International Publishers, New Delhi (2004).
3. The Story of Stuff: The impact of overconsumption on the planet, our communities, and our health and how we can make it better, Annie Leonard, Free Press, New York (2010).
4. The story of my experiments with truth: Mahatma Gandhi Autobiography, Mohandas Karamchand Gandhi, B. N. Publishing (2008).
5. Small is beautiful: A study of economics as if people mattered, E. F. Schumacher, Vintage Books, London (1993).
6. Slow is beautiful: New Visions of Community, Cecile Andrews, New Society Publishers, Canada (2006).
7. Economy of Permanence, J. C. Kumarappa, Sarva-Seva-Sangh Prakashan, Varanasi (2017).
8. Bharat Mein Angreji Raj, Pandit Sunderlal, Prabhath Prakashan, Delhi (2018).
9. Rediscovering India, Dharampal, Society for Integrated Development of Himilayas (2003).
10. Hind Swaraj or Indian Home Rule, M. K. Gandhi, Navajivan Publishing House, Ahmedabad (1909).
11. India Wins Freedom: The Complete Version, Maulana Abul Kalam Azad, Orient Blackswan (1988).
12. The Life of Vivekananda and the Universal gospel, Romain Rolland, Advaita Ashrama, India (2010).
13. Mahatma Gandhi: The Man who become one with the Universal Being, Romain Rolland, Srishti Publishers & Distributors, New Delhi (2002).

E-RESOURCES:

- AICTE – SIP Youtube Channel:
https://www.youtube.com/channel/UCo8MpJB_aaVwB4LWLAx6AhQ
- AICTE – UHV Teaching Learning Material:
<https://fdp-si.aicte-india.org/download.php#1>

23ES3103 G BASIC THERMODYNAMICS

Course Category:	Engineering Science	Credits:	3
Course Type:	Theory	Lecture -Tutorial-Practice:	3 - 0 - 0
Prerequisites:	23BS2102 Engineering Physics	Continuous Evaluation: Semester end Evaluation: Total Marks:	30 70 100

COURSE OUTCOMES

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

CO1	Illustrate the basic concepts of thermodynamics and can distinguish work and heat forms of energy													
CO2	Apply first of law of thermodynamics to flow and non-flow processes and thermodynamic systems													
CO3	Apply the second law of thermodynamics to systems and understand the concept of entropy, exergy and irreversibility													
CO4	Evaluate the properties of steam, gas mixtures and analyse steam and air cycles													
	Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)													
	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
CO1	H	M	L										M	
CO2	M	H	H										M	
CO3	M	H	H										M	
CO4	M	H	M										M	

COURSE CONTENT

UNIT I

FUNDAMENTAL CONCEPTS AND DEFINITIONS: Thermodynamic system, type of systems Macroscopic and microscopic points of view, properties and state of a substance, Thermodynamic equilibrium and Quasistatic Process, thermodynamic path, cycle, Zerothlaw of thermodynamics, Temperatures scales

WORK AND HEAT: Ideal gas equation, equation of state, Work transfer, pdV-work and heat transfer in various Quasistatic processes, flow work, path function and point function, heat transfer-A path function, comparison of heat and work.

UNIT II

FIRST LAW FOR NON-FLOW SYSTEMS: Joule Experiment in establishing First law of thermodynamics, First law of thermodynamics for a system undergoing a cycle and for a change in state of system, Energy –a property of a system, internal energy and enthalpy, constant volume and constant pressure specific heats and their relation to internal energy and enthalpy of ideal gases.

FIRST LAW FOR FLOW SYSTEMS: Control mass and control volume, first law of thermodynamics for a control volume, steady flow energy equation and application to engineering equipment.

UNIT III

SECOND LAW OF THERMODYNAMICS: Cyclic heat engines and Refrigerators, Kelvin Planks and Clausius statements, Equivalence of Kelvin Planks and Clausius statements, Carnot cycle, Carnot theorem and its corollary, absolute thermodynamic temperature scale, efficiency of reversible heat engine and COP of reversed heat engine, Causes of irreversibility, Concept of Exergy and irreversibility (Theory).

ENTROPY: Clausius Theorem, property of entropy, Inequality of Clausius, Entropy change in irreversible process, Entropy principle, Problems on Entropy change and entropy generation in system during change of state, T-ds relations.

UNIT IV

PROPERTIES OF GAS MIXTURES: Properties of mixture of gases-Dalton's law of Partial Pressures, Internal Energy, enthalpy and specific heats of gas mixtures and Entropy of gas mixtures

PURE SUBSTANCES: P-v, P-T, T-s and h-s diagrams for a pure substance, Triple point, Critical point, Dryness fraction, Steam tables, problems using steam tables and Mollier chart.

VAPOUR AND AIR POWER CYCLES: Ideal Rankine cycle, Otto cycle, Diesel cycle, Dual cycle

TEXT BOOKS

- [1] P. K. Nag, "Engineering Thermodynamics" 6th edition, Tata Mc Graw Hill Education Private Limited, 2017.
- [2] Mahesh M. Rathore, Thermal Engineering, Tata McGraw-Hill Education, 2010
- [3] G.J. Van Wylen & Sonntag, "Fundamentals of Classical Thermodynamics", 4th Edition, Wiley publication 2005

REFERENCE BOOKS

- [1] Yunus A. Cengel M. and Michael A. Boles, "Thermodynamics – An Engineering Approach", 8th edition, McGrawHill Education (India) Private Limited, 2014.
- [2] R.K. Rajput, Thermal Engineering, Lakshmi Publications Limited, 2020

E-RESOURCES AND OTHER DIGITAL MATERIAL

- [1] www.learnthermo.com/tutorials.php
- [2] www.khanacademy.org/science/physics/thermodynamics
- [3] www.courseera.org/learn/thermodynamics-intro
- [4] www.edx.org/course/thermodynamics-iitbombayx-me209-1x-1
- [5] <http://nptel.ac.in/courses/112106141>
- [6] <http://nptel.ac.in/courses/112108148>

Note: *Steam tables are permitted in internal and external examinations*

23ME3304
MECHANICS OF MATERIALS

Course Category:	Professional Core	Credits:	3
Course Type:	Theory	Lecture -Tutorial-Practice:	3 - 0 - 0
Prerequisites:	23PC2104B Engineering Mechanics	Continuous Evaluation: Semester end Evaluation: Total Marks:	30 70 100

COURSE OUTCOMES

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

CO1	Estimate the stresses and strains in structural members subjected to axial loading and analyse the members subjected to torsion.
CO2	Construct Shear force and Bending moment diagrams for determinate beams and analyse the members subjected to bending.
CO3	Evaluate the deflections of determinate beams and safe load on columns.
CO4	Solve plane stress problems and calculate the stresses in thin cylindrical and spherical vessels.

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO I	PSO II
CO1	H	M	L											M
CO2	M	H	L											M
CO3	M	H	L											M
CO4	M	H	L											M

(L-Low, M-Medium, H-High)

UNIT - I

TENSION, COMPRESSION AND SHEAR : Introduction, Concepts of Normal Stress and Strain, Stress-Strain Diagrams, Elasticity and Plasticity, Linear Elasticity and Hooke's Law, Poisson's Ratio, Shear Stress and Strain, Allowable Stresses and Allowable Loads. Numerical problems on Change in length of axially loaded members, Change in length for a tapered bar under axial loading.

TORSION: Introduction, Torsional deformations of Circular Bar, Circular bars of linearly elastic materials, Transmission of power by circular shafts.

UNIT - II

STATICALLY DETERMINATE BEAMS: Introduction, Types of Beams, Loads and Reactions, Shear Force and Bending Moments, Relationships between Load, Shear Force and Bending Moment, Shear Force and Bending Moment Diagrams.

BENDING STRESSES IN STATICALLY DETERMINATE BEAMS: Introduction, Pure bending, Bending stress Equation, Design of beams for bending stresses

UNIT – III

DEFLECTIONS OF STATICALLY DETERMINATE BEAMS: Introduction, Differential Equations of the Deflection Curve, Deflections by Integration of the Bending Moment Equation, Macaulay's Method.

COLUMNS: Introduction, Buckling and Stability, Columns with Pinned ends, Columns with other support conditions, Limitations of Euler's Formula, Rankine's Formula.

UNIT – IV

ANALYSIS OF PLANE STRESS: Introduction, Plane Stress, Principal Stresses and Maximum Shear Stress. Mohr's Circle for Plane Stress.

THIN CYLINDRICAL AND SPHERICAL PRESSURE VESSELS:

Introduction, Stresses in thin cylindrical and spherical pressure vessels subjected to internal pressure. Effect of internal pressure on the dimensions of the thin cylindrical and spherical pressure vessels.

Text Books:

- [1] James M. Gere and Barry J. Goodno, "Mechanics of Materials", Eighth edition, CENGAGE Learning, 2013
- [2] R.K. Bansal, "Strength of Materials" Sixth edition, Laxmi Publishers, 2017

Reference books:

- [1] Dr. Sadhu Singh, "Strength of Materials", Ninth edition, Khanna Publishers, 2007.
- [2] R.K. Rajput, "Strength of Materials", First Edition, S. Chand & Company, 2006.
- [3] S.S. Rattan, "Strength of Materials", Third Edition, Tata McGraw Hill Education Private Limited, 2017.

E-resources and other digital material:

- [1] Prof. M.S. Sivakumar, IIT Madras, Strength of material, [English], Web
Available: <http://nptel.ac.in/courses/112106141/>
- [2] Dr. Satish C Sharma, IIT Roorkee, Strength of material, [English], Web
Available: <http://nptel.ac.in/courses/112107146/>
- [3] Dr. S. P. Harsha, IIT Roorkee, Strength of material, [English], Video
Available: <http://nptel.ac.in/courses/112107147/>

23ME3305

KINEMATICS OF MACHINES

Course Category:	Professional Core	Credits:	3
Course Type:	Theory	Lecture -Tutorial-Practice:	3 - 0 - 0
Prerequisites:	23PC2104B Engineering Mechanics 23ES1105 Engg. Graphics	Continuous Evaluation: Semester end Evaluation: Total Marks:	30 70 100

COURSE OUTCOMES

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

CO1	Distinguish different Mechanisms and determine velocity of links using Instantaneous Centre Method.
CO2	Evaluate velocity and acceleration of various links in a Mechanism
CO3	Apply the analytical techniques for Synthesis of Mechanisms & Develop cam profiles
CO4	Illustrate the concepts of toothed gearing and gear trains

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO I	PSO II
CO 1	M	M	M											L
CO 2	M	H	M											L
CO 3	M	M	H											M
CO 4	M	H	H											M

(L-Low, M-Medium, H-High)

UNIT-I : INTRODUCTION : Mechanisms and machines, Rigid and resistant bodies, Link, Kinematic pair, Types of joints, Constrained motions, Degrees of Freedom, Mobility - Kutzbach criterion -Gruebler's equation - Grashoff's law, Classifications of Kinematic pairs, kinematic-chain, Linkage, mechanism and structure, Classification of mechanisms, Inversions of Mechanism- Four - bar chain, Single Slider - Crank Chain, Double – Slider Crank Chain.

INSTANTANEOUS CENTRE: Notation, Number of Instantaneous centres, Kennedy's theorem, Locating Instantaneous centres, Angular velocity by Instantaneous centre Method for simple mechanisms (Four bar and Slider - Crank Mechanism).

UNIT-II : VELOCITY AND ACCELERATION ANALYSIS: Introduction, Absolute and Relative Motion, Vectors, Addition and subtraction of Vectors, Motion of a Link, Velocity and Acceleration, Angular velocity and Angular acceleration of Links: Four bar Mechanism, Velocity and Acceleration of Intermediate and offset points. Velocity and acceleration of Slider - Crank Mechanism, Coriolis acceleration of Crank and Slotted Lever Mechanism.

UNIT-III : KINEMATIC SYNTHESIS : Stages of synthesis-Concepts of type, Number and dimensional synthesis - Tasks of dimensional synthesis, Concepts of function generation, Rigid body guidance and path generation, Freudenstein equation for function generation using three precision points for four bar mechanism. (3 precision points only).

CAMS: Introduction, Classification of cams and followers, Terminology and definitions, Displacement diagrams – Uniform velocity, simple harmonic and uniform acceleration motions, Graphical synthesis of cam profile limited to reciprocating, radial & offset follower. (Knife Edge and Roller Followers).

UNIT-IV: GEARS: Introduction, Classification of gears, Gear terminology, Law of Gearing, Velocity of Sliding, Forms of Teeth- Cycloidal Profile Teeth, Involute Profile Teeth, Comparison of Cycloidal and Involute tooth forms. Path of contact, Arc of contact, Number of pairs of Teeth in contact, Concept of Interference in Involute Gears. Minimum number of Teeth in Involute Gears,

GEAR TRAINS: Introduction, simple Gear Train, Compound Gear Train, Reverted Gear train, Planetary or Epicyclic Gear Train, Analysis of Epicyclic Gear Train using Tabular method only.

Text Books:

[1] S.S.Rattan, Theory of Machines, 4th Edition, 2014, TMH.

[2] Amitabha Ghosh and Asok Kumar Mallik, Theory of Mechanisms and Machines, 3rd Edition, 2006
East West Press

Reference Books:

[1] C S Sharma and Kamlesh Purohit, Theory of Mechanisms and Machines, Prentice Hall of India.

[2] Dr. R. K. Bansal & Dr. J. S. Brar, Theory of Machines 4th Edition, 2009, Lakshmi publications

[3] Robert L.Norton, Design of Machinery, 6rd Edition, 2019, McGraw-Hill Education.

Additional Resources:

[1] http://nptel.iitg.ernet.in/Mech_Engg/IIT%20Delhi/Kinematics%20of%20Machines.htm

[2] <http://freevidelectures.com/Course/2359/Kinematics-of-Machines>

[3] <http://www.rapidmaniac.com/search/relevant/All/solution-manual-kinematics-and-dynamics-ofmachines>

23TP3106 LOGIC & REASONING

Course Category:	Soft skills -I	Credits:	1
Course Type:	Learning by Doing	Lecture -Tutorial-Practice:	0- 0 - 2
Prerequisites:		Continuous Evaluation:	100
		Semester end Evaluation:	0
		Total Marks:	100

COURSE OUTCOMES

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

CO1	Think reason logically in any critical situation
CO2	Analyze given information to find correct solution
CO3	To reduce the mistakes in day to day activities in practical life
CO4	Develop time management skills by approaching different shortcut methods
CO5	Use mathematical based reasoning to make decisions
CO6	Apply logical thinking to solve problems and puzzles in qualifying exams for companies and in other competitive exams

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	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
CO1						M								
CO2		M												
CO3								M						
CO4									M					
CO5	M													
CO6	L													

COURSE CONTENT**UNIT I :**

1. Series Completion,
2. Coding-Decoding,
3. Blood Relation,
4. Puzzles test

UNIT II:

1. Direction sense test,
2. Logical Venn diagrams,
3. Number test, ranking test,
4. Mathematical operations

UNIT III:

1. Arithmetical Reasoning,
2. Inserting missing character,
3. Syllogism.
4. Binary logic.
5. Data sufficiency

UNIT IV: Non – Verbal:

1. Water images,
2. Mirror images,
3. Paper folding,
4. Paper cutting,
5. Embedded Figures,
6. Dot situation,
7. Cubes & Dice

TEXT BOOKS

1. R. S. Aggarwal, “ Verbal and non-verbal reasoning”, Revised Edition, S Chand publication, 2017 ISBN:81-219-0551-6,
2. Reasoning Guru Verbal & Non-Verbal Reasoning by Vikramjeeth, Multilingual Edition-2023. ISBN :978-9358706000

23MC3107
ENVIRONMENTAL SCIENCE

Course Category:	Audit Course	Credits:	-
Course Type:	Theory	Lecture -Tutorial-Practice:	2 – 0 - 0
Prerequisites:	Consciousness of Environment	Continuous Evaluation: Semester end Evaluation: Total Marks:	46+46+3+5 --- 100

Course Outcomes

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

CO1	Identify various factors causing degradation of natural resource and control measures [K3]
CO2	Identify various ecosystems and need for biodiversity[K3]
CO3	Interpret the problems related to environmental pollution and its Management [K2]
CO4	Apply the information and technology to analyze social issues [K3]

**Contribution of Course Outcomes towards achievement of Program Outcomes
(L-Low, Medium-M, H- High)**

	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
CO1	L							L					L	
CO2		L	L							L			L	
CO3				L	L							L	L	
CO4						L	L	L					L	

Course Content

UNIT I

The Multidisciplinary Nature of Environmental Studies Definition, scope and importance Need for public awareness.

Natural Resources :

Renewable and Non-renewable Resources: Natural resources and associated problems.

(a) Forest resources: Use and over-exploitation, deforestation. Timber extraction, mining, dams and their effects on forests and tribal people.

(b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.

(c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources.

(d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity.

(e) Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources.

(f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.

UNIT II

Ecosystems

Concept of an ecosystem. Structure and function of an ecosystem. Producers, consumers and decomposers. Energy flow in the ecosystem. Ecological succession. Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the following ecosystem: (a) Forest ecosystem (b) Grassland ecosystem (c) Desert ecosystem

(d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Biodiversity and Its Conservation

Introduction, definition: genetic, species and ecosystem diversity. Biogeographically 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.

UNIT III

Environmental Pollution

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

Solid waste management: Causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution.

Disaster management: Floods, earthquake, cyclone and landslides.

UNIT IV

Social Issues and the Environment:

From unsustainable to sustainable development. Urban problems related to energy.

Water conservation, rain water harvesting, watershed management. Resettlement and rehabilitation of people; its problems and concerns.

Environmental ethics Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Wasteland reclamation. Consumerism and waste products.

Environment Protection Act

Air (Prevention and Control of Pollution) Act. Water (Prevention and Control of Pollution) Act. Wildlife Protection Act. Forest Conservation Act. Issues involved in enforcement of environmental legislation.

Public awareness

Human Population and the Environment, Population growth, variation among nations, Population explosion—Family Welfare Programme.

Environment and human health

Human rights, Value education, HIV/AIDS, Women and Child Welfare, Role of Information Technology in environment and human health.

Field Work/ Case Studies

Visit to a local area to document environmental assets—river/forest/grassland/hill/ mountain. Visit to a local polluted site—Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds. Study of simple ecosystems—pond, river, hill slopes, etc.

Self-Study

Water resources, Threats to biodiversity, Solid waste management, Role of Information Technology in environment and human health.

Text books and Reference books

Text Book(s):

- [1]. Erach Bharucha. 2004, Environmental Studies for undergraduate courses, University Grants Commission, New Delhi, Bharati Vidyapeeth Institute of Environment Education and Research.

REFERENCE BOOKS:

- [1]. Anjaneyulu Y. Introduction to Environmental sciences, B S Publications PVT Ltd, Hyderabad
- [2]. Anjireddy. M Environmental science & Technology, BS Publications PVT Ltd, Hyderabad.
- [3]. Benny Joseph, 2005, Environmental Studies, The Tata McGraw- Hill publishing company limited, New Delhi.
- [4]. Principles of Environmental Science. & Engg. P. Venu Gopala Rao, 2006, Prentice-Hall of India Pvt. Ltd., New Delhi.

- [5]. Ecological and Environmental Studies – Santosh Kumar Garg, RajeswariGarg (or) RajaniGarg, 2006, Khanna Publishers, New Delhi.
- [6]. Essentials of Environmental Studies, Kurian Joseph & R Nagendran, Pearson Education publishers, 2005.
- [7]. A.K Dee – Environmental Chemistry, New Age India Publications.
- [8]. BharuchaErach- Biodiversity of India, Mapin Publishing Pvt.Ltd..

E-RESOURCES AND OTHER DIGITAL MATERIAL

- [1]. ErachBharucha. 2004, Environmental Studies for undergraduate courses, University Grants Commission, New Delhi, BharatiVidyapeeth Institute of Environment Education and Research.<https://www.ugc.ac.in/oldpdf/modelcurriculum/env.pdf>
- [2]. NPTEL Courses - Environmental Studies By Dr.Tushar Banerjee | Devi AhilyaViswavidyalaya, Indore.

23ME3651 PROGRAMMABLE LOGIC CONTROLLERS LAB

Course Category:	Skill oriented course	Credits:	1
Course Type:	Lab	Lecture -Tutorial-Practice:	0 – 0 - 2
Prerequisites:	Nil	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

COURSE OUTCOMES

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

CO1	Demonstrate knowledge of basic ladder logic instructions like timers, counters etc. used to program PLCs.
CO2	Apply PLC ladder programming for simple industrial processes.
CO3	Analyze the performance of PLC based systems.
CO4	Make use of various vendors PLCs to perform experiments as individual or team

**Contribution of Course Outcomes towards achievement of Program Outcomes
(L – Low, M - Medium, H – High)**

	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
CO1	H		M		M									M
CO2	H		M		M									M
CO3	H		M		M									M
CO4	H		M		M									M

COURSE CONTENT

List of experiments:

1. Implementation of logic gates using PLC ladder diagram (LD)
2. Implementation of timers using PLC
3. Implementation of counters using PLC
4. Positive and negative edge detection in PLC
5. Level control using PLC
6. Pressure control using PLC
7. Temperature control using PLC

8. Motor speed control using PLC
9. Automation of material handling system using PLC
10. Automatic pneumatic stamping machine using PLC
11. Automatic drilling system using PLC
12. Elevator control using PLC

23ME3352

SOLID MODELLING LABORATORY

Course Category:	Professional Core	Credits:	1.5
Course Type:	Laboratory	Lecture -Tutorial-Practice:	0 - 0- 3
Prerequisites:	23ES1105 Engineering Graphics	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

COURSE OUTCOMES

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

CO1	Construct 2D sketches in a modelling software
CO2	Develop part models of machine components
CO3	Combine part models of machine components for assembly
CO4	Translate geometric models to other file formats.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	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
CO1			M		H									H
CO2			M		H									H
CO3			M		H									H
CO4			M		H									H

COURSE CONTENT

Lab Exercises:

1. Construction of 2D sketches.
2. Modelling of simple machine components.
3. Assembly of Machine components.
4. Orthographic views of the assembled components.
5. Solid modelling of real components
6. Exporting the files to other file formats
7. Group assignment topic
 - i. Part drawing & Assembly of Screw jack
 - ii. Part drawing & Assembly of Stuffing Box

- iii. Part drawing of Marine engine connecting rod end
- iv. Part drawing & Assembly of Single tool post
- v. Part drawing & Assembly of Socket and spigot joint
- vi. Part drawing & Assembly of Foot-step bearing
- vii. Develop various types of GI pipe fittings
- viii. Develop double strap diamond butt joint

TEXT BOOKS

- [1] Pro/Engineer Wildfire 5.0 by Roger Toogood, Jack Zecher, SDC Publications.
- [2] Machine Drawing by K.L Narayana, P.Kannaiah, K.Venkata Reddy, Publisher: New Age International

REFERENCE BOOKS

- [1] Parametric Modeling with Pro/ENGINEER Wildfire 5.0
- [2] Parametric Modeling with Creo Parametric 1.0

E-RESOURCES AND OTHER DIGITAL MATERIAL

- [1] <http://www.proetutorials.com/>
- [2] http://learningexchange.ptc.com/tutorials/by_sub_product/ptc-creo-elements-pro-pro-engineer/sub_product_id:1
- [3] <http://www.eng-tips.com/viewthread.cfm?qid=48209>
- [4] <https://catiautor.com/>
- [5] www.v5train.com

NPTEL Video references:

- [1] <https://www.youtube.com/watch?v=c2VtgkfZ2BQ>
- [2] https://www.youtube.com/watch?v=hjgGxl4Yk_M
- [3] <https://www.youtube.com/watch?v=xsKtzWBZ5FY>
- [4] <https://www.youtube.com/watch?v=rIFeKNzm4gE>
- [5] <https://www.youtube.com/watch?v=uCdypjnnKto>
- [6] https://www.youtube.com/watch?v=YIzwA_Wlj_M

23ME3353 COMPUTATIONAL METHODS LABORATORY

Course Category:	Professional Core	Credits:	1.5
Course Type:	Laboratory	Lecture -Tutorial-Practice:	0 -0- 3
Prerequisites:	23BS2101 Differential Equations & Vector Calculus 23PC2104B Engineering Mechanics	Continuous Evaluation: Semester end Evaluation: Total Marks:	30 70 100

COURSE OUTCOMES

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

CO1	Illustrate basic commands in MATLAB and perform matrix Operations
CO2	Evaluate linear equations, Numerical integration and ODE using FDM
CO3	Intercept Engineering Mechanics and Strength of Materials Problems
CO4	Solve Thermal Engineering Problems

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	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
CO1	H												H	
CO2	H	M											H	
CO3	L	H			H								H	
CO4	L	H		M	H								H	

COURSE CONTENT

List of Experiments:

1. Basic MATLAB Commands, functions and plot commands
2. Scalars, vectors and Matrix Operations
3. Solution of System of Linear Equations
4. Numerical Integration and Differentiation
5. Solution of ODE problem using FDM Method
6. Solution to simple Engineering Mechanics Problem

7. Solution to simple Vibration Problem
8. Solution to simple Strength of Materials Problem
9. Solution to simple Thermodynamics Problem
10. Solution to simple Fluid Dynamics Problem
11. Solution to simple Heat Transfer Problem

TEXT BOOKS & REFERENCE BOOKS

- [1] Solving Mechanical Engineering Problems with MATLAB, 2nd Edition, Simin Nasser, Linus Learning (2022)
- [2] MATLAB programming by Y.Kirani Singh & B.B. Chaudhuri. PHI Publications (2010).
- [3] Getting started with MATLAB -a quick reference for scientists & engineers by Rudra Pratap. Oxford University Press (2009).
- [4] An introduction to programming and numerical methods in MATLAB by S.R. Otto, J.P. Denier. Springer Publications (2007)
- [5] Ordinary and Partial Differential Equation Routines in C, C++, FORTRAN, Java, Maple, and MATLAB by H.J. Lee, W.E. Schiesser.
- [6] Graphics and GUIs with MATLAB, Third Edition (Graphics & GUIs with MATLAB) 3rd Edition by O. Thomas Holland, Patrick Marchand.

E-RESOURCES AND OTHER DIGITAL MATERIAL

- [1] <http://www.math.ucsd.edu/~bdriver/21d-s99/matlab-primer.html>
- [2] http://www.mathworks.in/academia/student_center/tutorials/launchpad.html
- [3] <http://www.cyclismo.org/tutorial/matlab/>
- [4] http://www.mathworks.com/matlabcentral/fileexchange?s_cid=wiki_matlab_17
- [5] http://www.youtube.com/user/matlab?feature=results_mai
- [6] <http://www.youtube.com/watch?v=DPLBPdux6bs>

23HS4101
ENGINEERING ECONOMICS AND MANAGEMENT

Course Category:	Management Course	Credits:	2
Course Type:	Theory	Lecture -Tutorial-Practice:	2 – 0 – 0
Prerequisites:		Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

COURSE OUTCOMES

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

CO1	Understand the principles of management and various forms of organizations.
CO2	Understand the various aspects of business economics.
CO3	Perceive the knowledge on Human resources and Marketing functions.
CO4	Evaluate various alternatives economically and methods of calculating depreciation.

Contribution of Course Outcomes towards achievement of Program Outcomes

	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 I	PSO II
CO1	M											M		M
CO2	M				H							M		M
CO3	M											M		M
CO4	M				H							M		M

(L-Low, M-Medium, H-High)

UNIT – I

Management: Introduction to Management, Functions of Management, Principles of Scientific Management, Modern Principles of Management.

Forms of Business Organization: Salient Features of Sole Proprietorship, Partnership, Joint Stock Company, Co-operative Society and Public Sector.

UNIT - II

Introduction to Economics: Introduction to Basic Economic Concepts, Utility Analysis: Marginal Utility

and Total Utility, Law of Diminishing Marginal Utility, Law of Equi Marginal Utility.

Demand Analysis: Theory of Demand: Demand Function, Factors Influencing Demand, Demand Schedule and Demand Curve, Shift in Demand, Elasticity of Demand: Elastic and Inelastic Demand, Types of Elasticity.

Supply Analysis: Supply Schedule and Supply Curve, Factors Influencing Supply, Supply Function.

UNIT – III

Human Resource Management: Meaning and difference between Personnel Management and Human Resource Management, Functions of Human Resource Management.

Marketing Management: Concept of Selling And Marketing – Differences, Functions of Marketing, Product Life Cycle, Concept of Advertising, Sales Promotion, Types of Distribution Channels, Marketing Research, Break-Even Analysis.

UNIT – IV

Financial Management: Functions of Financial Management, Time value of money with cash flow diagrams, Concept of Simple and Compound Interest.

Economic Alternatives: Methods of Evaluating Alternatives under Present worth method, Future worth method, Annual Equivalent method - Problems.

Depreciation: Causes of depreciation, Factors influencing depreciation, common methods of Depreciation: Straight Line Method, Declining Balance Method, Sum of Year's Digits Method –Problems.

Text Books:

- [1] M. Mahajan *Industrial Engineering and Production Management* Dhanpat Rai Publications 2nd Edition.
- [2] Martand Telsang "Industrial & Business Management" S.Chand publications

Reference books:

- [1] R.Paneerselvam "Production and Operations Management" PHI
- [2] Philip Kotler & Gary Armstrong "Principles of Marketing", Pearson Prentice Hall, New Delhi, 2012 Edition.
- [3] IM Pandey, "*Financial Management*" Vikas Publications 11th Edition
- [4] B.B Mahapatro, "*Human Resource Management*", New Age International, 2011

E-resources and other digital material:

- [1] <https://www.toppr.com/guides/fundamentals-of-economics-and-management/supply/supply-function/>
- [2] <https://keydifferences.com/difference-between-personnel-management-and-human-resource-management.html>
- [3] <http://productlifecyclestages.com/>
- [4] <https://speechfoodie.com/cash-flow-diagrams/>

23ES4102D ENGINEERING METALLURGY

Course Category: Engineering Science	Credits: 3
Course Type : Theory	Lecture/Tutorial/ Practice: 3 /0/ 0
Prerequisites:	Continuous Evaluation: 30
23BS2102 Engineering Physics	Semester end Evaluation: 70
23BS1102A Engineering Chemistry	Total Marks: 100

COURSE OUTCOMES

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

CO1	Recognize the importance and concept of materials and solid solutions.
CO2	Exemplify the phase diagrams and TTT diagrams of steels.
CO3	Classify the heat treatment processes and strengthening mechanisms.
CO4	Outline the principles of powder metallurgy and manufacturing methods of different types of composites.

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO I	PSO II
CO1	H	M											L	L
CO2	H	M											L	L
CO3	H	M											L	L
CO4	H	M											L	L

(L-Low, M-Medium, H-High)

UNIT - I

INTRODUCTION TO MATERIAL SCIENCE: Material Science, Classification of materials, Requirement and selection of materials, Mechanical properties of materials.

INTRODUCTION TO CRYSTALLOGRAPHY: Space Lattice, Unit Cell, Bravais Lattices, Coordination number, Atomic Packing Factor for SCC, BCC and FCC, Crystal imperfections, Crystal deformation- Slip and Twinning.

SOLID SOLUTIONS: Introduction, Substitutional solid solutions, Ordered Substitutional solid solutions, Disordered Substitutional solid solutions, Hume Rothery's rule, Interstitial solid solution.

UNIT – II

PHASE DIAGRAMS: Binary phase diagrams – Phase rule – one component system, two component system, isomorphous, eutectic, eutectoid, peritectic and peritectoid systems, Fe-Fe₃C equilibrium diagram.

TTT Diagrams: TTT diagrams for eutectoid, hypo and hyper eutectoid steels.

UNIT – III

HEAT TREATMENT PROCESSES: Annealing, normalizing, hardening, tempering, austempering, martempering, flame Hardening, Induction Hardening & Chemical hardening techniques, hardenability concept and experimental determination.

STRENGTHENING MECHANISMS: Strain hardening, solid solution strengthening, grain refinement, dispersion strengthening.

UNIT – IV

POWDER METALLURGY: Powder metallurgy process, preparation of powders, Characteristics of metal powders, mixing and blending, compacting, sintering, Applications of Powder Metallurgy.

COMPOSITE MATERIALS: Introduction, Classification of composites, Characteristics of Composite Materials, Advantages and Dis-advantages of composite materials, applications of composite materials, various methods of component manufacture of composites – Hand Lay-up method, Resin transfer moulding, Filament winding process, and continuous pultrusion process.

Text Books:

- [1] Kodgirie .V.D and Kodgirie.S.V, “Material Science and Metallurgy”, Thirty-seventh Edition, Everest House Publication, 2015.
- [2] Raghavan.V, “ Material Science and Metallurgy” ,Fifth Edition, PHI Learning Pvt Limited,2013

Reference books:

- [1] Avenner , “Introduction to Physical Metallurgy”, Second Edition, Tata McGraw hill Education (India) Pvt Limited,1997.
- [2] Rajput R. K, “Material Science and Engineering”, Fourth Edition, S.K.kataria& Sons,2009.
- [3] C. Daniel Yesudian, D.G.Harris Samuel, “Material Science and Metallurgy”, First Edition, SCITECH, 2006.

E-resources and other digital material:

- [1] Prof.R.N.Ghosh, IIT Kharagpur, Solidification Binary Alloys, Iron-Carbon Phase Diagram,[English]Web Available:<https://www.youtube.com/results?searchquery=prof.r.n+ghosh+lecturers>
- [2] Prof.S.K.Gupta, IIT Delhi, Phase Diagrams, Crystal imperfections [English] Web Available: <https://www.youtube.com/watch?v=x3n9ht-eRfg>

23ME4303 MANUFACTURING PROCESSES

Course Category:	Professional Core	Credits:	3
Course Type:	Theory	Lecture -Tutorial-Practice:	3 - 0 - 0
Prerequisites:	23ES2103A Basic Mechanical Engineering.	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

COURSE OUTCOMES

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

CO1	Describe the Methodology of the casting processes.
CO2	Distinguish the special casting methods and their applications.
CO3	Familiarize with various Bulk Deformation and Sheet Metal operations.
CO4	Illustrate various Welding processes with applications.

**Contribution of Course Outcomes towards achievement of Program Outcomes
(L – Low, M - Medium, H – High)**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	H	M	L									
CO2	H		L									
CO3	H	M	L									
CO4	H		L									

COURSE CONTENT

UNIT – I Metal Casting Processes

Introduction to Manufacturing Processes, Sand casting - General method, pattern: types, materials and allowances, Molding Sand – Materials, preparation and properties, Types of Cores, Gating system and Risers: Types, Functions and Design (Numerical). Solidification process and time estimation (Numerical). Classification of Furnace: Constructional Features, Working Principle and Zones of Cupola Furnace, Electric Furnace – Arc. Advantages, Limitations and Applications.

UNIT – II Special Metal Casting Methods

Permanent Mold Casting, Die Casting: Hot chamber die casting- Cold chamber die casting, Centrifugal Casting: True Centrifugal Casting, Semi-centrifugal Casting and Centrifuging.
Investment casting - Shell Mold Casting - CO2 casting Process and Continuous Casting, Advantages, Limitations and Applications. Casting defects: Causes and Remedies.

UNIT – III Bulk Deformation and Sheet metal operations

Bulk Deformation Processes: Fundamentals, Hot and Cold working of metals - Rolling- Forging- Extrusion -Tube Making, and Wire Drawing. High Energy Rate Forming Processes: Explosive Forming, Electro Hydraulic Forming, Electro Magnetic Forming.

Sheet metal operations: Introduction, Sheet metal Blanking - Punching operations. Clearance and Shear as applied to Punching/Blanking operations (simple problems), Elastic recovery in bending operation.

UNIT – IV Metal Joining Welding Processes

Welding Processes: Fundamentals and classification of welding, Gas welding Processes: Working Principle of Oxy-acetylene Gas Welding, Arc Welding: TIG - MIG – Arc blow, Duty cycle. Resistance Welding: Principles of Resistance Welding - Types: Butt Welding, Spot Welding, Seam Welding. Advantages, Limitations and Applications.

Special welding Processes: Electron beam welding, Thermit Welding, Electro slag welding, Laser beam welding, Friction Welding, Friction stir Welding, Under Water Welding and Brazing & Soldering, Advantages, Limitations and Applications. Welding defects: Causes and Remedies.

TEXT BOOKS

- [1] Manufacturing Technology by P.N. Rao, Vol.1, Edition-3, 2009, TMH.
- [2] Production Technology (Manufacturing Processes) by P.C. Sharma, 2007, S. Chand Publishers.

REFERENCE BOOKS

- [1] Welding and welding Technology by Richard.L.Little, 1973, McGraw Hill.
- [2] Principles of Metal Casting by Heine, Loper, Rosenthal. 33rd Reprint, 2008, TMH.

E-RESOURCES AND OTHER DIGITAL MATERIAL

- [1] <https://themechanicalengineering.com/casting-process>.
- [2] [Bulk Metal Forming - an overview | ScienceDirect Topics](#)
- [3] [Different Sheet Metal Operations - Mech4study](#)
- [4] <https://workshopinsider.com/underwater-welding>.

23ME4304
FLUID MECHANICS AND HYDRAULIC MACHINES

Course Category:	Professional Core	Credits:	3
		Lecture-Tutorial -Practice:	3-0-0
Course Type:	Theory	Continuous Evaluation:	30
		Semester end Evaluation:	70
Prerequisites:		Total Marks:	100

COURSE OUTCOMES:

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

CO1	Evaluate the fluid properties and analyze the fluid flow
CO2	Apply the knowledge of fluid dynamics for flow analysis and analyze the losses in pipes
CO3	Apply the momentum principle in impact of jets & analyze the flow in boundary layer
CO4	Analyze the performance of hydraulic turbines and pumps

Contribution of Course Outcomes towards achievement of Program Outcomes

(L – Low, M - Medium, H – High)

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO I	PSO II
CO 1	H	M	L										M	
CO 2	M	H	H										M	
CO 3	M	H	H										M	
CO 4	M	H	M										M	

COURSE CONTENT

UNIT – I

FLUID PROPERTIES AND FLUID STATICS: Density, Specific weight, Specific gravity, viscosity, Surface Tension, Capillarity, Types of Fluids, Vapour pressure, Compressibility, Pressure and its measurements (Treatment limited to Manometers).

FLUID KINEMATICS: Stream line, path line, streak line, stream tube, classification of flows, one and three dimensional continuity equation.

UNIT – II

FLUID DYNAMICS: Surface and Body forces - Euler's equation of motion and Bernoulli's equation from Euler's equation, applications of Bernoulli's equation.

INTERODUCTION TO PIPE FLOW: Reynolds's experiment, Darcy-Weisbach equation, Minor losses in pipes (Treatment limited to explanation), flow through pipes in series and parallel, Hydraulic gradient and total energy lines.

UNIT – III

BOUNDARY LAYER CONCEPTS: Definition, Displacement Thickness, Momentum thickness, Energy Thickness, Drag and lift (Treatment limited to concept only).

INTERODUCTION TO TURBO MACHINERY: Review of momentum equation, Impact of jet of water on various configurations and derivation of force applied by jet in all applications, Introduction to velocity triangles and applications.

UNIT – IV

HYDRAULIC TURBINES: Classification of turbines, Pelton wheel construction and working principle, Francis and Kaplan turbines detailed discussion, Heads, Efficiencies and Performance of turbines.

HYDRAULIC PUMPS: Classification of pumps with definition, Working Principles and work done by Centrifugal and Reciprocating pumps.

Text Books

- [1] R.K.Bansal, "Fluid Mechanics & Hydraulic Machines" Tenth Edition, Laxmi Publications, 2023.
- [2] Robert W. Fox , Alan T. McDonald and Philip J. "Fluid Mechanics" Eighth edition, Wiley Publishers.

Reference Books

- [1] P.N.Modi & S.M. Seth., "Hydraulics and Fluid Mechanics", Second Edition, Standard Book House, 2005.
- [2] R.K. Rajput, "Fluid Mechanics & Hydraulic Machines", Ninth Edition, S.Chand & Company, 2015.
- [3] D.S.Kumar, "Fluid Mechanics & Fluid Power Engineering", Second Edition, S.K.Kataria & Sons Publishers, 2014.

E-Resources and other digital material

- [1] Prof. S.K. Som, IIT Kharagpur, Fluid Mechanics & Hydraulic Machines, [English],
Web Available: <http://nptel.ac.in/courses/112105171/>
- [2] Prop.Gowtham Biswas, IIT Kharagpur, Fluid Mechanics & Hydraulic Machines, [English],
Web Available: <http://nptel.ac.in/courses/112104118/>
- [3] Fluid Mechanics & Hydraulic Machines, [English], Web Available: <http://www.efluids.com/>

23ME4305 MACHINE DYNAMICS

Course Category:	Professional Core	Credits:	3
		Lecture-Tutorial -Practice:	3-0-0
Course Type:	Theory	Continuous Evaluation:	30
		Semester end Evaluation:	70
Prerequisites:	23PC2104B Engineering Mechanics	Total Marks:	100

COURSE OUTCOMES

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

CO1	Analyze balancing of rotating and reciprocating masses.
CO2	Examine the speed of governors and gyroscopic effects on vehicles.
CO3	Apply the concepts of energy fluctuations in fly wheels.
CO4	Calculate natural frequency for longitudinal, transverse and torsional vibrations.

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO I	PSO II
CO1	M	H	L											M
CO2	M	H	L											M
CO3	M	H	H											M
CO4	M	H	L											M

(L-Low, M-Medium, H-High)

UNIT – I

BALANCING OF ROTATING SYSTEMS: Introduction, Static balancing, Dynamic balancing, Transferring of a Force from one plane to another, Balancing of Several Masses in Different planes.

BALANCING OF RECIPROCATING SYSTEMS: Primary balancing only.

UNIT – II

GOVERNORS: Introduction, Watt Governor, Porter Governor, Hartnell Governor, Sensitiveness of a Governor, Hunting, Isochronism, Stability.

GYROSCOPES: Angular Velocity, Angular Acceleration, Gyroscopic Torque, Gyroscopic Effect on Air-planes and Naval Ships

UNIT – III

TURNING MOMENT DIAGRAMS: Introduction, Single - cylinder double – acting steam engine, Single - cylinder four stroke engine, Multi-cylinder engine, Fluctuation of energy, determination of maximum fluctuation of energy, coefficient of fluctuation of energy.

FLY WHEELS: Introduction, Coefficient of fluctuation of speed, energy stored in fly wheel.

UNIT – IV**UNDAMPED FREE VIBRATIONS:**

LONGITUDINAL VIBRATION: Introduction, Definitions, Types of vibrations, Basic features of vibrating systems, Degree of freedom, free longitudinal vibrations.

TRANSVERSE VIBRATION: Single concentrated load, shaft carrying several loads, whirling of shafts.

TORSIONAL VIBRATION: Single rotor systems and two rotor systems, Torsionally equivalent shafts.

Text Books:

[1] S.S.Rattan, “Theory of Machines”, Fifth edition, McGraw Hill Education (India) Private Limited, 2014

[1] Dr.R.K.Bansal & Dr.J.S.Brar,” Theory of Machines”, Fourth edition, Laxmi Publications (P) Limited, 2009.

Reference books:

[1] R.S.Khurmi & J.K.Guptha,“ Theory of Machines”, 14th Edition, S.Chand & Company, 2006.

[2] V.P.Singh,”Mechanical vibrations”, Second Edition, Dhanpat Rai & Co (P) Limited, 2009

E-resources and Other digital material:

[1] Video in web: <http://nptel.ac.in/courses/112104114/>

[2] Video in web: <https://youtu.be/OlZXxPVpmBs>

[3] Notes in web: http://www.vssut.ac.in/lecture_notes/lecture1429901026.pdf

23TP4106
ENGLISH FOR PROFESSIONALS

Course Category:	Soft Skills – 2	Credits:	1
Course Type:	Practical	Lecture – Tutorial – Practice:	0-0-2
Prerequisites:	Basic understanding of the language skills viz Listening, Speaking, Reading and Writing.	Continuous Evaluation:	100
		Semester end Evaluation:	0
		Total Marks:	100

Course Outcomes

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

CO1	Understand how to listen, reflect, and speak while communicating with others.
CO2	Recall the fundamentals of language in terms of grammar and vocabulary in communication.
CO3	Apply English language skills in various speaking contexts to present ideas with clarity and accuracy.
CO4	Analyze the different parts in Versant Test and answer them.

Contribution of Course Outcomes towards achievement of Program Outcomes
(L – Low, M – Medium, H – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	M									H		M
CO2	M									H		M
CO3	M								M	H		M
CO4	M									H		M

COURSE CONTENT

1. Conversation Starters :

Introduction – Seeking Permissions – Asking for Directions – Making Requests – Offering Help – Expressing Thanks – Conveying Apologies – Starting a Conversation with a Stranger – Practice.

2. Functional Conversations

Introducing Self – Introducing Others – Starting a Group Introduction – Icebreaker Introduction – Introducing a Formal Setting – Practice Exercises.

3. Grammar

Verbs – Tenses – Sentence Structures – Spotting the Errors.

4. Just A Minute

Introduction – Significance – Fluency – Coherence – Avoiding Errors – Communication Skills – Confidence – Practice.

5. Vocabulary

Idioms – Phrases – Significance – Meanings – Usage – Practice.

6. Elocution

Definition – Importance – Key Components – Voice Modulation – Articulation – Posture and Gestures – Practice.

7. Extempore

Introduction – Significance – Developing Quick Thinking – Communication Skills – Confidence – Practice.

8. Debate

Introduction – Understanding the Structure – Purpose of a Debate – Developing Basic Debating skills – Do's and Don'ts – Practice.

9. Versant Test

Overview of the Versant Test – Purpose and Importance – Format of the Test – Types of Questions – Practice.

10. Story Telling

Know Your Audience – Choose a Story – Set the Scene – Introduce the Characters – Build Suspense – Describe the Conflict – Show the Resolution – Share the moral/message – Use Vivid Language – Practice Delivery – Invite Reflection/Discussion – Follow Up.

Learning Resources

[1] English for Professionals Lab Manual

Reference Books

- [1] Wren & Martin. *English Grammar and Composition*. S.Chand & Company, 2023.
- [2] Dale Carnegie. *The Quick and Easy way to Effective Speaking*. Rupa Publications, 2016.
- [3] Richard A. Spears. *McGraw-Hill's Dictionary of American Idioms and Phrasal Verbs*. McGraw Hill, 2005.
- [4] Kamalesh Sadanand. *A Spoken English*. VOL 1&2, Orient BlackSwan, Second Edition, 2014.

E-Resources

- [1] <https://www.pearson.com/languages/hr-professionals/versant.html> Softx
- [2] <https://www.ted.com/talks>
- [3] <https://shortstoryproject.com/>

23ES4651

PYTHON PROGRAMMING LAB

Course Category:	Skill oriented course	Credits:	1
Course Type:	Lab	Lecture -Tutorial-Practice:	0 - 0 -2
Prerequisites:	23ES1104 -Introduction to programming	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course Objective: To understand the PYTHON environment and make numerical computations and analysis.

Course Outcomes:

COs	Statements
CO1	Solve the different methods for linear, non-linear and differential equations
CO2	Learn the PYTHON Programming language
CO3	Familiar with the strings and matrices in PYTHON
CO4	Write the Program scripts and functions in PYTHON to solve the methods
CO5	Evaluate different methods of numerical solutions

**Contribution of Course Outcomes towards achievement of Program Outcomes
(L-Low,M-Medium,H- High)**

	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
CO1	H			L								M	M	M
CO2	L			L								M	M	M
CO3	M			H								M	M	M
CO4	M			H								M	M	M
CO5	M			L								M	M	M

Write Programs in PYTHON Programming for the following:

1. To find the roots of non-linear equation using Newton Raphson's method.
2. Curve fitting by least – square approximations
3. To solve the system of linear equations using Gauss - elimination method

4. To solve the system of linear equations using Gauss - Siedal method
5. To solve the system of linear equations using Gauss - Jordan method
6. To integrate numerically using Trapezoidal rule
7. To integrate numerically using Simpsons rule
8. To find the largest eigen value of a matrix by Power – method
9. To find numerical solution of ordinary differential equations by Euler’s method
10. To find numerical solution of ordinary differential equations by Runge-Kutta method
11. To find numerical solution of ordinary differential equations by Milne’s method
12. To find the numerical solution of Laplace equation
13. To find the numerical solution of Wave equation
14. To find the solution of a tri-diagonal matrix using Thomas algorithm
15. To fit a straight using least square technique

Online Learning Sources

- https://www.udemy.com/course/python-the-complete-python-developer-course/?matchtype=e&msclkid=0584dfb54dc715f39c0bb9aaf74033be&utm_campaign=BG-Python_v.PROF_la.EN_cc.INDIA_ti.7380&utm_content=deal4584&utm_medium=udemyads&utm_source=bing&utm_term=_.ag_1220458320107116_.ad_.kw_Python+language_.de_c_.dm_.pl_.ti_kwd-76278984197882%3Aloc-90_.li_116074_.pd_.&couponCode=IND21PM
- https://www.w3schools.com/python/python_intro.asp
- <https://www.youtube.com/watch?v=eWRfhZUzrAc>
- https://onlinecourses.nptel.ac.in/noc20_cs83/preview
- <https://www.edx.org/learn/python>
- Virtual Labs - <https://python-iitk.vlabs.ac.in/>
- Virtual Labs - <https://virtual-labs.github.io/exp-arithmetic-operations-iitk/>
- Virtual Labs - <https://cse02-iiith.vlabs.ac.in/>
- https://mlritm.ac.in/assets/cse/cse_lab_manuals/R20_cse_manuals/Python%20Lab%20Manual.pdf

23ES4152
DESIGN THINKING & INNOVATION

Course Category:	Engineering Sciences	Credits:	2
Course Type:	Activity Based Learning	Lecture -Tutorial-Practice:	1 - 0 -2
Prerequisites:	Social Needs, Customer needs & market needs	Continuous Evaluation: Semester end Evaluation: Total Marks:	100

COURSE OUTCOMES

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

CO1	Able to define basic design components, Design thinking components and process													
CO2	Apply the design thinking techniques for solving problems in various sectors.													
CO3	Analyse to work in a multidisciplinary environment.													
CO4	Evaluate the value of creativity.													
	Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1			M											
CO2			M											
CO3			M						M					
CO4			M											

COURSE CONTENT

UNIT I

Introduction to Design Thinking & Design Thinking Process: Introduction to elements and principles of Design components, Introduction to design thinking, history of Design Thinking, New materials in Industry.

Design thinking process (empathize, analyze, idea & prototype), implementing the process in driving inventions, design thinking in social innovations. Tools of design thinking - person, costumer, journey map, brainstorming, product development

Activity: Every student presents their idea in three minutes, Every student can present design process in the form of flow diagram or flow chart etc. Every student should explain about product development.

UNIT II**Innovation**

Art of innovation, Difference between innovation and creativity, role of creativity and innovation in organizations. Creativity to Innovation. Teams for innovation, Measuring the impact and value of creativity.

Activity: Debate on innovation and creativity, Flow and planning from idea to innovation, Debate on value-based innovation.

UNIT III**Product Design**

Problem formation, introduction to product design, Product strategies, Product value, Product planning, product specifications. Innovation towards product design Case studies.

Activity: Importance of modeling, how to set specifications, Explaining their own product design.

UNIT IV**Design Thinking in Business Processes**

Design Thinking applied in Business & Strategic Innovation, Design Thinking principles that redefine business – Business challenges: Growth, Predictability, Change, Maintaining Relevance, Extreme competition, Standardization. Design thinking to meet corporate needs. Design thinking for Startups. Defining and testing Business Models and Business Cases. Developing & testing prototypes.

Activity: How to market our own product, about maintenance, Reliability and plan for startup.

TEXT BOOKS

1. Tim Brown, Change by design, 1/e, Harper Bollins, 2009.
2. Idris Mootee, Design Thinking for Strategic Innovation, 1/e, Adams Media, 2014.

REFERENCE BOOKS

1. David Lee, Design Thinking in the Classroom, Ulysses press, 2018.
2. Shrrutin N Shetty, Design the Future, 1/e, Norton Press, 2018.
3. William lidwell, Kritinaholden, & Jill butter, Universal principles of design, 2/e, Rockport Publishers, 2010.
4. Chesbrough.H, The era of open innovation, 2003.

E-RESOURCES AND OTHER DIGITAL MATERIAL

- <https://nptel.ac.in/courses/110/106/110106124/>
- <https://nptel.ac.in/courses/109/104/109104109/>
- https://swayam.gov.in/nd1_noc19_mg60/preview
- https://onlinecourses.nptel.ac.in/noc22_de16/preview

23ME4353

STRENGTH OF MATERIALS & FLUID MECHANICS LABORATORY

Course Category:	Professional Core	Credits:	1.5
		Lecture-Tutorial -Practice:	0-0-3
Course Type:	Laboratory	Continuous Evaluation:	30
Prerequisites:	23 PC 2104 B Engineering Mechanics. 23 ME 3104 Mechanics of Materials. 23 ME 3204 Fluid Mechanics & Hydraulic Machines.	Semester end Evaluation:	70
		Total Marks:	100

COURSE OUTCOMES

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

CO1	Determine Young's modulus using UTM [K5]
CO2	Evaluate hardness, Tensile, compressive, shear and impact strengths as per IS code of Practice [K5]
CO3	Measure the rigidity modulus by conducting torsion test on Mild Steel [K5]
CO4	Determine the coefficient of discharge for Venturimeter, orifice, orificemeter & Mouthpiece [K5]
CO5	Determine the Friction factor for a given pipe [K5]
CO6	Evaluate and analyse the characteristics of Centrifugal pumps, Reciprocating Pumps and Gear pumps [K5]

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	13	PSO I	PSO II
CO 1	M	H		M	H										M
CO 2	M	H		M	H										M
CO 3	M	H		M	H										M
CO 4	M	H		M	H									H	
CO 5	M	H		M	H									H	
CO 6	M	H		M	H									H	

(L-Low, M-Medium, H-High)

Strength of Materials Lab:

1. Determination of Young's modulus for Mild Steel by conducting Tension test on UTM
2. Load vs Deflection - Determination of Young's modulus on cantilever beam and simply supported beam.
3. Compression test- Determination of compressive strength of Concrete block or Wood
4. (a) Rockwell Hardness test - Determination of Hardness Number for different metal specimens such as Mild steel, cast iron, Brass, Aluminum (b) Brinnell's Hardness Test
5. Impact Test - (a) Charpy and (b) Izod: Determination of impact strength of Mild steel and cast iron specimens
6. Torsion test - Determination of Modulus of Rigidity of the material.
7. Double shear Test - Determination of shear strength of Mild steel specimens

Fluid Mechanics Lab:

1. Orifice / mouthpiece - Determination of coefficient of discharge
2. Venturimeter / Orifice meter - Determination of coefficient of discharge
3. Pipe friction - Determination of friction factor and size of roughness of a given pipe.
4. Single - stage centrifugal pump - To draw the operating characteristics of the pump and to determine the designed discharge and designed head from it.
5. Single - acting reciprocating pump - To draw the operating characteristic curves at constant speed and determination of efficiency.
6. Gear pump - To draw the operating characteristic curves and determination of overall efficiency

Text Books & References:

- [1] James M. Gere and Barry J. Goodno, "Mechanics of Materials"
Seventh edition, CENGAGE Learning, 2019
- [2] R.K.Bansal, "Fluid Mechanics & Hydraulic Machines"
Fifth edition, Laxmi Publishers, 2020
- [3] Dr. Sadhu Singh, "Strength of Materials"
Ninth edition, Khanna Publishers, 2017.
- [4] P.N.Modi & S.M. Seth., "Hydraulics and Fluid Mechanics",
Second edition, Standard Book House, 2015.

23ME4354

MANUFACTURING PROCESS LABORATORY

Course Category:	Professional Core	Credits:	1.5
		Lecture-Tutorial -Practice:	0-0-3
Course Type:	Laboratory	Continuous Evaluation:	30
		Semester end Evaluation:	70
Prerequisites:	23ME3203 Manufacturing Processes	Total Marks:	100

COURSE OUTCOMES

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

CO1	Develop various joints using fitting.
CO2	Create various welding joints.
CO3	Build various sand casting moulds.
CO4	Construct various models using 3D printing.

**Contribution of Course Outcomes towards achievement of Program Outcomes
(L – Low, M - Medium, H – High)**

	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
CO1			H	H										L
CO2			H	H										L
CO3			M	H										L
CO4			H	H										M

COURSE CONTENT

I. FITTING:

To make the following joints

- a. Half round Joint
- b. Stepped Joint
- c. Dovetail Joint

II .WELDING:

To make the following welding joints

- a. To make Lap Joint using Oxy Acetylene Gas welding
- b. To make 'T'– Joint using MIG welding
- c. To make Spot joint (Door Handle) using Resistance welding

III. FOUNDRY:

To make the following sand moulds

- a. Single piece pattern (Stepped Rectangular Block)
- b. Two piece pattern (Step Cone Pulley)
- c. Two piece pattern (Double end pipe flange)

IV. 3D PRINTING:

To make the following 3D print models

- a. Bolt & Nut
- b. Screw feeder
- c. Gear wheel

V. PROJECT:

To prepare a metal Casting (Automobile component) – Group assignment

TEXT BOOKS

- [1] S.K.HajraChowdary, A.K. HajraChowdary, NirjharRoy, "Elements of Workshop Technology, Vol.I".Media Promoters and Publishers Pvt.Ltd, Mumbai, Scitech Publications, Chennai, 2013

E-RESOURCES AND OTHER DIGITAL MATERIAL

- [1] https://www.youtube.com/watch?v=OwzHpVE_S4I
- [2] <https://www.youtube.com/watch?v=1nXbYXj7Xos>
- [3] <https://www.youtube.com/watch?v=0tOfaQ9pOGU>
- [4] <https://www.youtube.com/watch?v=wQaytFTckGU>
- [5] https://3d-p.eu/wp-content/uploads/2018/08/IO3_3DP-courseware_EN.pdf

THIRD YEAR

23ME5301 MACHINE TOOLS AND METAL CUTTING

Course Category: Professional Core

Credits: 3

Course Type : Theory

Lecture/Tutorial/ Practice: 3 /0/ 0

Prerequisites:

Continuous Evaluation: 30

20 ME 3304 Manufacturing Processes

Semester end Evaluation: 70

20 ME 3302 Mechanics of Materials

Total Marks: 100

Course Outcomes:

Upon successful Completion of the course, the student will be able to:

CO1: Recognize the basic principles, constructional features of Lathe and its mechanisms and operations.

CO2: Exemplify the working principle, operations of drilling machines and Milling machines.

CO3: Distinguish various machining processes such as Shaping, Planing, grinding and broaching.

CO4: Recognize the fundamental concepts of Metal Cutting, cutting tool materials, and tool life.

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO I	PSO II
CO1	H													L
CO2	H	L												L
CO3	H													L
CO4	M	M												L

(L-Low, M-Medium, H-High)

UNIT - I

KINEMATIC CONFIGURATION OF MACHINE TOOLS: Introduction, Classification of Machine Tools, Basic elements of machine tools, Machining Parameters: Cutting speed, feed and depth of cut.

LATHE: Constructional details, specifications, classification of lathes.

LATHE MECHANISMS: Spindle speed Mechanisms in Belt driven and All Geared Head stock, Apron and Half-nut mechanisms, Lathe accessories, Lathe Operations.

UNIT – II

DRILLING MACHINES: Types and specifications, Spindle feed mechanism, drilling operations, drilling time.

MILLING MACHINES: Working Principle, Types of milling machines, Up and Down Milling, Description and working of Universal Milling machine, Size and Specification, Milling operations, Milling cutters, Indexing, Indexing methods – Direct, simple and compound indexing, related simple problems.

UNIT – III

SHAPING AND PLANING: Constructional details, types of Shapers and Planers, specifications, operations, quick return mechanism and automatic feed mechanisms.

GRINDING: General Principles, Wheel materials, Selection and specifications, Truing and Dressing of grinding wheels, types of grinding, types of grinding machines, Super finishing operations (basic principles) - Honing, Lapping and Burnishing.

BROACHING: Introduction to Broaching, broaches, broaching methods and Machines.

UNIT – IV

THEORY OF METAL CUTTING: Introduction, Nomenclature of single point cutting tool, Basics of orthogonal and oblique cutting, Types of chips. Determination of shear angle, chip thickness ratio, shear stress, and shear strain in the chip, velocity relations, Merchant's theory of orthogonal cutting forces, related simple problems. Heat Generation and cutting tool temperature and its measurement, cutting fluids - types and required characteristics, Cutting tool materials: Requirements of Tool materials and types, Tool wear, and Tool life.

Text Books:

- [1] Workshop Technology - Vol.2 by Hazra Chowdary, 11th Edition, 2002.
- [2] Manufacturing Technology - Vol.2 by P. N. Rao, McGraw Hill Education (India) Pvt. Ltd., 3rd Edition, 2013.
- [3] Manufacturing Technology by R. K. Rajput, Laxmi Publications (P) Ltd., 1st Edition, 2007

Reference books:

- [1] Production Engineering by P.C. Sharma, S.Chand & Co. 10th Edition, 2008
- [2] Manufacturing Science by Ghosh & Mallick, 2nd Edition, John Wiley & Sons, New York, 1986.

E-resources and other digital material:

- [1] <https://openoregon.pressbooks.pub/manufacturingprocesses45/>
- [2] www.britannica.com/EBchecked/topic/463000/planer
- [3] www.americanmachinist.com/
- [4] <http://www.machinetools.net.tw/>

23ME5302 APPLIED THERMODYNAMICS

Course Category: Programme Core
Course Type : Theory
Prerequisites:
 23ES3103G Basic Thermodynamics

Credits: 3
Lecture/Tutorial/ Practice: 3/0/ 0
Continuous Evaluation: 30
Semester end Evaluation: 70
Total Marks: 100

Course Outcomes:

Upon successful Completion of the course, the student will be able to:

CO1: **Analyze** the performance of I.C engines and Steam nozzles [K3]

CO2: **Illustrate** the working of steam turbines and condensers and **analyze** the performance of steam turbines. [K3]

CO3: **Evaluate** the performance of air compressors and gas turbines [K3]

CO4: **Apply** thermodynamic principles in refrigeration and air conditioning systems [K3]

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO I	PSO II
CO1	L		M		M								L	
CO2	L		L		M								L	
CO3	L		L		M								L	
CO4	L		L		M								L	

(L-Low, M-Medium, H-High)

UNIT - I

I.C.ENGINES: Working of 4-S and 2-S spark and compression ignition engines, Comparison of SI and CI engines and 4 stroke and 2 stroke engines, Applications of IC Engines, Mean effective pressure, IP, BP, Thermal and Mechanical efficiencies.

STEAM NOZZLES: Types of nozzles, isentropic flow through nozzles, Effect of friction, Nozzle efficiency, Critical pressure ratio and maximum discharge, calculation of throat and exit areas using Mollier Diagram.

UNIT - II

STEAM TURBINES: Types of steam turbines, Impulse turbines, velocity diagrams, pressure and velocity compounding, Reaction turbines, velocity diagrams, degree of reaction.

STEAM CONDENSERS: Introduction to condensers, working principle of low-level parallel flow jet condensers and down flow-type surface condensers.

UNIT – III

AIR COMPRESSORS: (Reciprocating) Working, Effect of clearance volume, compression ratio, volumetric efficiency, indicated power, Multi-stage compressors and effect of inter-cooling, optimum intermediate pressure in a two-stage compressor, **(Rotary)** Working principle of centrifugal and axial flow compressors, Comparison of reciprocating and rotary compressors, Applications.

GAS TURBINES:

Ideal Brayton cycle, Open and closed cycle gas turbines, Methods for improvement of thermal efficiency of gas turbine plant, applications of gas turbines, comparison of gas turbines with IC engines and steam turbines

UNIT - IV

REFRIGERATION: Applications of refrigeration, Methods of refrigeration, working of refrigerator and heat pump, refrigerating effect, COP, vapor compression refrigeration system, influence of various parameters on cycle performance, Refrigerant tables.

PSYCHROMETRY AND AIR CONDITIONING: Psychrometric properties, psychrometric relations, psychrometric chart, psychrometric processes, Comfort conditions, summer and winter air conditioning systems.

Text Books:

- [1] Mahesh M. Rathore “Thermal Engineering” Fourth Edition, Tata- McGraw-Hill, 2010
- [2] R.K. Rajput “Applied thermodynamics”, second edition, Lakshmi Publications, 2014

Reference books:

- [1] P.K. Nag “Basic and Applied Thermodynamics”, second edition, Tata McGraw Hill, 2009
- [2] C.P. Arora “Refrigeration and Air Conditioning” third edition, Tata McGraw Hill, 2009
- [3] V Ganesan “Internal combustion engines” fourth edition, Tata McGraw Hill, 2017

E-resources and other digital material:

- [1] Prof. T.Sundararajan, Prof. U.S.Premananda Shet and Prof. J.M.Mallikarjuna, IITMadras, Applied Thermodynamics, [English], Web
Available: <http://nptel.ac.in/syllabus/112106133/>
- [2] Prof. Ravi Kumar, IIT Roorkee, Steam and Gas Power Systems, [English], Web
Available: <http://nptel.ac.in/syllabus/112107216/>
- [3] Prof.M. Ramgopal, IIT Kharagpur, Refrigeration and Air Conditioning, [English], Web Available:
<http://nptel.ac.in/syllabus/112105129/>
- [4] Dr.RaviKumar IITRoorkee, Refrigeration And Air-conditioning[English],Web
Available : https://onlinecourses.nptel.ac.in/noc18_me46/preview

Note: Use of Steam Tables, Refrigeration and Air-Conditioning Tables are permitted in Examinations.

23ME5303 DESIGN OF MACHINE ELEMENTS

Course Category: Professional Core

Course Type : Theory

Prerequisites:

20ES1104B Engineering Mechanics

20ME3302 Mechanics of Materials

20ME3305 Kinematics of Machines

Credits: 3

Lecture/Tutorial/ Practice: 3 /0/ 0

Continuous Evaluation: 30

Semester end Evaluation: 70

Total Marks: 100

Course Outcomes:

Upon successful Completion of the course, the student will be able to:

CO1: Acquire knowledge about the design procedure of machine elements and **Apply** the concepts of Theories of Failure

CO2: Design power screws and apply fatigue failure criteria for machine components under various loading conditions

CO3: Design permanent fasteners such as the riveted, welded joints under various loading conditions

CO4: Design temporary joints such as bolted joints and suspension systems such as helical springs.

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSOI	PSO II
CO1	M	H	H											M
CO2	M	H	H											M
CO3	M	H	H											M
CO4	M	H	H											M

(L-Low, M-Medium, H-High)

UNIT - I

Basics: Phases of Design, Types of Designs, Standardization in Design, Preferred Numbers and Significance

Design for Static Strength: Simple Stresses - Combined Stresses - Torsion and Bending Stresses - Stress Strain Relation, Various Theories of Failure - Factor of Safety and its Importance in Design.

UNIT - II

Design for Fatigue Strength: Stress Concentration - Theoretical Stress Concentration Factor - Fatigue Stress Concentrations Factor, Design for Fluctuating Stresses, Fatigue Strength and Endurance Limit, Gerber's parabolic curve, Goodman Diagram, Soderberg's line.

Power Screws: Types - Mechanics of Power Screws, Efficiency, Self-Locking of Screw and Stresses in Screw.

UNIT – III

Fasteners:

Riveted joints: Terminology, Failures of a Riveted Joint, Efficiency of a Riveted Joint, Design of Boiler Joints, Lozenge Joint, Design of Joints under Eccentric Loading.

Welded joints: Terminology, Advantages and Disadvantages of Welded Joints over Riveted Joints, Types of Welded Joints, Design of Eccentrically Loaded Welded Joints - Stresses induced on the joint be of different nature (Case-1) and of the same nature (Case-2).

UNIT – IV

Bolted joints: Design of Bolted Joints under Eccentric Loading – Eccentric Load acting Parallel to the Axis of Bolts, Eccentric Load acting Perpendicular to the Axis of Bolts, and Eccentric Load acting in the Plane Containing the Bolts.

Springs: Introduction, Materials, Types of springs, Helical Springs under Axial Load, Fatigue Loading.

Text Books:

- [1] V B Bhandari, “Design of machine elements”, Fourth Edition, Tata McGraw Hill Education Private Limited, 2017.
- [2] P.C. Sharma & D.K. Agarwal, “A Text Book Of Machine Design” SK Kataria & Sons, 2013

Reference books:

- [1] R.S Khurmi & J.K. Gupta, “A Text book of Machine Design” Fourteenth Edition, S.Chand &Co Ltd, 2015
- [2] Robert L.Norton, “Machine Design- An Integrated Approach”, Fifth Edition, Pearson Education, 2018.
- [3] P. Kannaiah, “Machine Design”, Second Edition, Scitech Publications Private Limited, 2011.

DATA BOOKS TO BE ALLOWED IN EXAMINATION:

- [1] Mahadevan & Balaveera Reddy, “Design data book”, - CBS Publishers
- [2] V.B.Bhandari, “Design data book”, Tata McGraw Hill book Co
- [3] Design data book, P.S.G. College of Technology, Coimbatore

E-resources and other digital material:

- [1] <http://nptel.ac.in/courses/112/105/112105124/>
- [2] <http://nptel.ac.in/courses/112/105/112105125/>
- [3] <http://nptel.ac.in/courses/112/106/112106137/>

23ME5404 A - IC ENGINES & GAS TURBINES

Course Category: Programme Elective

Credits: 3

Course Type: Theory

Lecture/Tutorial/Practice: 3 /0/ 0

Prerequisites:

Continuous Evaluation: 30

23ME Basic Thermodynamics

Semester end Evaluation: 70

23ME Applied Thermodynamics

Total Marks: 100

Course Outcomes:

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

CO1: *Interpret* the performance of I.C.Engines, Fuel supply systems [K2]

CO2: *Illustrate* the importance of combustion & Developments in I.C. Engines. [K2]

CO3: *Analyze* Gas Turbine cycles and their performance [K4]

CO4: *Interpret* the engine emissions and *Explain* Jet and rocket propulsion [K2]

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSOI	PSOII
CO1	H	M										M	M	
CO2	M						M					M	M	
CO3	H	M										M	M	
CO4	H	M					M					M	M	

UNIT – I

Performance of I.C.Engines: - valve timing diagrams and port timing diagrams, Indicator diagram, evaluation of Indicated Power, Brake power, Fuel consumption, SFC, Mechanical & thermal efficiencies, mean effective pressure, air-fuel ratio, Heat balance, Engine performance curves.

Fuel supply systems: S.I. Engines- Air-fuel mixture requirements, principle of Carburetion, Simple carburetor, improvements in simple carburetor, C.I Engines- Air fuel requirements, Fuel supply and injection systems, Bosch fuel pump and injector.

UNIT – II

Combustion in IC Engines: S.I. Engines- Normal combustion, abnormal combustion, C.I. Engines- Ignition delay, knock in C.I.Engines; Knock rating of fuels- Octane number and Cetane number, super charging, Turbo charging

Developments in IC Engines: MPFI, GDI, CRDI, VVT, HCCI, Wankel engine & Hybrid Technologies, Alternate fuels: Liquid fuels – Alcohols for SI and CI engine Biofuels, Gaseous fuels – Hydrogen – Fuel cell, storage, Natural gas, Biogas, CNG and LPG

UNIT – III

Gas Turbines: Classification of Rotary Machines, Thermodynamic Analysis, Closed and open Brayton cycle gas turbines, comparison with Reciprocating Engines.

Analysis of gas turbine cycles- Assumptions, gas turbine cycles with intercooling, Reheat and regeneration, Stagnation properties, compressor and Turbine Efficiency, Pressure losses, Heat Exchanger Effectiveness, , polytropic Efficiency, performance of Actual Cycle.

UNIT – IV

Engine emissions and control: Exhaust emissions- HC, CO, Nox, Particulate and other emissions, Emission control methods- Thermal converter, catalytic converter, particulate traps, EGR, Euro and Bharat Norms.

Jet and Rocket Propulsion: Basic principles of jet propulsion, specific thrust, Propulsive efficiency and overall thermal efficiency of a jet engine, concepts of turbo shaft, turboprop, turbofan, Turbojet, principles of rocket propulsion, types of rocket Propulsion-Solid and liquid rocket engines.

Text Books:

1. V.Ganesan “I.C. Engines”, 4th Edition, 2017, T.M.H Publications
2. Gupta .H.N, “Fundamentals of Internal Combustion Engines” 2nd edition 2013, Prentice-Hall Of India
3. V.Ganesan, Gas Turbines, 3rd Edition, 2017, T.M.H Publications.

Reference books:

- [1] Mahesh M Rathore, Thermal Engineering, Tata McGraw Hill publications
- [2] R.K.Rajput, I. C. Engines
- [3] M.L. Mathur & R.P. Sharma, “A Course in I.C. Engines”, 8th edition 1990, Dhanpat Rai & Sons
- [4] J.B Heywood, Internal Combustion Engine Fundamentals, McGraw-Hill publications
- [5] V.M. Domakundwar, “A Course in Internal Combustion Engines” 2nd edition 2010, Dhanapat Rai Publications

E-resources and other digital material:

1. <http://www.howstuffworks.com/engine.html>
2. <http://www.animatedengines.com/>
3. www.vssut.ac.in/lecture_notes/lecture1429900545.pdf
4. <http://freevideolectures.com/Course/88/Environmental-Air-Pollution/11>
5. ftp://152.66.39.22/pub/bsc/Internal_Combustion_Engines-Temp.pdf
6. <https://www.ge.com> > gas-power > resources > education

23ME5404 B - REFRIGERATION AND AIR CONDITIONING

Course Category: Professional Elective-1

Credits: 3

Course Type : Theory

Lecture/Tutorial/ Practice: 3

/0/ 0 Prerequisites: 23ME3303 Basic Thermodynamics

Continuous Evaluation:

30 Semester end Evaluation: 70

Total Marks: 100

Course Outcomes:

Upon successful Completion of the course, the student will be able to:

CO1: **Analyze** air refrigeration system and systems used in aircrafts.

CO2: **Interpret** simple VCR cycle and *compare* various components of VCR systems.

CO3: **Select** the most appropriate refrigerant for a given cooling application and **interpret** the impact of refrigerants on the environment

CO4: **Illustrate** the vapor absorption and other non-conventional refrigeration systems and their application as alternatives to VCR systems.

CO5: **Compute** psychrometric properties of air and **analyze** A/C processes & systems and Heat pump circuits to design real world heating & cooling needs.

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO I	PSO II
CO 1	M	M	H										M	
CO 2	M	M	H										M	
CO 3	M		H				H						M	
CO 4	M		M				M						M	
CO 5	H	M	H				L						M	

(L-Low, M-Medium, H-High)

UNIT I:

Introduction to refrigeration: Applications, methods of refrigeration, unit of refrigeration, C.O.P. **Refrigerants-** classification, nomenclature, desirable properties, commonly used refrigerants and alternative refrigerants.

Air refrigeration: Bell Coleman cycle, Open and Dense air systems, Actual refrigeration cycle, advantages

of air refrigeration, refrigeration needs of aircrafts, types of aircraft refrigeration systems, problems.

UNIT – II:

Vapor compression refrigeration: simple vapor compression refrigeration cycle, T-S, P-h diagrams, Effect of super heating, sub cooling, evaporative and condenser pressures, pressure losses, problems. **VCR System components:** Compressors- types, comparison, Condensers - classification, working, Evaporators – Flooded and dry expansion types, Expansion devices – AEV, TEV and capillary tube.

UNIT-III

Vapor absorption system: COP of absorption system, max COP, working of NH_3 - Water system, H_2O -Li Br system, three fluid absorption systems, comparison between VCR and VAR systems.

Steam jet refrigeration system: Principle of working, applications merits and merits. **Non-conventional refrigeration methods:** Principle and operation of thermoelectric refrigeration, Vortex tube and adiabatic demagnetization.

UNIT – IV:

Air conditioning: Psychrometry- Psychrometric properties and processes, Psychrometric chart, Summer, winter and year round A/C systems, human comfort and effective temperature.

Cooling Loads: Sensible and latent heat loads, RSHF, GSHF, ESHF & ADP, air conditioning load Calculations, Types of heating, heat pump, different heat pump circuits, application.

Text books:

- [1] A course in refrigeration and air conditioning – Domkundwar, Arora, Domkundwar, Dhanapat Rai & Co., 2022
- [2] Refrigeration and air conditioning - C. P. Arora. Tata McGraw-Hill, 4th Edition, 2020

Reference books:

- [1] Principles of Refrigeration - Roy J. Dossat., 4th Edition- 2002, Pearson Education Ltd.
- [2] Refrigeration and air conditioning- Stoecker and Jones 1983, McGraw Hill

Data Books:

- [1] Refrigeration & Air conditioning Data book by Domkundwar & Domkundwar, Dhanapat Rai & Co.
- [2] Refrigerant & Psychrometric Tables & charts., SS Banwait and SC Laroia, Birla pub. pvt ltd.

E-resources and other digital material:

- [1] <http://www.refrigerationbasics.com/index.htm>
- [2] <https://home.howstuffworks.com/ac.htm>
- [3] <https://www.ashrae.org/>
- [4] <https://www.geeksforgeeks.org/refrigeration-and-air-conditioning/>
- [5] <https://jacobsheating.com/blog/air-conditioning-guide/>

23ME5404 C - AUTOMOBILE ENGINEERING

Course Category: Program Elective

Course Type: Theory

Prerequisites:

Basic Thermodynamics

Credits: 3

Lecture – Tutorial – Practice: 3 / 0 / 0

Continuous Evaluation: 30

Semester End Evaluation: 70

Total Marks: 100

Course Outcomes:

Upon successful completion of the course, the student will be able to

CO1: Identify the different engine components & maintenance procedures.

CO2: Illustrate different automobile cooling, lubrication and electrical systems.

CO3: Understand the working of automobile transmission system components.

CO4: Identify different automobile vehicle suspension and control systems.

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSOI	PSO II
CO 1	M					M							L	
CO 2	M					M							L	
CO 3	M					M							L	
CO 4	M					M							L	

(L – Low, M – Medium, H - High)

Course Content:

UNIT – I

Introduction: Classification of automotive vehicles, applications, transmission arrangements.

Engine Components: Engine construction, combustion chambers for petrol and diesel engines, pistons, DTSI, valve arrangements and operating mechanisms, firing order, crankshaft, flywheel.

Engine Servicing and Maintenance: Engine trouble-shooting, engine testing procedures and instruments used, engine tests, reconditioning of engine components – valve seat boring, cylinder reboring, crankshaft grinding.

UNIT – II

Cooling systems for I. C. Engines: Need for cooling system, air cooling and water cooling - thermo-syphon and forced circulation, radiator, thermostat, antifreeze solutions.

Lubricating systems for I. C. Engines: Petrol, splash, pressure & dry sump lubrication systems, oil filters, crankcase ventilation.

Electrical system for I. C. Engines: Ignition systems – battery-, magneto- & electronic Ignition, spark plugs, alternator, cutout, current and voltage regulators, starting motors - Bendix drive mechanism, lighting, instruments and accessories.

UNIT – III

Transmission system: Introduction to chassis & transmission, Clutches – single plate, multi-plate, diaphragm and centrifugal clutches, clutch actuating mechanisms.

Gear boxes and others: Gear Box types - sliding mesh, constant mesh & synchromesh type, selector mechanism, automatic transmission, continuously variable transmission system, propeller shaft, differential.

UNIT – IV

Suspension systems: Need for suspension systems, springs – Coil, Leaf, shock absorbers, axles – front and rear, different methods of floating rear axle, front axle and wheel alignment

Vehicle control: Steering mechanisms and power steering, types of brakes and brake actuation mechanisms (air and hydraulic), disc brakes, anti-lock braking system, air bags, types of wheels & tyres.

Text books:

- [1] Automobile Engineering – Vol. I & II - Kirpal Singh, Standard Publishers.
- [2] Automobile Engineering - R.B. Gupta, Satya Prakashan.

Reference books:

- [1] Automobile Engineering - G.B.S. Narang, Khanna Publishers.
- [2] Automotive Mechanics - Joseph Heitner, Van Nostrand Reinhold.
- [3] Automotive Mechanics – William H. Crouse, D.L. Anglin, Tata McGraw hill.

E-resources and other digital material

- ☐ www.gec.ac.in/~bsm/automobile/automobile.html
- ☐ <http://auto.howstuffworks.com/engine2.htm>
- ☐ www.carbibles.com/steering_bible.html
- ☐ www.educyclopedia.be/education/carjava.htm

23ME5205 A MECHATRONICS

Course Category: Open Elective-I/Job oriented Elective

Credits: 3

Course Type : Theory

Lecture/Tutorial/ Practice: 3/0/0

Prerequisites :

Continuous Evaluation: 30

20ME3305-Kinematics of Machines

Semester end Evaluation: 70

20ES4102 – Basic Electronics

Total Marks: 100

Course Outcomes:

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

CO1: Understand the working principles of various Sensors and Transducers.

CO2: Develop system models & transfer function for Mechanical, Electrical, Fluid & Thermal systems.

CO3: Compare different controllers such as Proportional, Derivative, Integral, PI, PD and PID.

CO4: Analyze various case studies related to Mechatronics systems.

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO I	PSOII
CO1	M	M			M				M					M
CO2	M	M			M				M					M
CO3	M	M			M				M					M
CO4	M	M			M				M					M

(L-Low, M-Medium, H-High)

UNIT – I

Introduction to Mechatronics: Introduction to embedded systems, the design process, traditional and mechatronics designs, Sensors & Transducers: Introduction, performance terminology, sensors - potentiometer sensor, strain gauged element, Capacity element, LVDT, Optical Encoders and Tacho generator, Selection of sensors.

Signal Conditioning: Introduction data acquisition – Quantizing theory, Analog to digital conversion, digital to analog conversion.

UNIT – II

Basic System Models: Modeling of one and two degrees of freedom Mechanical, Electrical, Fluid and thermal systems. Block diagram representations for these systems.

Actuation systems: Hydraulic and pneumatic systems, directional control valves, valve actuation symbols, Pressure control valves, single and double action cylinders, cylinder sequencing.

UNIT – III

Closed loop controllers: Continuous and discrete processes, control modes, Two-step, Proportional, Derivative, Integral, PID controllers.

Digital logic: Logic gates, Applications of logic gates: digital comparator, coder. SR flip-flop.

UNIT – IV

PLC : Introduction, basic structure, I/P, O/P, processing, programming, ladder diagrams, timers, internal relays and counters, data handling, analogue input and output, selection of PLC.

Design: Designing Mechatronics systems, possible design solutions, case studies of Mechatronics systems – i) Pick and place robot ii) Car park barriers iii) Bar code- reader

Text Books:

- [1] Mechatronics: Electronic control systems in Mechanical and Electrical Engineering by W. Bolton, PEARSON , 6th Edition, 2015.
- [2] Introduction to Mechatronics – David and Alcaitore Michael B.Histand TMH, 4th Edition, 2006.

Reference books:

- [1] Mechatronics by N P Mahalik, 1st Edition, 2003, TMH.
- [2] Mechatronics System design by Devdas Shetty and Richard A Kolk, Cengage Learning, 2nd edition.

E-resources and other digital material:

- [1] www.engr.colostate.edu/~dga/mechatronics/resources.html
- [2] www.NI.com/
- [3] www.cambridgemechatronics.com/
- [4] www.pdf-free-download.com/mechatronics-labs.pdf

23ME5205 B ADDITIVE MANUFACTURING

Course Category: Open Elective

Course Type : Theory

Pre-requisites: Nil

Semester end Evaluation: 70

Total Marks: 100

Credits: 3

Lecture/Tutorial/ Practice: 3/0/0

Continuous Evaluation: 30

Course Outcomes:

Upon successful Completion of the course, the student will be able to:

CO1: Recognize the importance and application of AM models in engineering design

CO2: Develop various liquid and solid based models using different AM methods

CO3: Explore various powder based models using different AM methods

CO4: Familiarize methodology to manipulate the STL file for improved part accuracy and the Applications of AM

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PS O I	PS O II
CO1	H		M			M						M		M
CO2	H		H			H						H		H
CO3	M		H		L	L						L		H
CO4	H		H		M	M						M		H

(L-Low, M-Medium, H-High)

UNIT-I

Introduction: Additive Manufacturing, AM Parts Used, Generic AM Process, Distinction between AM and CNC Machining, Prototype Fundamentals, Historical Development, Fundamentals of RP, Advantages of RP, Classification of RP processes.

UNIT - II

Stereo Lithography System - Process, Principle, Strengths and weaknesses, Applications.

Solid Ground Curing (SGC) - Process, Principle of operation, Strengths and Weaknesses, Applications.

Laminated Object Manufacturing (LOM) - Principle of Operation, LOM materials, Process, Strengths and weaknesses, Applications.

UNIT –III

Fused Deposition Modeling (FDM) -Principle, process, Strengths and weaknesses, Applications.

Laser Engineering Net Shaping (LENS): Principle, process, Strengths and weaknesses, Applications.

Selective Laser Sintering (SLS): Principle, process, Strengths and weaknesses, Applications

UNIT IV

Software for RP: STL format, STL file problems, Consequences of building valid and invalid tessellated models, STL file manipulation.

Applications: Applications in Design, Applications in Engineering, Analysis and Planning, Design and Production of Medical Devices.

TEXT BOOKS:

- [1] C K Chua, K F LEONG, C S LIM , Rapid prototyping 3rd edition, Principles & Application, NAnyang Technological University, Singapore 2010
- [2] Ian Gibson. David Rosen, Brent Stucker – “Additive Manufacturing Technologies, 3D Printing, Rapid Prototyping, Direct Digital Technologies”, Second Edition, Springer, 2015.

REFERENCE BOOKS:

- [1] Andreas Gebhardt, Jan- Stefen Heotter,” Additive Manufacturing. 3D printing for Prototyping and Manufacturing”, Hanser Gardner Publications, 2016.
- [2] Bandyopadhyay, Amit, Bose, Susmita. “Additive Manufacturing”, CRC Press, 2016.

E-RESOURCES AND OTHER DIGITAL MATERIAL:

Web Resources:

- [1] http://www.additive3d.com/rp_int.htm
- [2] <https://www.rolanddga.com/applications/rapid-prototyping>
- [3] <http://www.emeraldinsight.com/journal/rpj>
- [4] <http://additivemanufacturing.com/>
- [5] http://www.eos.info/additive_manufacturing/for_technology_interested

NPTEL Videos:

- [1] <https://www.youtube.com/watch?v=7L42aRs68WI>
- [2] <https://www.youtube.com/watch?v=3Z80AcM09nQ>
- [3] https://www.youtube.com/watch?v=eLw_RBF4WQ8
- [4] <https://www.youtube.com/watch?v=LCQoi10cGTo>

23ME5351 FUELS AND I.C ENGINES LABORATORY

Course Category: Programme Core

Credits: 1.5

Course Type: Laboratory

Lecture-Tutorial-Practice: 0-0-3

Continuous Evaluation: 30

Semester end Evaluation: 70

Prerequisites: Knowledge on working of Fuels & I.C.Engines

Total Marks: 100

Course Outcomes:

Upon successful completion of the course the students will be able to

- CO1** Measure the thermal properties of different fuels & lubricants
- CO2** Determine the efficiency of Compressor and Blower
- CO3** Evaluate the operating characteristics of I.C.Engines
- CO4** Draw the valve and port timing diagrams of two and four stroke Engines.
- CO5** Calibrate a pressure gauge for accuracy

Contribution of Course Outcomes towards achievement of Program Outcomes
(L-Low, M-Medium, H-High)

COs /POs	1	2	3	4	5	6	7	8	9	10	11	12	PSOI	PSOII
CO1	M			H		H							M	
CO2	M			H									M	
CO3	M			H		H							M	
CO4	M			H									L	
CO5	M			H									L	

Course Contents: Any Ten of the following:

Fuels Laboratory:

- To determine the viscosity of the given sample of oil at various temperatures in Redwood standard seconds using Redwood/Saybolt Viscometer.
- To test the given pressure gauge using Dead weight pressure gauge tester.
- To draw the port/valve time diagram of petrol/diesel engine.
- To determine the calorific value of the given solid fuel by Bomb Calorimeter
- To determine the calorific value of the given Gaseous fuel by Junkers Calorimeter
- To determine the Flash and Fire Points of the given oil by Abel's Apparatus.
- To study assembling and disassembling of Two stroke, single cylinder petrol engine

I.C.Engines Laboratory:

- To conduct a performance test on a four stroke, single cylinder Diesel engine With Eddy current Dynamometer.

2. To conduct a performance test on twin cylinder diesel engine with electrical Dynamometer.
3. To conduct a test on Air compressor to determine the volumetric efficiency and Isothermal efficiency at various delivery pressures.
4. To measure the discharge of air through the blower test rig.
5. To conduct a performance test on a four stroke, single cylinder Petrol/LPG Engine with Eddy current dynamometer.
6. To Prepare Heat Balance sheet on single cylinder Diesel/petrol engine.
7. To conduct a performance test on a four stroke, single cylinder Diesel engine with Band brake Dynamometer using Bio-Diesel.
8. To Determine the frictional loss of the engine at its rated speed by Retardation Test.
9. To Distill the given sample of gasoline and to draw the distillation Characteristic of the oil.

Reference: Internal Combustion Engines - V. Ganesan, 4th Edition, 2017 TMH Pub.

23ME5352 MACHINE TOOLS LABORATORY

Course Category : Programme Core

Credits: 1.5

Course Type : Practical

Lecture/Tutorial/Practice: 0/0/3

Prerequisites:

Continuous Evaluation: 30

20ES1153 Workshop practice Lab

Semester End Evaluation: 70

Total Marks: 100

Course Outcomes:

Upon successful Completion of the course, the student will be able to:

CO1: Illustrate Lathe machine constructional details and perform various Lathe operations.

CO2: Exhibit the ability in developing sequence of machining operations using drilling machine.

CO3: Demonstrate milling machine constructional details and perform different Milling operations.

CO4: Develop the models independently by using Shaping, Planning and Slotting machines.

CO5: Explain the Surface and centerless Grinding machine constructional details and perform various grinding operations.

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSOI	PSO II
CO 1			H	H										H
CO 2			H	H										H
CO 3			H	H										H
CO 4			H	H										H

(L-Low, M-Medium, H-High)

Course content

1. Lathe:

- (a) Step Turning, Taper Turning, Knurling, Threading, Drilling and Boring.
- (b) Measurement of cutting forces using dynamometer during turning operation.

2. Drilling:

Drilling, Reaming, counter boring and counter sinking on drilling machine.

3. Milling:

- (a) Manufacturing of Key-way, concave & convex, dovetail cutting, T-slot cutting
- (b) Gear manufacturing using indexing mechanism in milling machine.

4. Shaping:

Making models by involving production of flat surface, External keyway

cutting, Stepcutting and internal keyway cutting on shaping machine.

5. Planing and Slotting:

- (a) Plain surface finishing performed by planing machine
- (b) Making of round to square shape, internal keyways and external keyways by Slotting Machine.

6. Tool and cutter grinding and centerless grinding Machine

- (a) Grinding of Single Point Cutting Tools and Multi point cutting tool cutters and drill bit grinding by Tool and Cutter grinding machine.
- (b) Finishing of cylindrical jobs by using centerless grinding Machine

Text Books:

[1] S.K.HajraChowdary, A.K. HajraChowdary, NirjharRoy, "Elements of Workshop Technology, Vol.II".Media Promoters and Publishers Pvt.Ltd, Mumbai, Scitech Publications, Chennai, 2013

23TP 5106 PERSONALITY DEVELOPMENT

Course Category: Institutional Core
Course Type : Learning by Doing
Prerequisites:

Credits: 1
Lecture/Tutorial/ Practice: 0 /0/ 2
Continuous Evaluation: 100

Semester end Evaluation: 00

Total Marks: 100

Course Outcomes:

Upon successful Completion of the course, the student will be able to:

CO1: Understand the corporate etiquette.

CO2: Make presentations effectively with appropriate body language.

CO3: Be composed with positive attitude

CO4: Understand the core competencies to succeed in professional and personal life

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSOI	PSO II
CO 1												M		
CO 2												M		
CO 3												M		
CO 4												M		

(L – Low, M- Medium, H – High)

UNIT – I

1. Self-Introduction
2. Shaping Young Minds – A Talk by Azim Premji (Listening Activity)
3. Self – Analysis, Developing Positive Attitude
4. Perception – Importance of analytical thinking

UNIT – II

1. Communication Skills – Need and Methods
2. Body-Language-I; How to interpret and understand other's body language
3. Body Language – II; How to improve one's own Body Language
4. Anger Management

UNIT – III

1. Stress Management
2. Time Management – Methods of using time effectively
3. Social , Business & Dining Etiquette
4. Telephone and Email Etiquette

UNIT-IV

1. Standard Operation Methods - Note Making & Note Taking
2. Minutes Preparation
3. Email Writing
4. Email – Practice Session
5. Letter Writing – Formal & Informal

UNIT – V

1. Team Building
2. Leadership Qualities
3. Six Thinking Hats

UNIT – VI

1. Vocabulary
2. Correction of Sentences
3. Sentence Completion – Course of Action
4. Sentences Assumptions

UNIT – VII

1. Sentence Arguments
2. Reading Comprehension-Practice work
3. Group Discussion
4. Group Discussion – Practice Session

UNIT-VIII

1. Resume Preparation
2. Interview Skills
3. Mock Interviews

Methodology: Audio—Visuals / Hand Outs (Compiled/Created by Training Division, T&P Cell, VR Siddhartha Engineering College), Board & Chalk and Interactive Sessions.

23ME5653 MECHATRONICS & AUTOMATION LAB

Course Category: Skill Enhancement Course -2

Credits: 1

Course Type : Laboratory

Lecture/Tutorial/ Practice: 0/0/2

Prerequisites: Fundamentals of Electronics Components

Continuous Evaluation: 30

Semester end Evaluation: 70

Total Marks: 100

Course Outcomes:

CO1: Demonstrate knowledge of Modular Automated Production System (MAPS) and logic gates

CO2: Create PLC ladder programs for simple tasks.

CO3: apply timers, counters and comparators commands using PLC

CO4: Operate MAPS system as an integrated flexible manufacturing system.

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO I	PSOI I
CO1	M	M			M				M					M
CO2	M	M			M				M					M
CO3	M	M			H				H					M
CO4	M	M			M				H					M

Course content

Lab Exercises:

1. Understand Modular Automated Production System (MAPS) and use of sensors, controller and communication related issues.
2. Study of PLC programming Language viz. STEP-7 Basic (TIA portal) V13.0
3. Implementation of logic gates viz. OR, AND, NOR, NAND etc. through PLCs.
4. Execute ladder program to regulate actuation of conveyor belt.
5. Use ladder program to perform sorting based on object material type.
6. Use ladder program to perform sorting based on object colour.
7. Use ladder program to perform sorting based on object height.
8. Ladder programming for accomplishing spacing between products on the conveyor
9. Ladder programming for accomplishing rotary pick and place task.

10. Develop programs to index a rotary table for accomplishing automatic bottle filling.
11. Understand fault identification and troubleshooting in automation through MAPS.
12. Demonstrate working of the MAPS system as an integrated flexible manufacturing system.

Text books:

1. Mechatronics Electronic control systems in Mechanical and Electrical Engineering by W. Bolton, PEARSON, 4th Edition, 2011.
2. Introduction to Mechatronics – David and Alcaire Michael B.Histand TMH, 4th Edition, 2006.

Reference Book:

1. E.O.Deobelin, “Measurement Systems –Application and Design”, Tata McGraw Hill, 2004.
2. H S Kalsi, “Electronic Instrumentation”, 2nd Edition, Tata McGraw Hill
3. A Barua, “Fundamentals of Industrial Instrumentation”, Wiley India, 2011.

E-resources and other digital material:

Resources:

- [1] <https://www.mechatronics.colostate.edu/>
- [2] <https://eil-iitg.vlabs.ac.in/>
- [3] https://www.researchgate.net/publication/310239627_Mechatronics_Lab_Manual_ME_6712
- [4] www.NI.com

Video references:

- [1] https://www.youtube.com/watch?v=o4_NeqlJgOs
- [2] <https://www.youtube.com/watch?v=0cpSi8C95DY>
- [3] https://www.youtube.com/watch?v=Hx33qw-z_cQ
- [4] <https://www.youtube.com/watch?v=ZApY8wwWPpg>
- [5] <https://www.youtube.com/watch?v=19aGHGMOx1w>

23ME6301- HEAT TRANSFER

Course Category: Programme Core

Course Type : Theory

Prerequisites:

23ME3303 BTD

23BS4101F FM & HM

Credits: 4

Lecture/Tutorial/ Practice: 3 /1/ 0

Continuous Evaluation: 30

Semester end Evaluation: 70

Total Marks: 100

Course Outcomes:

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

CO1: Solve one dimensional steady state heat conduction problems. (1, 3, 4) [K3]

CO2: Evaluate transient conduction problems and performance of heat exchangers. (1, 3, 4) [K4]

CO3: Apply the convective heat transfer principles and use empirical relations to solve convective heat transfer problems. (1, 3, 4) [K3]

CO4: Apply the Laws of Radiation to compute radiation heat transfer between bodies. (1, 3, 4) [K3]

Cognitive Levels (K): K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO I	PSO II
CO1	H		H	M									M	
CO2	H		H	M									M	
CO3	M		H	M									M	
CO4	M		H	M									M	

(L-Low, M-Medium, H-High)

UNIT – I

Introduction:

Modes and basic laws of heat transfer - steady and unsteady heat transfer, Fourier equation, thermal resistance, thermal conductivity of materials, general heat conduction equation, initial and boundary conditions.

Steady State Conduction:

Conduction through a single and multi-layered plane, cylindrical and spherical walls, conduction with heat generation - plane wall and cylinder with uniform heat generation, critical thickness of insulation.

Heat transfer from extended surfaces:

Steady flow of heat along a rod, heat dissipation from an infinitely long fin, fin insulated at the tip, fin losing heat at the tip, fin performance, thermometric well.

UNIT – II

Transient Heat Conduction:

Transient conduction in solids with infinite thermal conductivity, time constant and response of a thermocouple. One dimensional transient heat flow in solids with finite conduction resistance using Heisler and Grober charts.

Heat Exchangers:

Classification of heat exchangers, performance analysis, overall heat transfer coefficient, fouling factor, LMTD approach, effectiveness and NTU approach.

UNIT – III**Forced Convection:**

Convective heat transfer coefficient, boundary Layer concept, empirical relations for solving problems of forced convection over a flat plate, cylinder and sphere, analogy between momentum and energy transfer, empirical relations for solving problems of forced convection through circular tubes.

Free Convection:

Free convection problems in external flows (vertical, horizontal and inclined plates, vertical and horizontal cylinders, and spheres) using empirical relations.

Concepts of pool boiling and flow boiling regimes, film-wise and drop-wise condensation.

UNIT – IV**Radiation - Processes and properties:**

Introduction, absorptivity, reflectivity and transmissivity, concept of Black body, spectral and spatial energy distribution, Plank's law, Stefan Boltzmann law, Wien's displacement law, Kirchhoff's law, gray body and selective emitters, intensity of radiation, Lambert's Cosine law.

Radiation Exchange between surfaces:

Heat exchange between black bodies, shape factor algebra, heat exchange between non-black bodies– infinite parallel plates and concentric cylinders, small gray bodies, electrical network approach, radiation shields, combined radiation and convection heat transfer coefficient.

Text Books

- | R. K. Rajput, "Heat and Mass Transfer", S Chand & Company Ltd, Publisher, 5th Revised Multi Colour Edition, 2012.
- | D. S. Kumar, "Heat & Mass Transfer", S. K. Kataria & Sons, 9th Edition, 2015.
- | P. K. Nag, "Heat and Mass Transfer", Tata McGraw Hill, 2011.

Reference Books

- | N. Ozisik, "Heat Transfer - A Basic Approach", TMH, 1985.
- | J. P. Holman, "Heat Transfer", Tata McGraw Hill, 2008.
- | Incropera and Dewitt, "Introduction to Heat Transfer", John Wiley, 2011.

E-Resources and other digital material

IIT video lecturers (NPTEL): <https://nptel.ac.in/courses/112101097/>
<https://www.grc.nasa.gov/www/k-12/airplane/heat.html>
<http://study.com/academy/lesson/heat-transfer-phase-changes.html>
<https://www.tes.com/teaching-resource/heat-transfer-convection-11810446>

NOTE: Heat and Mass Transfer Data Book is allowed in the examinations.

23ME6302- ROBOTICS

Course Category: Programme Core

Course Type : Theory

Prerequisites:

Physics for Engineering

Engineering Chemistry

Credits: 3

Lecture/Tutorial/ Practice: 3 /0/ 0

Continuous Evaluation: 30

Semester end Evaluation: 70

Total Marks: 100

Course Objectives:

- To provide basic knowledge of robotic systems, anatomy, types, and components used in automation.
- To introduce robot end effectors, sensors, and vision systems for intelligent operation.
- To develop skills in kinematics, transformations, and motion analysis of manipulators.
- To familiarize students with AI integration in robotics through industrial case studies and applications.

Course Outcomes:

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

CO1: Describe the structure, anatomy, and classification of industrial robots and their applications.

CO2: Identify and explain various end effectors, grippers, and machine vision systems used in robotic applications

CO3: Explain the working principles of different sensors and their role in robot control and feedback systems.

CO4: Apply kinematic concepts and analyse the integration of AI techniques in robotic systems for industrial automation.

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO I	PSO II
CO1	H	M											L	L
CO2	H	M											L	L
CO3	H	M											L	L
CO4	H	M											L	L

(L-Low, M-Medium, H-High)

UNIT I

Introduction: Robotics, Robot Anatomy, Degree of freedom, Work volume, Robot Components, Classification of robots by coordinate system and control system, Precision of movement, specification of robots, Economic Considerations, Fixed versus flexible automation, Applications of robots.

UNIT II

Robot End Effectors: Introduction, End effector, Types of end effectors, Grippers – Mechanical grippers, Vacuum cups, Magnetic grippers, Adhesive grippers, Hooks, scoops

and other miscellaneous devices, Tools as end effectors, Robot/End effector interface, considerations in the selection and design.

Machine Vision: Introduction, Functions of machine vision, applications of machine vision.

UNIT III

Robotic Sensory Devices: Introduction, Non-optical position sensors – potentiometers, Linear Variable Differential Transformers, optical position sensors – opto interrupters, optical encoders (absolute & incremental).

Proximity Sensors: Contact type, Non-contact type – reflected light scanning laser sensors.

Touch & Slip Sensors: Tactile sensors – proximity rod & photo detector sensors, slip sensors – Forced oscillation slip sensor, interrupted type slip sensors

UNIT IV

Transformations and Kinematics: Objectives, Forward and inverse kinematics, homogenous coordinates, basic transformation operations, forward solution – Denavit Hartenberg procedure. Simple problems involving homogeneous transformations as applicable to rotation and translation.

Integration of AI and Robotics: Introduction, the Five Levels of Autonomy in Robots, Case Studies in AI-Based Robotics: Predictive Maintenance, Autonomous Mobile Robots, Quality Inspection, Precision Agriculture.

Text books:

1. Robotic Engineering by Richard D.Klafter, Prentice Hall, Tata Mc Graw-Hill, 1995. 3rd Edition.
2. Mikell P. Groover, Industrial Robotics: Technology, Programming, and Applications, Tata McGraw-Hill Education, 1st Edition, 2008.

Reference books:

1. International Federation of Robotics (IFR), Artificial Intelligence in Robotics – Position Paper, IFR Publications, 2022.
2. Introduction to Robotics – John J. Ceaig, Addison Wesley, 3rd Edition
3. Robotics – K. S. Fu, Gonzalez & Hee, Tata Mc Graw-Hill, 1995. 3rd Edition.
4. Robotics for Engineers by Yoram Koren. Tata Mc Graw-Hill, 1995. 3rd Edition.

E-resources and other digital material:

1. https://onlinecourses.nptel.ac.in/noc21_me32/preview?utm_source=chatgpt.com
2. https://youtube.com/playlist?list=PLYqSpQzTE6M_XM9cvjLLO_Azt1FkgPhpH&si=5oSi-FfEcKg1AEly
3. https://youtu.be/AsxvuSTXhbw?si=IA5N1W_KX80d0tjp

23ME6303-DESIGN OF TRANSMISSION SYSTEMS

Course Category: Programme Core

Course Type : Theory

Prerequisites:

Engineering Mechanics

Kinematics of Machinery

Mechanics of Materials

Design of Machine Elements

Credits: 4

Lecture/Tutorial/ Practice: 3 /1/ 0

Continuous Evaluation: 30

Semester end Evaluation:70

Total Marks:100

Course Outcomes:

Upon successful Completion of the course, the student will be able to:

CO1: Design shafts, keys and couplings under different loading conditions

CO2: Explain the philosophy of lubrication and design the journal and roller bearings

CO3: Design different types of clutches and brakes

CO4: Determine the key design parameters for transmission systems like spur and helical gears and IC engine components such as piston and connecting rod

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO I	PSO II
CO1	M	H	H											M
CO2	M	H	H											M
CO3	M	H	H											M
CO4	M	H	H											M

(L-Low, M-Medium, H-High)

UNIT - I

Shafts: Design of solid and hollow shafts for strength – For Bending, Torsion, Combined bending and torsion and combined bending, torsion and axial loads.

Keys: Introduction, Design of square and flat keys

Shaft Couplings: Rigid couplings – Muff, split muff couplings, Flexible coupling

UNIT - II

Bearings and Lubrication: Lubrication, Types of lubrications, types of lubricants, properties of lubricants, types of Bearings, Bearing materials, Journal bearing design (using McKee's equation and Raymond and Boyd charts & tables)

Ball and Roller Bearings: Static load, Dynamic load, Equivalent radial load, selection of ball and roller bearings

UNIT – III

Brakes:- Introduction to Brakes, Types, Analysis and design of block brakes, band brakes, block and band brakes

Clutches: Analysis and design of simple and multiple disc clutches, centrifugal clutches, friction materials; comparison of brakes and clutches

UNIT – IV

Spur Gears: Terminology of spur gear, standard systems of Gear Tooth, Force analysis, Gear tooth failures, Lewis Equation.

Helical Gears: Terminology of helical gears, virtual number of teeth, Tooth proportions, force analysis, Lewis Equation.

I. C. Engine Components: Introduction, Design of trunk type piston and connecting rod

Text Books:

[1] V B Bhandari, —Design of machine elements, Fourth Edition, Tata McGraw Hill Education Private Limited, 2017.

[2] P.C. Sharma & D.K. Agarwal, —A Text Book Of Machine Design, SK Kataria & Sons, 2013

Reference books:

[1] R.S Khurmi & J.K. Gupta, —A Text book of Machine Design, Fourteenth Edition, S.Chand & Co Ltd, 2015

[2] Robert L.Norton,—Machine Design- An Integrated Approach, Fifth Edition, Pearson Education, 2018.

[3] P. Kannaiah, —Machine Design, Second Edition, Scitech Publications Private Limited, 2011.

DATA BOOKS TO BE ALLOWED IN EXAMINATION:

[1] Mahadevan & Balaveera Reddy, —Design data book, - CBS Publishers

[2] V.B.Bhandari, —Design data book, Tata McGraw Hill book Co

[3] Design data book, P.S.G. College of Technology, Coimbatore

E-resources and other digital material:

[1] <http://nptel.ac.in/courses/112/105/112105124/>

[2] <http://nptel.ac.in/courses/112/105/112105125/>

[3] <http://nptel.ac.in/courses/112/106/112106137/>

23ME6404A

FINITE ELEMENT METHOD

Course Category: Programme Elective

Credits: 3

Course Type: Theory

Lecture/Tutorial/ Practice: 3 /0/ 0

Prerequisites: 23ME3304- Mechanics of Materials,
23ME6302 - Heat Transfer

Continuous Evaluation: 30

Semester End Evaluation: 70

Total Marks: 100

Course Outcomes:

Upon successful Completion of the course, the student will be able to:

CO 1: Understand the philosophy of FEM and solve 1-D bar problems.

CO 2: Apply FEM to planar truss and beam problems.

CO 3: Apply FEM to 2-D plane-stress, plane-strain and axisymmetric problems, and perform 1-D numerical integration.

CO4: Apply FEM to 1-D and 2-D steady state heat transfer problems.

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSOI	PSOII
CO1	M	H	L		M									M
CO2	M	H	L		M									M
CO3	M	H	L		M									M
CO4	M	H	L		M								M	

(L-Low, M-Medium, H-High)

UNIT – I

Fundamental concepts: Introduction, stresses and equilibrium, boundary conditions, strain-displacement relations, stress-strain relations for plane stress, plane strain, 2-D axisymmetric and three-dimensional cases, potential energy and equilibrium; the Rayleigh-Ritz method, Galerkin's method.

Basic concepts of FEM and one dimensional problems: Fundamental concepts, Finite Element Modeling using linear 1-D elements, coordinates and shape functions, the potential energy approach, element stiffness matrix and element load vector, assembly of the global stiffness matrix and load vector, properties of global stiffness matrix, the Finite Element equations; treatment of boundary conditions, examples of axially loaded members.

UNIT – II

Plane trusses: Introduction, plane trusses, local and global coordinate systems, element stiffness matrix, treatment of boundary conditions, stress calculations, example of plane truss with three members.

Planar beams: Introduction, potential energy approach, element stiffness matrix for two node planar beam element, load vector, boundary conditions, simple beam problems.

UNIT – III

Two dimensional problems: Introduction, plane stress and plane strain, Finite Element Modeling, Constant Strain Triangle (CST); potential energy approach, derivation of element stiffness matrix, derivation of force vector for body forces and linearly varying pressure load, problem modeling and boundary conditions. simple problems.

Finite element formulation for an axisymmetric linear triangular element, potential energy approach, derivation of element stiffness matrix, derivation of force vector for body forces and uniformly distributed pressure load, simple problems. **Numerical integration:** One- dimensional integrals using one-point formula, One-dimensional integrals using two-point formula.

UNIT – IV

One-dimensional steady state heat transfer: Introduction, one dimensional steady state heat conduction, Governing equation, boundary conditions: specified temperature, convection and heat flux, Galerkin's approach for heat conduction using linear 1-D elements, one-dimensional steady state heat transfer in thin fins using linear 1-D elements. Simple problems.

Two-dimensional steady state heat transfer: Two dimensional steady state heat conduction, Differential equation, boundary conditions: specified temperature, convection and heat flux, Galerkin's approach for 3-node triangular elements, Derivation of element matrices, simple problems with maximum 3 unknowns.

Text book:

- [1] Introduction to Finite Elements in Engineering by T. R. Chandrupatla and A. D. Belegundu, 3rd Edition, PHI Learning Private Limited, 2011.

Reference books:

- [1] Singiresu S. Rao, "The Finite Element Method in Engineering", Fifth edition, Butterworth-Heinemann, 2011.
- [2] Applied Finite Element Analysis – Larry J. Segerlind, John Wiley and Sons, Second Edition, 1984

E-resources and other digital material:

- [1] https://en.wikipedia.org/wiki/Finite_element_method
- [2] <http://reference.wolfram.com/applications/structural/FiniteElementMethod.html>
- [3] <https://www.youtube.com/watch?v=oNqSzzycRhw>

23ME6404B

MECHANICAL VIBRATIONS

Course Category: Humanities & Social Sciences

Credits: 3

Course Type : Theory

Lecture/Tutorial/ Practice: 3 /0/ 0

Prerequisites: Engineering Mechanics,
Machine dynamics

Continuous Evaluation: 30

Semester end Evaluation: 70

Total Marks: 100

Course Outcomes:

Upon successful Completion of the course, the student will be able to:

CO1: Analyze single degree of freedom damped and un-damped systems executing free Vibrations.

CO2: Analyze single degree of freedom forced vibration systems and critical speeds of shafts.

CO3: Interpret the concepts of un-damped two-degrees of freedom systems and vibration absorbers.

CO4: Analyze multi-degree of freedom systems natural frequencies and mode shapes.

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO I	PSOII
CO1	H	H	M											M
CO2	H	H	M											M
CO3	H	H	M											M
CO4	H	H	M											M

(L-Low, M-Medium, H-High)

UNIT - I

Free vibrations of un-damped and damped single DOF systems: Overview of un-damped single DOF systems, Different types of damping, Free vibrations with viscous damping, Over-damped system, Critically-damped system, Under-damped system, Logarithmic decrement.

Forced vibrations of single DOF systems: Introduction, Forced vibrations with constant harmonic excitation, steady state vibrations.

UNIT - II

Applications of Forced vibrations of single DOF systems: Forced vibrations with rotating and reciprocating unbalance, Forced vibrations due to excitation of the support, Energy dissipated by damping, Vibration isolation and transmissibility.

Critical speeds of shafts: Critical speed of a light shaft having a single disc without damping, critical speed of a light shaft having a single disc with damping.

UNIT – III

Un-damped two-degrees of freedom systems: Natural frequencies of rectilinear and torsional systems, Semi-definite system, generalized coordinates and co-ordinate coupling.

Vibration absorbers: un-damped dynamic vibration absorber, centrifugal pendulum absorber.

UNIT – IV

Multi-Degree of freedom systems: Free vibrations- equations of motion, Influence coefficients, Natural frequencies and mode shapes (Eigen values and Eigenvectors). Orthogonal properties of normal modes.

Torsional Vibrations of Multi Rotor Systems: Vibrations of geared systems

Text Books:

- [1] Mechanical Vibrations by G. K. Grover, New Chand & Bros, 8th edition, 2009.
- [2] Mechanical Vibrations by Dr.R.K.Singal, S.K.kataria& Son, First edition, 2010-2011.

Reference books:

- [1] Mechanical Vibrations by Dilip Kumar Adhwarjee, Laxmi Publications, 1st Edition, 2007
- [2] Mechanical Vibrations by V.P.singh, DhanpatRai& Co. (P) Ltd, Delhi, 4th edition, 2015
- [3] Mechanical Vibrations by Singiresu S Rao, Prentice Hall, Fifth Edition, 2011

E-resources and other digital material:

- 1. <http://nptel.ac.in/courses/112103112/1>
- 2. <http://freevideolectures.com/Course/2684/Mechanical-Vibrations>

23ME6404C
ADVANCED MECHANICS OF MATERIALS

Course Category: Programme Elective

Credits: 3

Course Type : Theory

Lecture/Tutorial/ Practice: 3 /0/ 0

Prerequisites: 20ES1104C Engineering Mechanics – I
20ME3302 Mechanics of Materials

Continuous Evaluation: 30

Semester end Evaluation: 70

Total Marks: 100

Course Objective:

The objective of this course is to provide an in-depth understanding of the behavior of materials and structural members under complex loading conditions. It aims to extend the fundamental concepts of stress, strain, and deformation learned in mechanics of materials to more advanced topics such as statically indeterminate structures, energy methods, Thick wall shells, centrifugal stresses, curved beams, unsymmetrical bending. The course enables students to analyze and design engineering components considering realistic loading and material behaviors for practical applications in mechanical and structural systems.

Course Outcomes:

Upon successful Completion of the course, the student will be able to:

CO1: Compute stress, strain, and deformations for statically in-determinate bars.

CO2: Sketch Shear force and bending moment diagrams for in-determinate beams.

CO3: Inspect stresses and strains in pressure vessels & rotating discs.

CO4: Identify shear centers and calculate stresses in curved beams.

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSOI	PSO II
CO1	H	L	M											M
CO2	M	M	H											M
CO3	M	M	H											M
CO4	M	M	H											M

(L-Low, M-Medium, H-High)

UNIT – I

Statically Indeterminate Bars: Introduction, Analysis of bars of composite sections, Thermal stresses in composite bars.

Strain Energy and Energy Principles: Introduction, strain energy of axial loaded members, gradually applied load, suddenly applied load, impact loading.

UNIT - II

Fixed Beams: Introduction, Shear force and bending moment diagrams of fixed beams, Analysis by the differential equations of the Deflection curve, Slope and deflections by integration of bending moment equations, Macaulay's Method.

Continuous Beams: Introduction, Clapeyron's theorem of three moments, Shear force and bending moment diagrams of continuous beams, Beams with overhang and fixed ends.

UNIT – III

Thick Cylindrical and Spherical Pressure Vessels: Stresses in a thick cylindrical shell, Stresses in compound thick cylinders, Initial difference in radii at the junction of the compound cylinder for Shrinkage, Stresses in thick spherical shells.

Centrifugal Stresses: Introduction, Rotating Ring, Rotating Disc, Rotating Disc of uniform strength.

UNIT – IV

Curved Beams: Stresses in Beams of small and large initial curvature, The Winkler-Bach theory, Stresses in Crane Hook with trapezoidal cross-section.

Shear Center: Shear centre, determination of shear centre for channel section, determination of shear centre for I – section.

Text Books:

- [1] R.K.Bansal, “Strength of Materials” Fifth edition, Laxmi Publishers, 2012
- [2] Dr. Sadhu Singh, “Strength of Materials”, Ninth edition, Khanna Publishers, 2007.

Reference books:

- [1] R.K. Rajput, “Strength of Materials”, First Edition, S.Chand & Company, 2006.
- [2] S.S.Rattan, “Strength of Materials”, Second Edition, Tata McGraw Hill Education Private Limited, 2012.
- [3] Surendra Singh, “Strength of Materials”, First Edition, S.K.Kataria & Sons.

E-resources and other digital material:

- [1] Prof. S.K.Maiti, IIT Bombay, Advanced Strength of material, [English],
Web <https://nptel.ac.in/courses/112101095/>
<http://www.nptelvideos.in/2012/12/advanced-strength-of-materials.html>
- [2] James M. Gere and Barry J. Goodno, “Mechanics of Materials”, Eighth edition, CENGAGE Learning, 2009
https://www.academia.edu/31679740/Mechanics_of_Materials_8th_Edition

23ME6405 A- METROLOGY

Course Category: Programme Elective

Course Type : Theory

Prerequisites:

Basics of Mechanical Engineering

Physics for Engineers

Credits: 3

Lecture/Tutorial/ Practice: 3/0/0

Continuous Evaluation: 30

Semester end Evaluation: 70

Total Marks:100

Course Objective:

The objective of this course is to provide students with a comprehensive understanding of measurement principles, standards, and techniques used to ensure accuracy, precision, and quality in engineering manufacturing processes. It aims to develop knowledge of various measuring instruments, systems of limits, fits and tolerances, gauges, surface finish measurement, and advanced metrology techniques. The course also focuses on enabling students to select appropriate measurement methods and instruments for inspection and quality control in industrial applications.

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

CO1: Identify various devices for linear and angular measurements.

CO2: Distinguish the limits, fits, tolerances, interchangeability and gauge design.

CO3: Classify knowledge on comparators and surface roughness measuring instruments

CO4: Demonstrate the interferometer, CMM and form measuring instruments.

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO I	PSO II
CO1	H													M
CO2	H	M	M											M
CO3	M													M
CO4	M													M

(L-Low, M-Medium, H-High)

UNIT – I:

Metrology: Introduction, scope, activities, objectives, categories, need of inspection, accuracy and precision, factors effecting accuracy.

Standards of Length and Angle: End standards, line standards, wavelength standards, slip gauges, angle gauges, sine bars, and spirit levels.

UNIT – II:

Limits, fits and gauges: Theory of limits, Fits, Tolerances and their selection, Hole Basis and shaft basis systems, IS system of limits & fits, Simple problems. Interchangeability, Selective Assembly, Limit gauges, Taylor's Principle of limit gauging, plug gauges, Ring gauges and their applications.

UNIT – III:

Comparators: Mechanical comparators- Read comparator, Sigma comparator, Solex pneumatic gauge, Electrical & Electronic comparator, projectors, Tool Maker's Microscope, Auto collimator and angle dekkor

Measurement of surface finish: Surface texture, roughness, waviness, Indian standard terminology, Various methods of measuring surface finish, Tomlinson surface meter and Taylor Hobson Talysurf.

UNIT – IV:

Advances in Metrology: Laser interferometry, Michelson Interferometer, Single frequency DC Interferometer, AC Laser Interferometer, AC Laser Interferometer, Basic concept of CMM, types of CMM, constructional features, and applications.

Form Measurement: Principles and methods of straightness, flatness measurement, thread measurement and gear measurement.

Text books:

- [1] Metrology - R.K.Jain, Twenty First Revised edition. 2015, Khanna publishers
- [2] A Textbook of Metrology by M Mahajan, 2nd edition 2011, Dhanpath Rai Publications.
- [3] Engineering Metrology by Vinod Thombre Patil, , First edition 2018, Nirali Prakasan.

Reference Books:

- [1] Engg.Metrology – D.M.Antony
- [2] A Text book of Engg.Metrology – I.C.Gupta., 7th Edition, Dhanapathrai publications
- [3] Hand Book of Industrial Metrology – ASTM.
- [4] Mechanical Measurements by T. G. Beckwith, Roy D. Marangoni, John H. Lienhard V.6th edition.2009, Pearson Prentice Hall

E-resources and other digital material:

- [1] <http://www.metrologymetro.com>
- [2] <http://www.emtoolbox.nist.gov/>.
- [3] <http://en.wikipedia.org/wiki/Metrology#Basics>

23ME6405B -Theory of Metal Cutting

Course Category: Programme Elective

Credits: 3

Course Type : Theory

Lecture/Tutorial/ Practice: 3 /0/ 0

Prerequisites:

Continuous Evaluation: 30

Manufacturing Processes

Semester end Evaluation: 70

Machine Tools

Total Marks: 100

Course Outcomes:

Upon successful Completion of the course, the student will be able to:

CO1: Explain the ASA, ORS and NRS systems of tool geometry and derive their Inter-relationships.

CO2: Develop the relations for chip reduction coefficient, shear angle, shear strain, Forces, power and specific energy with orthogonal cutting.

CO3: Analyze thermal aspects and tool wear relationships in orthogonal cutting.

CO4: Select cutting tool material for improving tool life and understand the mechanics of Multipoint cutting tool machining.

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	M		M											M
CO2	M		M											M
CO3	M		M											M
CO4	M		M											M

(L-Low, M-Medium, H-High)

UNIT I

Introduction: Classification of Mfg. Processes, History of Machining, Scope and Significance of Machining.

Geometry of Cutting Tools: Geometry of single-point cutting tool: Tool-in hand system, ASA system, Significance of various angles of single point cutting tools, Orthogonal Rake System (ORS), Conversions between ASA and ORS systems – Graphical and Analytical Methods, Normal Rake System (NRS) & relation with ORS.

UNIT II

Mechanics of Machining Processes: Orthogonal and Oblique cutting, Types of chips, chip-breakers, Chip reduction coefficient, shear angle, shear strain, Built- Up-Edge and its effect in metal cutting.

Merchant's analysis of metal cutting process: Various forces, power and specific energy in cutting, Problems on Tool Geometry and Mechanics of Machining.

Theories of Metal Cutting: Ernst & Merchant theory, Modified Merchant's theory, Lee & Shaffer Theory, Chip-tool Natural Contact Length – Hahn's Analysis Stress distribution at Chip-Tool Interface – Zorev's Analysis, Machining with controlled contact cutting,

UNIT III

Thermal aspects in Machining: Sources of heat generation, Effects of temperature, Determination of cutting temperature using analytical methods, Determination of cutting temperature using experimental methods, Methods of Controlling Cutting Temperature.

Tool wear, Tool life, Machinability and Machining Economics: Wear Mechanisms, Types of tool wear, Tool Life and Machinability, A brief treatment for single pass turning operations, Problems on Economics of Machining.

UNIT IV

Cutting Tool Materials: Desirable Properties of tool materials, Characteristics of Cutting Tool Materials, inserts, coated tools.

Mechanics of Multipoint Machining processes: Drill Geometry & Mechanics of Drilling Process, Geometry of Milling Cutters and Mechanics of Milling process, Mechanics of Grinding (plunge grinding and surface grinding), Grinding wheel wear.

Oblique Cutting: Mechanics of Oblique Cutting.

Text Books:

- [1] M. C. Shaw, Metal cutting-Principles and Practices, Cambridge University press. 2005
- [2] Rao PN, Manufacturing Technology–Metal Cutting and Machine Tools, 3/e, TMH, New Delhi, 2013.
- [3] Bhattacharya A, Metal Cutting: Theory and Practice, New Central Book Agency, Kolkata, 2007

Reference books:

- [1] Winston A. Knight and Geoffrey Boothroyd, Fundamentals of Machining and Machine Tools, 3/e, Taylor & Francis Group, 2005.
- [2] Trent, E. M. and P. K. Wright, Metal Cutting, 4 th edition, Butterworth-Heinemann, 2000

E-resources and other digital material:

- [1] <https://openoregon.pressbooks.pub/manufacturingprocesses45/>
- [2] www.americanmachinist.com/
- [3] <http://www.machinetools.net.tw/>

23ME6405C- METAL FORMING

Course Category: Elective

Course Type : Theory

Prerequisites: Strength of Materials

Credits: 3

Lecture/Tutorial/ Practice:3 /0/ 0

Continuous Evaluation: 30

Semester end Evaluation:70

Total Marks:100

Course Outcomes:

Upon successful Completion of the course, the student will be able to:

CO 1: Understand fundamentals of metal forming.

CO 2: Know various process parameters and applied loads in forging and sheet metal working.

CO 3: Analyze Rolling and Extrusion processes and associated parameters.

CO4: Analyze Drawing and various High Energy Rate forming processes.

Contribution of Course Outcomes towards achievement of Professional Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO I	PSO II
CO1	M	M	M											H
CO2	M	M	M											H
CO3	M	M	M											H
CO4	M	M	M											H

(L-Low, M-Medium, H-High)

UNIT – I

Fundamentals of Metal Forming: Concepts of true stress and true strain. Stress-strain relationship in plastic deformation. Yield criteria and their significance, Tresca & Von-Mises yield criteria. Formability limits. Classification of forming processes, Mechanisms of metal forming: slab method, deformation energy method, temperature of metal working, hot working, Warm working, cold working friction and lubricants., Strain rates in metal forming. Super plasticity. Development of metallurgical structure during deformation

UNIT – II

Forging: Classification of forging processes, forging of plate, forging of circular discs, open die and closed-die forging, forging defects, and powder metallurgy forging. Problems on flow stress, true strain and forging load.

Press tools: General classification and components of press tools. Types of dies like simple dies, compound dies combination dies and progressive dies. Blanking, punching, problems on Blanking and punching force, clearances, Elastic recovery and shear.

Sheet metal forming: Forming methods, bending, stretch forming, Spinning.

UNIT – III

Rolling: Rolling processes, forces and geometrical relationship in rolling, simplified analysis, rolling load, rolling variables, theories of cold and hot rolling, problems and defects in rolling, torque and power calculations, Problems.

Extrusion: Classification, Hot Extrusion, Analysis of Extrusion process, defects in extrusion, extrusion of tubes and production of seamless pipes. Problems on extrusion load.

UNIT – IV

Drawing: Drawing of tubes, rods, and wires: Wire drawing and tube drawing processes, analysis of wire, deep drawing and tube drawing .Problems on draw force.

Advanced Metal forming processes: Electromagnetic forming. Explosive Forming, Electrohydraulic forming.

Miscellaneous Forming Processes: Coining, Thread Rolling, Tube piercing,

Text Books:

1. Manufacturing Science- Amitabha Ghosh , Asok Kumar Mallik, EWP
2. Mechanical Metallurgy by G. E. Dieter, McGraw-Hill.
3. Fundamentals of Metal Forming Processes – B.L. Juneja

Reference Books:

1. Metal Forming: Fundamentals and Applications by Taylan Altan (ASM Series in Metal Processing)
2. Introduction to Industrial Mechanical Working Process by G. W. Rowe
3. Materials & Processes In Manufacturing By E.Paul De Garmo, J T Black & Ronald A Koshav
4. Modern Control Engineering by Ogata, PHI Publ. Prentice-Hall of India Pvt. Ltd.
5. Manufacturing Technology (Foundry, Forming and Welding) by P. N. Rao, TMH.

E-resources

- [1] https://www.iitg.ac.in/engfac/ganu/public_html/Metal%20forming%20processes_full.pdf
- [2] https://www.vssut.ac.in/lecture_notes/lecture1525419667.pdf
- [3] https://www.uobabylon.edu.iq/eprints/publication_1_29712_1045.pdf

Open Elective – II
(NPTEL)

- A. Solar Energy Engineering & Technology
- B. Sustainable Energy Technology
- C. Fundamentals of Artificial Intelligence
- D. Artificial Intelligence & Machine Learning in Materials Engineering.

23ME6351- HEAT TRANSFER LABORATORY

Course Category: Programme Core

Credits:1.5

Course Type: Laboratory

Lecture/Tutorial/Practice:0/0/3

Prerequisites: Basic Thermodynamics,
Fluid Mechanics, Heat Transfer

Continuous Evaluation: 30

Semester end Evaluation: 70

Total Marks: 100

Course Outcomes:

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

CO1: Evaluate steady and unsteady heat conduction.

CO2: Evaluate heat transfer by convection and combined modes.

CO3: Determine Stefan Boltzmann constant and Emissivity of a grey body.

CO4: Determine COP of Refrigeration and Air conditioning systems.

Contribution of Course Outcomes towards the achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	L2	PSOI	PSO II
CO 1			M	H	L								M	
CO 2			M	H	L								M	
CO 3			M	H	L								M	
CO 4			M	H	L								M	

(L-Low, M-Medium, H-High)

Experiments:

1. Measurement of Thermal conductivity of metal rod
2. Measurement of Thermal conductivity of insulating powder
3. Heat transfer through a lagged pipe apparatus
4. Heat transfer from pin fin in forced convection
5. Heat transfer by forced convection through a duct
6. Heat transfer by natural convection over a cylindrical surface
7. Heat transfer in Parallel flow and Counter flow heat exchangers
8. Heat transfer in Cross flow heat exchanger
9. Determination of Stefan Boltzmann constant
10. Measurement of Emissivity of a Grey surface
11. Determination of COP of Vapour compression refrigeration system
12. Determination of COP of an Air conditioning system
13. Estimation of Transient heat conduction

NOTE: Heat and Mass Transfer Data Book is allowed in the examination.

23ME6352 - SIMULATION AND ANALYSIS LABORATORY

Course Category: Programme Core

Credits:1.5

Course Type : Laboratory

Lecture/Tutorial/ Practice: 0 /0/ 3

Prerequisites : Engineering Mechanics
Mechanics of Materials

Continuous Evaluation:30

Semester end Evaluation:70

Total Marks:100

Course Objective:

The objective of this laboratory course is to enable students to gain practical knowledge and hands-on experience in using ANSYS software for the simulation and analysis of engineering problems. It aims to develop the ability to model, analyze, and interpret results for structural & thermal systems using finite element methods. Students will learn how to apply boundary conditions, mesh generation, and material properties to simulate real-world engineering scenarios and validate analytical or experimental results.

Course Outcomes:

Upon successful Completion of the course, the student will be able to:

CO1: Understand fundamental concepts of finite element methods

CO2: Simulate and analyze stepped bars

CO3: Simulate and analyze plane trusses

CO4: Simulate and analyze beams

CO5: Simulate and analyze 1-D heat transfer.

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSOI	PSO II
CO1	L		M		H							M		M
CO2	L		M		H							M		M
CO3	L		M		H							M		M
CO4	L		M		H							M		M
CO5	L		M		H							M	M	

(L-Low, M-Medium, H-High)

Course Content:

Finite Element Analysis Package (ANSYS)

1. Fundamental Concepts in Finite Element Methods with an example of stepped bar.
2. ANSYS ® Graphical User Interface.
3. Two step bar analysis.

4. Multi step and different material determinate and in-determinate bars analysis.
5. Finite Element Method for Plane truss analysis.
6. Simulation of Plane truss.
7. Finite Element Method for analysis of beams.
8. Analysis of beams.
9. Finite Element Method for 1-D heat transfer.
10. Analysis of 1-D heat transfer problems

23TP6107- QUANTITATIVE APTITUDE

Course Category: Soft skill-4
Course Type: Learning by Doing
Prerequisites: --

Credits: 1
Lecture -Tutorial-Practice: 0 - 0 - 2
Continuous Evaluation: 100
Semester end Evaluation: ---
Total Marks: 100

COURSE OUTCOMES

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

CO1	Solve various Basic Mathematics problems by following different methods
CO2	Follow strategies in minimizing time consumption in problem solving Apply shortcut methods to solve problems
CO3	Confidently solve any mathematical problems and utilize these mathematical skills both in their professional as well as personal life.
CO4	Analyze, summarize and present information in quantitative forms including table, graphs and formulas

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 – Low, 2 - Medium, 3 – High)

	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
CO1	M													
CO2		M												
CO3	M													
CO4				M										

COURSE CONTENT:

UNIT I:

Numerical ability I:

Number system, HCF & LCM, Average, Ratio & Proportion

Numerical ability II:

Problems on ages, Partnership, Percentages, Profit & Loss, Allegation

UNIT II:

Arithmetical ability I:

Time & Work, Pipes & Cistern, Chain Rule

Arithmetical ability II:

Time & Distance, Problems on Trains, Boats & Steams

UNIT III:**Arithmetical ability:**

Simple interest and compound interest, Calendar and Clock

Logical ability:

Permutations and Combination, and Probability, Cubes

UNIT IV:**Mensuration:**

Areas, Volumes

Data interpretation:

Tabulation, Bar graphs, Pie charts, line graphs

Learning Resources:**TEXT BOOKS**

- R. S. Aggarwal “Quantitative Aptitude”, Revised., S Chand publication, 2017, ISBN:8121924987

23HS6153- ADVANCED COMMUNICATION SKILLS LAB

Course Category:	Skills Enhancement Course	Credits:	1
Course Type:	Lab	Lecture - Tutorial - Practice:	0-0-2
Prerequisites:	Notable level of skill in language proficiency, including listening, speaking, reading, and writing, reaching a semi-advanced level.	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course Outcomes:

Upon successful Completion of the course, the student will be able to:

- CO1** Relate effective listening and reading skills essential for professional contexts.
- CO2** Demonstrate clear and persuasive spoken communication for argumentation and proficiency in public speaking.
- CO3** Apply sophisticated and creative written communication suitable for administrative and corporate documentation.
- CO4** Analyze comprehensive life skills by adeptly communicating in various personal and professional settings for career and personal growth opportunities.

Contribution of Course Outcomes towards achievement of Professional Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12
CO1										H		
CO2								L	M	H		
CO3										H		
CO4									M	H		L

(L-Low, M-Medium, H-High)

COURSE CONTENT

1) Reading Comprehension

Understanding Main Idea – Analyzing Supporting Details – Drawing Inferences – Recognizing Text Structure – Critical Reading – Active Reading Strategies.

2) Listening Skills

Active Listening Techniques – Empathetic Listening – Avoiding Distractions – Clarification and Confirmation – Responding Appropriately – Reflective Listening– Note-taking Techniques – Summarizing and Analyzing – Ted Talks.

3) Relationship Building

Assertiveness – Adaptability – Emotional Intelligence – Conflict Management.

4) Professional Presentations

Planning and Preparation – Audience Analysis – Structuring Presentation – Visual Aids and Multimedia – Delivery Techniques – Handling Q&A Sessions – Overcoming Presentation Anxiety.

5) Cover Letter & Resume Writing

Cover Letter – Resume Formatting and Design – Creating a Professional and Eye-Catching Document – Highlighting Achievements – Tailoring Your Resume – Including Relevant Keywords.

6) Video Resume

Introduction – Professional Background – Visual Presentation – Personal Branding – Achievements and Accomplishments – Call to Action – Editing and Production.

7) Statement of Purpose (SOP)

Introduction – Educational Background and Training – Subject Matter Expertise – Relevant Skills and Attributes – Research Interests – Fit with the Program – Future Contribution.

8) Book/Film Review

Overview and Summary – Plot Analysis – Cinematography/Writing Style – Acting/Characterization – Themes and Messages – Audience Appeal – Final Thoughts and Recommendation.

9) Kinesics & Para Linguistic Features

Understanding Nonverbal Communication – Body Language – Vocal Cues – Cultural Variations – Emotional Expression – Deception Detection.

10) Life Skills – Poster Presentation

Introduction to Life Skills – Creative Thinking – Critical Thinking – Emotional Intelligence — Communicating Ideas Visually and Effectively

Text Books:

ADVANCED COMMUNICATION SKILLS LAB MANUAL

Reference Books:

1. Sanjay Kumar and Pushp Lata. Communication Skills. Oxford University Press, New Delhi, 2011.
2. Nira Konar, English Language Laboratories. PHI Learning Private Limited, New Delhi, 2011.

E-resources

Softx & Walden Software

23MC6108
TECHNICAL PAPER WRITING & IPR

Course Category: Mandatory Course
Course Type: Theory
Prerequisites: -

Credits: 0
Lecture/Tutorial/ Practice: 2/0/0
Continuous Evaluation: 100
Semester end Evaluation: 0
Total Marks: 100

Course Outcomes:

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

CO1: Understanding the concept of innovation and its importance in organizations.

CO2: Apply innovation management strategy in new product development.

CO3: Understanding the Intellectual Property Rights and the key legal

aspects CO4: Analyze the concept of entrepreneurship and skills

Contribution of Course Outcomes towards the achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO I	PSO II
CO1		L						M	M		M			
CO2		M						L	M		M			
CO3		M						M	H		H			
CO4		L						H	M		M			

(L-Low, M-Medium, H-High)

UNIT – I:

INNOVATION MANAGEMENT: INTRODUCTION

Definition of Innovation - Need for Innovation - Types of Innovation (Product, Process and Organization) - Sources of Innovation - Technology Adoption - Barriers to Innovation

UNIT – II:

INNOVATION: NEW PRODUCT DEVELOPMENT

Meaning and Classification of New Product - Role of Innovation in New Product Development - Key Factors in New Product Development Strategy - Organizational Growth through New Product Development – Managing Innovations

UNIT – III:

INTELLECTUAL PROPERTY RIGHTS (IPRs)

Definition of IPRs - Need for IPRs - Kinds of Intellectual Property Rights: Patents, Copyrights, Trade Marks, Trade Secret, Design, Geographical Indications - Legal Aspects of IPRs - IPRs in India.

UNIT – IV:

ENTREPRENEURSHIP

Concept and Nature of Entrepreneurship - Need for Entrepreneurship - Types of Entrepreneurship - Entrepreneurial Skills - Emerging Trends in Entrepreneurship - Environment for Entrepreneurship

Text Books:

- [1] Paul Trott, Innovation Management and New Product Development, Pearson Education Limited, UK, 2017.
- [2] Nithyananda, K V., Intellectual Property Rights: Protection and Management, Cengage Learning India Private Limited, 2019
- [3] Dr. S S Khanka, Entrepreneurial Development, S Chand, New Delhi, 2020.

Reference books:

- [1] Managing innovation: Integrating Technological, Market and Organizational Change, Joe Tidd, John Besant, 2018.
- [2] Neeraj, P., & Khusdeep, D, Intellectual Property Rights. PHI Learning Private Limited, India, 2019.
- [3] Vasant Desai, The Dynamics of Entrepreneurial Development and Management, Himalaya Publishing House, India, 2022.

E-resources and other digital material:

- [1] [https://edisciplinas.usp.br/pluginfile.php/5553082/mod_folder/content/0/Trott%20-%202017%20-%20roz%20Innovation-Management-and-New-Product- Development.pdf?forcedownload](https://edisciplinas.usp.br/pluginfile.php/5553082/mod_folder/content/0/Trott%20-%202017%20-%20roz%20Innovation-Management-and-New-Product-Development.pdf?forcedownload)

COMPUTER AIDED MANUFACTURING

Course Category: Program Core

Credits: 3

Course Type: Theory

Prerequisites: Engineering Mechanics-I
Machine Tools and Metal Cutting

Lecture/Tutorial/ Practice: 3-0-0

Continuous Evaluation: 30

Semester End Evaluation: 70

Total Marks: 100

Course Outcomes:

Upon successful Completion of the course, the student will be able to:

CO1: Acquire the concepts of NC machine tools, their classification, and CNC hardware basics.

CO2: Understand the concepts of CNC, DNC, Adaptive control and Manual part programming.

CO3: Know the fundamentals of A P T Language, Looping and jumping, Subroutines.

CO4: Distinguish the concepts of CAPP, CIMS and Benefits.

Contribution of Course outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSOI	PSO II
CO1	M		M											M
CO2	M	M	M											M
CO3	M	M	M											M
CO4	M		M											M

(L – Low, M - Medium, H – High)

UNIT - I

Numerical Control in Production Systems: Role of computers in manufacturing, components of NC Systems, Classification of NC systems, NC Applications, Advantages and disadvantages of NC machines.

CNC Hardware basics: Objectives, Structure of CNC Machine tools, Drive systems, Actuation systems, Feedback devices, Axes- Standards.

UNIT - II

Computer Control of NC Machines: Principles of operation of CNC, Developments in CNC systems, Types of DNC, Advantages of CNC and DNC, Adaptive Control Machining.

Manual Part Programming: Manual Part Programming Codes & Concepts, Cutter Length Compensation, Cutter Radius Compensation, Canned Cycles, Simple Programming Examples.

UNIT - III

Computer Assisted Part Programming: Advantages of Computer Assisted Part Programming, APT Language, Geometry, Motion Commands, Macros, Simple Programming Examples.

Advanced part programming method: Objectives, Polar coordinates, Parameters, Looping and jumping, Subroutines.

UNIT – IV:

Computer Aided Process Planning: Types of Computer Aided Process Planning, Retrieval type of Process Planning Systems, Generative Process Planning Systems, Benefits of CAPP.

CIMS: Introduction to Computer Integrated Manufacturing Systems (CIMS) and Implementation, Benefits of CIM.

Text Books:

- [1] P. N. Rao, T. K. Kundra & N. K. Tiwari, “Numerical Control & Computer Aided Manufacturing”, Tata Mc- Graw Hill Publishers, New Delhi, 2008.
- [2] Mikell P. Groover, “CAD/ CAM”, Prentice Hall of India, 3rd Edition, Delhi, 1995.

Reference books:

- [1] Mikell P. Groover, “Automation, Production Systems and CIM”, Prentice Hall of India, 2nd Edition, New Delhi, 1995.
- [2] Yoram Koren, “Computer Control of Manufacturing Systems”, Mc- Graw Hill International Publishers, Singapore, 2010.
- [3] N. K. Mehta, “Machine Tool Design and Numerical Control”, Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.

E-resources and other digital material:

- [1] <http://nptel.iitm.ac.in>
- [2] <http://www.engr.sjsu.edu>
- [3] <http://web.iitd.ac.in>
- [4] www.britannica.com/EBchecked/topic/130575/computer-aided-manufacturing.
- [5] http://en.wikipedia.org/wiki/Computer-aided_design#overview.

OPERATIONS RESEARCH

Course Category: Programme Core

CourseType: Theory

Prerequisites: Probability and statistics

Credits:3

Lecture-Tutorial-Practice:3-0-0

ContinuousEvaluation:30

SemesterEndEvaluation:70

TotalMarks:100

Upon successful Completion of the course, the student will be able to:**CO1:** Develop an LPP model and apply different methods for solving.**CO2:** Determine optimal allocation of resources.**CO3:** Apply Queuing theory model and Project scheduling techniques to real life problems**CO4:** Evaluate the concept of game theory and develop optimal schedule.

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	H	H			H									M
CO2	M	H			H									M
CO3	M	H			H									M
CO4	M	H			H									M

(L-Low, M-Medium, H-High)

UNIT – I**Introduction:** Definition and Scope of Operations Research, Limitations of Operations Research, Model Building in Operations Research.**Linear programming:** Mathematical formulation of the problem, Graphical method, Simplex method, artificial basis technique: BigM method, dual Simplex method and Two Phase Simplex method, Sensitivity Analysis**UNIT – II****Transportation problem:** Basic feasible solution by north-west corner method, Vogel's approximation method, assignment by inspection method. Finding optimal solution, degeneracy, unbalanced transportation matrix.**Assignment problem:** Hungarian method- One-to-one assignment problem, unbalanced assignment matrix, optimal solution – Traveling salesman problem, Teacher – course assignment, Task allocation.

UNIT – III

Queuing theory: Queuing systems and their characteristics. Single channel models with Poisson arrivals and Exponential service times with finite queue length and infinite queue length - M/M/1 (∞ /FIFO), M/M/1 (N/FIFO) Systems, Multichannel models with Poisson arrivals and Exponential service times - M/M/C (∞ /FIFO) System.

Project planning through networks: Arrow (Network) Diagram representation. Rules for constructing an arrow diagram, PERT and CPM, Critical path calculations, earliest start and latest completion times, Determination of critical path, determination of floats, Probability considerations in project, cost considerations in project scheduling, crashing (least cost project scheduling).

UNIT – IV

Game theory: Optimal solution of two-person zero-sum games, the max-min and min-max principle. Games without saddle points, mixed strategies. Arithmetic and algebraic methods, reduction by dominance and average, method of sub games, graphical method.

Sequencing: Introduction, Job shop Scheduling, Flow shop Scheduling, Solution of Sequencing Problem, Processing of n Jobs through two machines, Processing of n Jobs through m machines.

Text Books:

[1] S. D Sharma, 'Kedarnath, Ramnath & Co., Operations Research, Macmillian publishers Meerut. 16th Edition, 2009.

[2] V. K Kapoor Operations Research, S. Chand Publications, 7th edition, 2001.

Reference books:

[1] R Pannarselvam, Operations Research, Pentice Hall of India Pvt Ltd-New Delhi 2nd Edition. 2006

E-resources and other digital material:

[1] <http://en.wikipedia.org>

[2] <http://coral.ie.lehigh.edu>

[3] <http://books.google.co.in>

[4] <http://www.universalteacherpublications.com/univ/ebooks/or/Ch1/origin.htm>

[5] <http://www.wolfram.com/solutions/OperationsResearch>

MANUFACTURING MANAGEMENT

Course Category: Professional Elective

Credits: 3

Course Type : Theory

Prerequisites:

Lecture/Tutorial/ Practice: 3 /0/ 0

Continuous Evaluation: 30

Semester end Evaluation: 70

Total Marks: 100

Course Outcomes:

Upon successful Completion of the course, the student will be able to:

CO1: Understand the different types production systems and various forecasting methods.

CO2: Develop a Master production schedule.

CO3: Apply an appropriate inventory model.

CO4: Identify the variations and causes in a production process.

Contribution of Course Outcomes towards achievement of Program Outcomes

	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
CO1	M										H			M
CO2	M										H			M
CO3	M										H			M
CO4	M										H			M

(L-Low, M-Medium, H-High)

UNIT - I

Production systems: Continuous and intermittent production. Mass and flow production, batch production, job order production, production functions. Production Planning & Control Functions.

Forecasting: Forecasting variables, forecasting procedure, and methods of forecasting: moving average, least squares, simple exponential smoothing, linear regression, correlation coefficient, problems.

UNIT - II

Aggregate planning and scheduling: Long range, intermediate range and short range plans, the aggregate planning problem, aggregate planning strategies.

Master scheduling: Master scheduling formation: inputs and outputs. Master scheduling methods.

UNIT – III

Materials Management and Inventory Control: Functions of materials management, purpose of inventories, types of inventories, relevant costs in inventory control, ABC, VED and XYZ analysis.

Materials requirement planning (MRP): Importance of MRP and CRP, MRP system inputs and outputs, bill of materials, MRP logic, MRPII, Just in Time Production Systems: Just-in-Time System: Evolution, Characteristics of JIT Systems, Continuous Improvement, The Kanban System, Calculation of number of Kanban's Requirements for implementation JIT – benefits of JIT.

UNIT – IV

Quality control: Tolerance limits of a process, control charts for variables: X and R charts. Control charts of attributes, p-chart, and c-chart.

Acceptance sampling: single sampling, double sampling and multi sampling plans for attributes, OC curves, Introduction to TQM, Deming's quality philosophy, Taguchi quality philosophy, introduction to e-Manufacturing.

Text Books:

- [1] Joseph G. Monks "Operations Management" 3rd Edition TMH,1987.
- [2] Marthand Telsang "*Industrial Engineering and Production management*" S.Chand Publications.

Reference books:

- [1] Dale H. Besterfield "Quality Control" Prentice Hall 1995
- [2] V. K Kapoor Operations Research,S.ChandPublications , 7 th edition, 2001.
- [3] Gopalakrishnan and Sudhakareshan "Materials Management"

E-resources and other digital material:

- [1] <https://www.managementstudyguide.com/total-quality-management.htm>
- [2] <https://www.uthsc.edu/its/business-productivity-solutions/lean-uthsc/deming.php>
- [3] <https://checkify.com/blog/taguchi-method/>
- [4] <https://www.slideshare.net/ranjitabraham/e-manufacturing>

FLEXIBLE MANUFACTURING SYSTEMS & GROUP TECHNOLOGY

Course Category : Program Elective

Lecture/Tutorial/Practice: 3/0/0

Credits: 3

Continuous Evaluation: 30

Course Type : Theory

Semester End Evaluation: 70

Prerequisites : -Nil-

Total Marks: 100

Course Outcomes:

Upon successful Completion of the course, the student will be able to:

CO1: Familiarize with the concept of Automation, Flexible Manufacturing Systems - Architecture and its classifications.

CO2: Identify the different concepts of automated material handling and various automated storage systems.

CO3: Analyze the computer control systems of FMS and concepts of Group Technology.

CO4: Recognize the different types coding systems and applications of GT.

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO I	PSO II
CO 1	H				M		L							M
CO 2	H				M		L							M
CO 3	H				M		L							M
CO 4	H				M		L							M

(L-Low, M-Medium, H-High)

UNIT I

Introduction: Automation, Need of automation, Basic elements of an automated system, Types of automation, Manufacturing Automation, Components of manufacturing system, classification of manufacturing systems.

Introduction to FMS system: Need, Concept of flexibility, Types of FMS, Architecture of FMS, Components of FMS, Work piece flow in FMS, FMS planning and implementation issues, FMS benefits and applications

UNIT II:

Automated material handling: Function of Material handling systems, Types of Material handling equipment, Conveyor systems, Automated Guided Vehicles (AGV), Industrial Robots.

Automated storage systems: Storage System Performance, Storage Location Strategies, Automated storage and Retrieval Systems, Characteristics of Storage Systems.

UNIT III:

Computer control system of FMS: Functions of Computer Control system, architecture, Continuous versus Discrete Control, Computer Process Control, Forms of Computer Process Control, Programmable Logic Controllers, Factory communications, Local area networks.

Group Technology: Introduction, Need, Part families, Methods for developing part families.

UNIT IV:

Basic type of codes: Codes and coding systems structures, Hierarchical codes, Poly code, Mixed code, Optiz classification and coding system, KK-3 system, the MICLASS system, Production flow analysis, **Group Technology Machine Cells:** Advantages and Limitations, Guidelines for implementing Group Technology, Applications of GT.

Text Books:

1. Automation, Production Systems and Computer Integrated Manufacturing by M.P.Groover, 3rd Edition 2007, Prentice Hall.
2. CAD/CAM/CIM by P.Radhakrishnan, S.Subramanyan & V.Raju, 2nd Edition 2002, New age international publishers.

Reference Books:

1. Performance Modeling of Automated Manufacturing Systems, N. Viswanadham, Y.Narahari.1992, Prentice hall.
2. Computer Aided Design and Manufacturing by K. Lalit Narayan, 2008, PHI Pvt. Ltd.
3. CAD/CAM Handbook by Eric Teichloz.1985, TMH.
4. Computer Integrated Design and Manufacturing by Bedworth Henderson, 1991, TMH.

E-resources and other digital material

- [1] <http://www.mechanicalindetail.info/advanced-manufacturing-systems/>
- [2] <http://www.scribd.com/doc/19321303/Flexible-Manufacturing-SystemsFMS-A-Whitepaper>.

23ME7404A

COMPUTATIONAL FLUID DYNAMICS

Course Category: Programme Elective

Credits: 3

Course Type: Theory

Lecture/Tutorial/ Practice: 3 /0/ 0

Prerequisites: 24ME202 Engineering Thermodynamics

Continuous Evaluation: 30

24ME205 Fluid Mechanics and Hydraulic Machines

Semester end Evaluation: 70

23ME6301 Heat Transfer

Total Marks: 100

Course Outcomes:

Upon successful Completion of the course, the student will be able to:

CO1: Identify the applications of CFD and formulate the governing equations of fluid flow with appropriate boundary conditions.

CO2: Classify partial differential equations and develop finite difference approximations for partial derivatives using discretization techniques.

CO3: Formulate numerical solution procedures for parabolic and hyperbolic equations and examine their stability characteristics.

CO4: Analyze common finite difference techniques and pressure–velocity coupling methods used in the numerical solution of fluid flow problems.

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO I	PSO II
CO 1	H		L		L								M	
CO 2	H		L		L								M	
CO 3	M	M	M		H								M	
CO 4	M	M	M		H								M	

(L-Low, M-Medium, H-High)

UNIT I:

Introduction to CFD, CFD as a research tool, CFD as a design tool, applications of CFD.

Models of flow, Governing equations of fluid flow – Navier Stokes and Euler's equations: Continuity, Momentum and Energy equations in differential form, Physical boundary conditions.

UNIT – II:

Classification of PDEs in to Hyperbolic, parabolic and elliptic equations: Classification of quasi-linear PDEs, The Eigenvalue method, Classification of second order PDEs.

Finite Difference equations- Taylor series, order of accuracy, forward, backward and central differences for first order and second order differential equations.

UNIT – III:

Difference equations, Explicit and Implicit approaches, Thomas Algorithm (TDMA)

Analysis of stability, VN stability criteria for parabolic (1-D unsteady heat equation) and Hyperbolic (1st order wave equation) equations, Courant number.

UNIT – IV:

Simple CFD techniques: Lax-Wendroff technique, McCormack's technique and Iterative and Relaxation techniques.

Pressure correction technique, staggered grid, SIMPLE algorithm, Boundary conditions for pressure correction method.

Text books:

- [1] Computational Fluid Dynamics – The Basics with Applications - John. D. Anderson, JR., McGrawHill Education (India) Edition 2012.
- [2] Computational Fluid Dynamics - T. J. Chung, Cambridge University Press, 2nd Edition, 2014.

Reference books:

- [1] Introduction to computational fluid mechanics - Niyogi, Chakravarty, Laha, Pearson pub, 1st Edition, 2009.
- [2] Numerical heat transfer and fluid flow - S.V. Patankar, Hemisphere Pub., 1st Edition.
- [3] Computational Fluid flow and Heat transfer - K. Muralidhar and T. Sundararajan-, Narosa Pub. 2nd Edition, 2003.

E-resources and other digital material:

- [1] <http://ocw.mit.edu/courses/mecharlical-engineering/2-29-numerical-fluid-mechanics-fall2011/>
- [2] <http://nptel.ac.in/courses/112105045/> (IIT Kharagpur)
- [3] <http://nptel.ac.in/courses/112107080/> (IIT Roorkee)
- [4] <http://nptel.ac.in/courses/112104030/> (IIT Kanpur)
- [5] <http://www.nptelvideos.in/2012/11/computational-fluid-dynamics.html> (IIT Madras)
- [6] <http://www.cfd-online.com/>

23ME7404 B**ENERGY RESOURCE UTILIZATION****Course Category: Program Elective****Lecture – Tutorial – Practice: 3-0-0****Credits: 3****Continuous Evaluation: 30****Course Type:** Theory**Semester End Evaluation: 70****Prerequisites:****Total Marks: 100**

23ME5302 Applied Thermodynamics

23ME5404A IC Engines and gas Turbines

Course Outcomes:

Upon successful completion of the course, the student will be able to

CO1: Apply the principles to analyze the operation and performance of steam and hydroelectric power plants.**CO2:** Analyze and evaluate the working and components of diesel, gas, and nuclear power plants.**CO3:** Evaluate and differentiate energy conservation measures for various non-conventional energy resources and assess their effective utilization.**CO4:** Apply the principles of energy auditing to analyze its types, objectives, and the use of relevant instruments.**Contribution of Course Outcomes towards achievement of Program Outcomes**

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO 1		M											M	
CO 2		M											M	
CO 3		M											M	
CO 4		M											M	

(L – Low, M – Medium, H - High)

Course Content:**UNIT - I****Hydrology and Hydroelectric power plant:** Introduction, Hydrology-rainfall, runoff and their measurement, hydrograph, flow duration curve, mass curve and calculation of storage capacity, Hydro Electric power plant-Elements, Layout, Classification, advantages.**Steam power plant:** Typical layout of steam power plant, site selection, coal handling, ash handling, draught, coal analysis, pulverized coal firing system, electrostatic precipitator, deaeration, cooling towers.**UNIT – II****Diesel and gas turbine power plants:** General plant layouts, working of Diesel power plant, working of closed and open gas turbine plants, applications, advantages and disadvantages.**Nuclear power plants:** Nuclear fission, chain reaction, types of reactors -Pressurized water reactor,

boiling water reactor, liquid metal Fast Breeder reactor.

Solar energy: Solar thermal conversion, solar thermal power generation photo voltaic conversion

Unit – III

Wind energy: basic components of wind energy conversion systems, Classification of wecs, types of wind machines.

Energy from Bio-gas: Classification of Bio-gas Plants, Factors affecting Bio-digestion or generation of Gas, Thermionic Generation and generation.

Geo-thermal energy: Geothermal sources, hydrothermal resources, Vapor dominated systems, liquid dominated systems.

Energy from ocean: Ocean thermal energy conversion systems, Open cycle OTEC system, Closed cycle OTEC system.

UNIT – IV

Direct energy conversion systems: principle operation of a fuel cell (with reference to H_2, O_2 cell), principle of MHD Power generation

Energy Management:

Power Plant Economics: Introduction, Load duration curves, various performance factors (load factor, diversity factor, use factor etc.), operating costs, effect of load factor on cost per kWh.

Energy Auditing: Introduction, types of energy audit – audit instruments, energy conservation schemes – energy index – cost index – pie charts – sankey diagrams – load profiles

Text books:

1. Power Plant Engineering- P.K.Nag – Tata McGraw hill , 3rd Edition.
2. Non-Conventional Energy Resources - G.D.Rai -Khanna publications 4th Edition
3. Energy management-W.R.MURPHY& G.MICKAY

Reference books:

1. Power Plant engineering- - ARORA,DOMAKUNDWAR,DHANPATRAI & CO 2010
2. Power Plant Technology - M.M. EL Wakil TMH, 1984
3. Principles of Energy Conversion - A.W.Culp, TMH,1979
4. Waste heat recovery systems-D.A.Reay-Pergmon press
5. Hand book of energy audits-Albert Thuann
6. Energy Management Conservation and Audits- Anil Kumar CRC Press

E-resources and other digital material

1. en.wikipedia.org/wiki/Thermal_power_station

JET & ROCKET PROPULSION

Course Category Professional Elective-V

Credits: 3

Course Type : Theory

Lecture/Tutorial/ Practice: 3 /0/ 0

Prerequisites:

Continuous Evaluation: 30

Basic Thermodynamics, Applied Thermodynamics

Semester end Evaluation: 70

Total Marks: 100

Course outcomes

CO1: Understand the methods to improve the efficiency of gas turbines and the performance of axial flow compressors.

CO2: Analyse the performance of axial flow turbines and Apply knowledge to discuss their applications.

CO3: Analyse the performance characteristics of jet propulsion systems.

CO4: Explain and illustrate the working principles of rocket propulsion systems.

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO I	PSO II
CO1		L	M										L	
CO2		L	M										L	
CO3		L	M	L									L	
CO4				L									L	

UNIT I:

FUNDAMENTALS OF ROTATING MACHINES: Energy equation, Classification of Machines, working principle of Gas turbines, open and closed cycles, Actual cycle

AXIAL FLOW COMPRESSORS: Principle of operation, stage velocity triangles, work input to the compressor, work done factor, Degree of Reaction, Surging, choking and stalling.

UNIT II:

AXIAL FLOW TURBINES: Working principle, Velocity triangles of single stage turbine, Work output, Blade and stage efficiencies, Degree of Reaction - fifty per cent reaction stage

APPLICATIONS OF GAS TURBINES: Typical applications of gas turbines - electric

power generation applications - marine application, locomotive, automotive, aircraft and process applications – additional features of gas turbine engines - trends in future development.

UNIT III:

JET PROPULSION: Introduction, Air breathing jet engines, classification -Working principle, Advantages, Disadvantages and Applications of Ram jet engine, Pulse jet engine, Turbo jet engine and Turbo prop engines.

ANALYSIS of JET ENGINES: Thrust and thrust equation, Efficiencies - Ram, thermal, and overall efficiency. Simple problems. Applications

UNIT – IV

ROCKET PROPULSION: Performance differences of the air-breathing engine and the rocket engines- classification of Rockets- Principle of solid propellant rocket engine, liquid propellant rocket engine, Solid and liquid propellants- advantages, disadvantages

ADVANCED ROCKETS: Working of Nuclear propulsion, electro dynamic propulsion, Ion rocket- Plasma rocket- Applications

Text Book:

- [1] Gas Turbines - Ganesan V., TMH.
- [2] Gas turbines and propulsive systems - Khajuria P.R., Dubey S.P., Dhanpat Rai Pub.
- [3] Gas turbines and Jet & Rocket propulsion - Mathur M.L., Sharma R.P. Standard Pub.

Reference Books:

- [1] Gas Turbine Theory - Cohen H., Rogers G. and Saravanamuthu H., John Wiley.
- [2] Turbines, Compressors and Fans - Yahya S.H, Tata McGraw-Hill.

E-resources and other digital material:

- [1] <http://nptel.ac.in/courses/101101002/>
<http://nptel.ac.in/courses/112104117/13>

Artificial Intelligence and Machine Learning

Course Category: Open Elective/ Job Oriented Elective

Credits: 3

Course Type : Theory

Lecture/Tutorial/ Practice: 3 /0/0

Prerequisites : Fundamentals of programming

Continuous Evaluation: 30

Semester end Evaluation: 70

Total Marks: 100

Course Outcomes:

Upon successful Completion of the course, the student will be able to:

CO1: Explain the fundamentals of Artificial Intelligence, intelligent agents, and their environments.

CO2: Analyze and apply uninformed and informed search strategies for problem-solving.

CO3: Explain machine learning concepts, types, and apply supervised learning algorithms for prediction.

CO4: Use unsupervised learning techniques for data analysis.

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSOI	PSO2
CO1	M												L	
CO2	M		M										L	
CO3	M				M			M					L	
CO4	M		M		M			M					M	

(L-Low, M-Medium, H-High)

UNIT - I

Introduction: What is AI? Foundation of AI and history of AI. State of the art, Agents and Objects.

Intelligent Agents: Agents and Environments, the concept of rationality, the nature of environments, structure of Agents.

Solving Problems By Search: Problem-Solving Agents, Formulating problems, Searching for Solutions.

UNIT – II

Uninformed Search Strategies: Breadth-first search, Depth-first search, Searching with Partial Information,

Informed (Heuristic) Search Strategies: Greedy best-first search, A* Search: Minimizing the total estimated solution cost, Heuristic Functions, Local Search Algorithms and Optimization Problems, Online Search Agents and Unknown Environments.

Expert system characteristics of expert system, common sense -Qualitative physics, common sense ontologist,

UNIT – III

Introduction to Machine Learning

Machine Learning Concepts: Types of Machine Learning (Supervised, Unsupervised, Reinforcement Learning) Key Terminologies (Features, Labels, Training, Testing, Validation). Evaluation Metrics (Accuracy, Precision, Recall, F1 Score, ROC-AUC).

Supervised Learning

Linear Regression: Simple and Multiple Linear Regression Regularization Techniques (Ridge, Lasso).

UNIT – IV

Classification Algorithms: Logistic Regression, K-Nearest Neighbors (KNN), Support Vector Machines (SVM), Decision Trees, Random Forests, Gradient Boosting (XGBoost, LightGBM, CatBoost).

Unsupervised Learning

Introduction to Unsupervised Learning, Difference between supervised and unsupervised learning, Applications of unsupervised learning, Introduction to clustering Intuition and working of K-Means algorithm,

Text Books:

1. Stuart Russell and Peter Norvig, Artificial Intelligence, A Modern Approach, Pearson Publishers, 2020, 4th Edition.
2. Nils J Nilsson, " Artificial Intelligence: A New Synthesis " Morgan Kaufmann Publications, 2000.
3. Machine Learning, Tom Mitchell, McGraw Hill, 1997.
4. Ethem Alpaydin, Introduction to Machine Learning, PHI, 2016.

Reference books:

1. Kevin Knight, Elaine Rich and Shivshankar B. Nair, Artificial Intelligence, McGraw Hill, 2017, 3rd Edition.
2. David Poole, Alan Mackworth, Randy Goebel, Computational Intelligence: a Logical approach, Oxford University Press, 1st Edition, 2004.
3. G. Luger, Artificial Intelligence: Structures and Strategies for complex problemsolving, Pearson Education, 4th Edition, 2001
4. T. Hastie, R. Tibshirani, J. Friedman. The Elements of Statistical Learning, 2e, 2008.

E-resources and other digital material:

1. Fundamentals of Artificial Intelligence, https://swayam.gov.in/nd1_noc19_me71/preview

23ME_____
ELECTRIC AND HYBRID VEHICLES

Course Category: Open Elective
Type : Theory

Credits: 3 Course
Lecture/Tutorial/ Practice: 3/0/ 0
Continuous Evaluation: 30
Semester end Evaluation:70
Total Marks:100

Course Outcomes:

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

CO1: Acquire knowledge about fundamental concepts, principles, analysis and design of hybrid and electric vehicles.

CO2: Identify various sources for hybrid vehicles and their working.

CO3: Judge suitable hybrid vehicle as per the need based on the type of motor and configuration used

CO4: Identify power electronic converters involved and charging methods

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSOI	PSO II
CO1		M											M	
CO2			M										M	
CO3					M								M	
CO4									M				M	

(L-Low, M-Medium, H-High)

UNIT - I:

Introduction to hybrid vehicles:

Introduction to Electric Vehicle (EV) and Hybrid Electric Vehicles (HEV's), advantages and limitations, air pollution and global warming, Environmental Analysis. Fundamentals of EV & HEV powertrain and transmission

EV & HEV Power Transmission Systems:

EV transmission systems: direct drive, single-speed reduction, multi-speed transmission and in-wheel motor drive, transmission components, basic architecture of hybrid electric vehicles (HEVs), configurations of HEVs: series, parallel, series-parallel, concept of power flow in EV and HEV systems, Hybridness.

UNIT- II: Energy sources for hybrid vehicles

Battery:

Principle and types, Li-ion battery, Nickel-Metal Hydride (NiMH), Lead-Acid, Battery Parameters, Battery Charging

Fuel cells:

History of fuel cell vehicle, Operating principles of PAFC, PEM, DMFC, MCFC, SOFC and PCFC, Performance evaluation techniques

UNIT- III: Electric machines for hybrid vehicles**Fundamentals of Electrical Machines:**

Introduction to Electrical Machines, Concepts of Torque production, Rotating Magnetic Field, Second Magnetic Field, classification of Electrical Machines, regenerative braking system

Electric machines of EV and HEV's:

Electric Machines for EV Applications: working principles of synchronous and induction machines, permanent magnet synchronous machines (PMSM), switched reluctance motors (SRM), and brushless DC (BLDC) motors, and basic control methods of permanent magnet machines.

UNIT-IV: Power electronics for EV/HEV:**Fundamentals of Power Electronics:**

Introduction to power electronics in EV and HEV systems, semiconductor devices such as diodes, MOSFETs and IGBTs, basic converter circuits including DC–DC converters and inverters

Power Electronics in EV/HEV:

Role of power electronic control, functions of Electronic Control Unit (ECU) in motor drive and converters, bidirectional power flow for battery charging and discharging.

Suggested Books:

1. Iqbal Husain, ELECTRIC and HYBRID VEHICLES, Design Fundamentals, CRC Press, 2003.
2. Mehrdad Ehsani, Yimin Gao, Ali Emadi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals”, CRC Press, 2010.
3. Ali Emadi, Advanced Electric Drive Vehicles, CRC Press, 2015.
4. Gianfranco, Electric and Hybrid Vehicles: POWER SOURCES, MODELS, SUSTAINABILITY, INFRASTRUCTURE AND THE MARKET, Pistoia Consultant, Rome, Italy, 2010

Reference Books:

1. M. Ehsani, *Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design*, CRC Press, 2005.
2. D. C. Hanselman, *Brushless Permanent Magnet Motor Design*, Magna Physics Pub, 2006
3. Sandeep Dhameja, “Electric Vehicle Battery System
4. M. G. Say, *The Performance and Design of Alternating Current Machines*, CBS Publishers, New Delhi
5. R. Krishnan, *Electric motor drives: modeling, analysis, and control*, Prentice Hall, 2001
6. Rand D.A.J, Woods, R & Dell RM Batteries for Electric vehicles <https://swayam.gov.in/courses/-electric-vehicle>

RENEWABLE ENERGY SOURCES

Course Category: Program Elective

Lecture – Tutorial – Practice: 3-0-0

Credits: 3

Continuous Evaluation: 30

Course Type: Theory

Semester End Evaluation: 70

Prerequisites:

Total Marks: 100

23ME5302 Applied Thermodynamics

Course Outcomes:

Upon successful completion of the course, the student will be able to

CO1: Explain the basic concepts of solar energy, solar radiation, and solar energy collection systems.

CO2: Describe the working of wind energy and biomass energy systems

CO3: Explain the principles and applications of geothermal and hydrogen energy systems.

CO4: Describe the basic principles and working of direct energy conversion systems and fuel cells..

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO 1		M											M	
CO 2		M											M	
CO 3		M											M	
CO 4		M											M	

(L – Low, M – Medium, H - High)

Course Content:

UNIT-I

Solar Radiation and its measurement: Solar radiation at earth surface, Environmental impact of solar power, solar radiation measurement- Pyrometers, Solar radiation data

Solar Energy Collectors: Flat plate and concentrating collectors, Applications – solar heating and cooling techniques, solar distillation and drying, photovoltaic energy conversion.

UNIT-II

Wind Energy: Basic principle of wind energy conversion, Sources and potentials, horizontal and vertical axis windmills

Bio-Mass: Principles of Bio-Conversion, Anaerobic /Aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas.

UNIT-III

Geothermal Energy: Resources, types of wells, methods of harnessing the energy, potential in India.

Hydrogen energy: Hydrogen production methods- Electrolysis, Thermo chemical method, Solar energy method, Hydrogen transportation, Utilisation of hydrogen gas.

UNIT-IV

Direct Energy Conversion: Thermo-electric generators, Seebeck, Peltier and Joule Thompson effects, MHD generators, principles, dissociation and ionization

Fuel cells: Functions of the fuel cell, working principle of PEM fuel cell, Applications of fuel cell

Suggested Textbooks

1. G.D. Rai, *Renewable Energy Sources*, Khanna Publishers.
2. Twidell & Weir, *Renewable Energy Resources*, Routledge.
3. Sukhatme & Nayak, *Solar Energy: Principles of Thermal Collection and Storage*, Tata McGraw-Hill.

Reference Books

1. Boyle, *Renewable Energy: Power for a Sustainable Future*, Oxford University Press.
2. B H Khan, *Non-conventional energy resources*, Tata McGraw-Hill.

E-resources

1. https://onlinecourses.nptel.ac.in/noc26_ch26/preview
2. https://onlinecourses.nptel.ac.in/noc25_ph50/preview
3. https://onlinecourses-archive.nptel.ac.in/noc18_ge14/preview

PROJECT MANAGEMENT

Course Category: Elective

Course Type : Theory

Prerequisites:

Credits: 3

Lecture/Tutorial/ Practice: 3 /0/ 0

Continuous Evaluation: 30

Semester end Evaluation:70

Total Marks:100

Course Outcomes:

Upon successful Completion of the course, the student will be able to:

CO1: Understand the significance of project management its objectives and various phases involved in project management life cycle.

CO2: Gain knowledge regarding project feasibility study and various Organizational issues.

CO3: Able to apply various tools like CPM & PERT in project management.

CO4: Gain knowledge in risk management and role of IT in project management.

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	a	b	c	d	e	f	g	h	i	k	j	l	PSO I	PSO II
CO1	M											H		H
CO2	M											H		H
CO3	M											H		H
CO4	M											H		H

(L-Low, M-Medium, H-High)

UNIT - I

Basics of Project Management: Introduction, Evolution of project management, Objectives of project management, Types of project, Types of project delays, Benefits of project Management, Stake holders of a project.

Project Management Life cycle: Phases of Project Management Life Cycle, Role of a Project Manager (PM).

UNIT - II

Project Feasibility study: Introduction, Pre-Feasibility Study, Types of feasibility, Steps of feasibility study.

Project Organizational Structures: Introduction, Concept of Organizational Structure, Essential qualities of a project manager, Organizational structure for projects, Project management offices.

UNIT – III

Techniques of Project Management: Introduction, Guidelines for network construction, Critical path method, Gantt chart, Project Evaluation and review technique.

Crashing of Project network: Introduction, General guidelines for network crashing, Types of crashing.

UNIT – IV

Project Risk Management and failure: Introduction, Types of Risk, Steps in Risk Management, Risk Assessment, Project failure-causes of project failure.

Project Management Information System: Introduction, Project Management Information System (PMIS), Planning of PMIS.

Text Books:

- [1] P. Panneerselvam, R. Senthilkumar, “Project Management” PHI 2009.
- [2] Ramakrishna & Kamaraju “ Essentials of Project Management” Kindle Edition PHI, 2010

Reference books:

- [1] Harold Kerzner “Project Management- A system approach to planning, scheduling & Controlling” Eleventh Edition, wiley.
- [2] Thomas Erickson & P. V. Khatri “ Project Management” Global Vision Publishing House (2015).

E-resources and other digital material:

- [1] <https://project-management.com/top-10-main-causes-of-project-failure/>
- [2] <https://www.brightbpm.com/project-planning/44058-the-project-management-information-system-pmis-described/>
- [3] <https://www.usbr.gov/excellence/Finals/FinalIntroPM.pdf>
- [4] www.manage.gov.in/studymaterial/PM.pdf

STATISTICAL QUALITY CONTROL

Course Category: Programme Elective

Credits:3

CourseType: Theory

Lecture/Tutorial/Practice:3/0/0

Prerequisites:

ContinuousEvaluation:30

ManufacturingManagement

SemesterEndEvaluation:70

TotalMarks:100

CourseOutcomes:

Upon successful Completion of the course, the student will be able to:

CO1: Understand the philosophy and basic concepts of quality improvement.

CO2: Demonstrate the ability to design, use and interpret control charts for variables and attributes.

CO3: Perform analysis of process capability and its measurements.

CO4: Understand and interpret few modern quality improvement methodologies.

ContributionofCourseOutcomestowardsachievementof ProgramOutcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSOI	PSOI
CO1											M	H		M
CO2											M	H		M
CO3											M	H		M
CO4											M	H		M

(L-Low, M-Medium, H-High)

CourseContents

UNITI

Introduction: The Meaning of Quality and Quality Improvement; Brief History of Quality Methodology; Statistical Methods for Quality Control and Improvement;

Total Quality Management: quality philosophy, links between quality and productivity, quality costs, legal aspects of quality implementing, quality improvement.

Modeling Process Quality: Mean, Median, Mode, Standard deviation, Calculating area, The Deming funnel experiment, Central limit theorem, z score

UNITII

Statistical Basis of the Control Charts: Chance and assignable causes, basic principles, choices of control limits, significance of control limits, sample size and sampling frequency, rational subgroups, analysis of pattern on control charts, warning limits, Average Run Length-ARL

Control Charts for Variables: Control Charts for X-Bar, R- Charts, X-Bar, S- Charts Numerical Problems, Analysis of patterns on Control Charts, Control Charts for attributes: np-charts-chart-Chart and U-Chart, Comparison between control Charts for variables and Control Charts for attributes.

UNIT III

Process Capability: The foundation of process capability, Natural Tolerance limits, cp – process capability index, CPK, PP – process performance index, summary of process measures. Process capability analysis by various means including control charts.

CUSUM and EWMA charts: introduction their interpretations, and relevant assumptions (step signal and increasing exponential signal)

UNIT IV

Acceptance Sampling: Single, Double, Multiple, and Sequential sampling plans , OC curves AOQL, LTPD, AQL, LTPD, AOQ, AOQL, ASN, ATI functions with graphical interpretation (OC Curve)

Introduction to Six Sigma: over view of six sigma, Lean Manufacturing and Total Quality Management (TQM) Organizational Structure and Six Sigma training Plans. Voice of Custmers (VOC).

Text Books:

1. Statistical Quality Control, E.L.Grant and R.S.Leavenworth, 7th edition McGraw-Hill Publisher
2. Statistical quality control M. Chandran ,2 nd edition.
3. Introduction to Statistical Quality Control, R.K Guptha.

Reference Book:

1. Quantitative Techniques and management, N D Vohra, 4th edition Tata McGraw Hill 2019.

Web Resources:

1. <https://study.com/academy/lesson/operating-characteristic-oc-curve-definition-uses.html>.
2. <https://www.businessmanagementideas.com/production-2/control-charts-for-variables-and-attributes-quality-control/7044>.

DESIGN & METROLOGY LABORATORY

Course Category:	Programme Core	Credits:	1.5
Course Type:	Laboratory	Lecture - Tutorial - Practice:	0 - 0 - 3
Prerequisites:	Machine Dynamics- 23ME4303	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes		Upon successful completion of the course, the student will be able to:													
Design laboratory	CO1	Evaluate the time period of oscillations of simple, compound pendulum systems.													
	CO2	Determine the whirling speed of shafts under different boundary conditions and Understand the gyroscopic effect of moving bodies													
Metrology laboratory	CO3	Measure the internal taper angle, external taper angle, tool signature, elements of a given thread by using metrology instruments													
	CO4	Demonstrate the working and applications of surf tester, comparator, FFT analyzer and gauges													
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M- Medium, H – High)		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-I	PSO-II
	CO1	L			M										M
	CO2	L			M										M
	CO3	L			M										M
	CO4	L			M										M
Course Content	Design Laboratory: 1. Vibration measurements: Simple pendulum. 2. Vibration measurements: compound pendulum. 3. Determine the whirling speed of shafts 4. Understand the gyroscopic effect of moving bodies using Motorized Gyroscope 5 Journal Bearing Apparatus. 6. User defined design based experiment.														
	Metrology laboratory: 1. Measuring external taper angle of a given work piece using sine bar. 2. Measuring external taper angle of a given work piece using roller and slip gauges.														

	- Measuring internal taper angle of a given work piece using Vernier depth gauge. - Measuring screw thread effective diameter by using three wire methods. - Measuring different elements of a thread using profile projector. - Measuring angular dimensions of a tool using tool -maker's microscope. - Measurements of surface finish using surf tester Model Demonstrations: - Vibration measurements by using FFT Analyzer. - Co-ordinate Measuring Machine - Demonstration of various gauges
Text books and Reference books	
E-resources and other digital material	www.iitg.ernet.in/scifac/qip/public.../r.../chapter_5_gyroscope.pdf www.nptel.ac.in/courses/112101096/download/lecture-25.pdf https://en.wikipedia.org/wiki/Critical_speed https://www.youtube.com/watch?v=HpIEeBtJupY

CAM Laboratory

Course Category: Programme Core

Course Type : Theory

Prerequisites:

Machining Processes, CAD Modeling

Credits: 1.5

Lecture/Tutorial/ Practice: 0 /0/ 3

Continuous Evaluation: 30

Semester end Evaluation:70

Total Marks:100

Course Objectives:

- Introduce students to CNC part programming for turning and milling operations.
- Provide hands-on experience in generating tool paths and machining components using CAM software.
- Demonstrate the integration of CAD models with CNC machining.
- Familiarize students with additive manufacturing concepts and component fabrication.

Course Outcomes:

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

CO1: Develop and practice CNC part programs for various turning operations.

CO2: Generate and practice CNC programs for milling operations using CAM tools.

CO3: Fabricate simple components using additive manufacturing techniques.

CO4: Model and manufacture mechanical components and assemblies.

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO I	PSO II
CO1	3	2	2	1	2								1	1
CO2	3	2	3	2	3								1	1
CO3	2	1	2	2	2								1	1
CO4	3	2	3	2	3								1	1

(1-Low, 2-Medium, 3-High)

List of CNC Experiments

1. Introduction to CNC programming – program structure, basic G and M codes.
2. Step turning operation – program development and simulation.
3. Taper turning and profile turning operations.
4. Multiple turning operations including threading, finishing and parting.
5. Linear and circular interpolation programming.
6. Mirror imaging in CNC programs.
7. Milling operations – circular pocketing.
8. Milling operations – rectangle pocketing
9. Drilling cycles in CNC machining.

List of 3D printing Experiments

10. Design and fabrication of feed screw.
11. Design and fabrication of gear wheel.
12. Modeling and fabrication of muff coupling.
13. Design and fabrication of robotic hand gripper.
14. Introduction to DED Metal 3D Printing Process – program structure, basic G and M codes.
15. Design and fabrication of Cylinder using Metal 3D Printing

Text books:

1. P. N. Rao, CAD/CAM – Principles and Applications, PHI Learning, 2004.
2. Chua C.K., Leong K.F, LIMC.S, —Rapid Prototyping: Principles and Applications, World Scientific publications, 3rd Edition, 2010.

Reference books:

1. Computer Control of Manufacturing Systems – Y Koren, McGraw Hill, 1983
2. Andreas Gebhardt, Jan-Steffen Hötter - Additive Manufacturing 3D Printing for Prototyping and Manufacturing” Hanser Publications, Cincinnati. 2016.

E-resources and other digital material:

1. <http://www.mfg.mtu.edu/cyberman/machtool/auto/nc/index.html>
2. <http://www.instruction.greenriver.edu/manufacturing/08Spr/NC%20PGM.pdf>
3. http://elabz.com/wpcontent/uploads/2010/04/ER4u_User_Manual.pdf
4. <http://cncmanual.com/?s=mastercam+manual>
5. <http://nptel.ac.in/courses/Webcourse-contents/IIT-Delhi/>
6. <http://www.mfg.mtu.edu/cyberman/machtool/auto/nc/method.html>
7. <http://nptel.ac.in/courses/112107077/38>

ROBOTICS LABORATORY

Course Category:	Programme Core	Credits:	1.5
Course Type:	Laboratory	Lecture - Tutorial - Practice:	1 - 0 - 2
Prerequisites:	Robotics-	Continuous Evaluation: Semester end Evaluation: Total Marks:	30 70 100

Course outcomes		Upon successful completion of the course, the student will be able to:													
	CO1	Understand and apply robotic modelling and simulation tools for offline programming of industrial robots.													
	CO2	Design and develop robotic work cell environments for material handling applications such as pick and place operations.													
	CO3	Demonstrate the use of teach pendant for online programming and control of robotic manipulators.													
	CO4	Develop and execute robotic programs for industrial applications including pick and place, arc welding, and spot welding operations.													
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M- Medium, H – High)		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-I	PSO-II
	CO1	L			M										M
	CO2	L			M										M
	CO3	L			M										M
	CO4	L			M										M
Course Content	<u>Lab Exercises:</u> 1. Introduction to a Robotic Modelling and Simulation software for learning Offline Programming. 2. Create a work cell environment for a material handling robot to perform Pick and Place Job. 3. Learn the use of a Teach Pendant for Online Programming of a Robotic Manipulator 4. Create a program and execute Pick and Place Operation using Material Handling Robot 5. Create a program and produce a Seam Weld Joint using Arc Welding Robot. 6. Create a program and produce a Spot Weld Joint using Spot Welding Robot.														
Text books and Reference books	Text Books: [1] Industrial Robotics by Mikell P. Groover, H Weiss, Roger N Nagel, Nicholas G Odrey, Ashish Dutta, Mc Graw Hill Education. [2] Robotic Engineering by Richard D. Klafter, Prentice Hall, Tata Mc Graw-Hill, 1995. 3rd Edition.														

	[3] Robotics and Control - R K Mittal and I J Nagrath, THH Publications Reference books: [1] Introduction to Robotics – John J. Craig, Addison Wesley, 3rd Edition [2] Robotics – K. S. Fu, Gonzalez & Lee, Tata Mc Graw-Hill, 1995. 3rd Edition.
E-resources and other digital material	[1] https://library.abb.coH/ [2] https://www.fronius.coH/en-in/india/ [3] http://www.obara.co.jp/en/product/spot/controller.htHl

FLUID FLOW SIMULATION LAB

Course Category: Advanced Skill Course

Credits: 2

Course Type: Laboratory course

Lecture/Tutorial/ Practice: 1/0/2

Prerequisites: 23ES3103 Basic Thermodynamics

Continuous Evaluation: 30

23ME4304 Fluid Mechanics

Semester end Evaluation: 70

23ME6301 Heat Transfer

Total Marks: 100

Course Outcomes:

Upon successful Completion of the course, the student will be able to:

CO1: Simulate the fluid flow concepts using CFD software.

CO2: Apply the convergence techniques to refine the solution

CO3: Interpret the results to arrive reasonable conclusions

CO4: Document the results generated in a systematic manner.

Contribution of Course Outcomes towards achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO I	PSO II
CO 1	H	L										M	H	
CO 2	M	M		H	H								L	
CO 3	L	H		H	H					L		H	M	
CO 4				H	H					H				

(L-Low, M-Medium, H-High)

Experiments:

1. Demo on Preprocessing, Solver and Post processing of CFD software.
2. Simulation of Couette flow
3. Simulation of Channel flow
4. Flow through circular pipe
5. Simulation of Hydrodynamic Boundary Layer over a Flat Plate
6. Simulation of Thermal Boundary Layer over a Flat Plate
7. Flow over Cylinder and Sphere (Demo)
8. Flow over an aerofoil (Demo)

Text books:

- [1] Computational Fluid Dynamics - Basics with Applications - John. D. Anderson, McGraw Hill Education (India), 2012.
- [2] Computational Fluid Dynamics - T. J. Chung, Cambridge University Press, 2nd Edition, 2014.

Reference books:

- [1] Introduction to computational fluid mechanics - Niyogi, Chakravarty, Laha, Pearson Publication, 1st Edition, 2009.
- [2] Numerical heat transfer and fluid flow - S.V. Patankar, Hemisphere Publication, 1st Edition.
- [3] Computational Fluid flow and Heat transfer - K. Muralidhar and T. Sundararajan, Narosa Publication, 2nd Edition, 2003.

E-resources and other digital material:

- [1] <https://www.ansys.com/en-in/products/fluids/ansys-fluent>
- [2] <https://courses.ansys.com/index.php/fluids/>
- [3] <https://confluence.cornell.edu/display/SIMULATION/FLUENT+Learning+Modules>
- [4] <https://forum.ansys.com/discussion/1493/ansys-fluent-tutorials>
- [5] <https://cfd.ninja/ansys-tutorials/ansys-fluent-tutorials/>
- [6] <http://users.abo.fi/rzevenho/ansys%20fluent%2018%20tutorial%20guide.pdf>

INDIAN CONSTITUTION

Course Category:	Optional Course	Credits:	-
Course Type:	Theory	Lecture-Tutorial-Practice:	2-0-0
Prerequisites:		Continuous Evaluation:	100M
		Semester End Evaluation:	--
		Total Marks:	100M

Course Outcomes

	Upon successful completion of the course, the student will be able to :
CO1	Understand the spirit and origin of the fundamental law of the land
CO2	Understand how fundamental rights can be protected and the fundamental duties of the citizens
CO3	Understand the Directive Principles of State Policy, the structure and formation of the Indian Government at center as well as state and the procedure of amendment to the Constitution
CO4	Understand the municipalities and panchayats as the self-governing bodies, when and how an emergency can be imposed and its consequences.

Course Contents:

UNIT-I : Introduction to Constitution of India:

- Nature of the Indian Constitution
- Scope of the Indian Constitutional Law
- Salient features and characteristics of the constitution of India
- Concept and definition of state under the Constitution

UNIT-II : Fundamental Rights:

- Scheme of the fundamental rights
- Right to equality, right against discrimination, etc
- Right to life and personal liberty, education and cultural rights.
- Constitutional Remedies and Fundamental Duties

UNIT-III: Nature of the Indian Constitution:

- Directive principles of state policy
- Distribution of legislative and financial powers between the union and the states.
- Parliamentary Form of Government in India
- Procedure of amendment of the constitutional provisions

UNIT-IV: Emergency Provisions:

- Grassroot Democracy: Municipalities and Panchayats
- National emergency
- President's rule
- Financial emergency.

Text Books:

M.P. Jain, Indian Constitutional Law (8th ed. 2018).

V.N. Shukla, Constitution of India (Mahendra Pal Singh ed., 13th ed. 2017).

D.D. Basu, Introduction to the Constitution of India (26th ed. 2022).

Reference Books:

J.N. Pandey, Constitutional Law of India (58th ed. 2021).

H.M. Seervai, Constitutional Law of India (4th ed. 2006).

P.M. Bakshi, The Constitution of India (18th ed. 2023).

Granville Austin, The Indian Constitution: Cornerstone of a Nation (1966).

***** ALL THE BEST *****

EIGHTH SEMESTER

MAJOR PROJECT AND INTERNSHIP

Course Category: Project

Credits: 12

Course Type: Practical

Lecture - Tutorial - Practice: 0/0/24

Prerequisites:

Continuous Evaluation: Semester end 30

Evaluation: 70

Total Marks: 100

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

CO1: Identify the problem, define objectives and scope of the project work.

CO2: Carryout Team work.

CO3: Prepare and present a comprehensive report of the project work.

CO4: Apply the principles of Thermal Engineering to solve problems.

CO5: Solve Engineering problems using the concept of design and manufacturing.

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSOI	PSOII
CO1									H					
CO2				H										
CO3							H	M						
CO4	M	M			H			M			M		H	
CO5	M	M			H			M			M			H