AUTONOMOUS

SYLLABUS

III & IV Semesters

B.E in Mechanical Engineering

2023

MITE

Invent Solutions

MANGALORE INSTITUTE OF TECHNOLOGY & ENGINEERING

MANGALORE INSTITUTE OF TECHNOLOGY & ENGINEERING

(A Unit of Rajalaxmi Education Trust®, Mangalore)
Autonomous Institute affiliated to VTU, Belagavi, Approved by AICTE, New Delhi
Accredited by NAAC with A+ Grade & ISO 9001:2015 Certified Institution

Institute Vision

*"To attain perfection in providing **Globally Competitive Quality Education** to all our Students and also benefit the global community by using our strength in **Research and Development**"*

Institute Mission

"*To establish world class educational institutions in their respective domains, which shall be C**enters of Excellence** in their stated and implied sense. To achieve this objective we dedicate ourselves to meet the challenges of becoming **Visionary and Realistic**, **Sensitive and Demanding**, **Innovative and Practical,** Theoretical **and Pragmatic;** ALL at the same time"*

Department Vision

To develop technically competent Mechanical Engineering Professionals, Entrepreneurs and Researchers for the benefit of the society

Department Mission

- *To provide a well-balanced program of instructions to impart concepts on basics and applied areas of Mechanical Engineering.*
- *To provide the state-of-the-art facility for learning, skill development and research in design and manufacture areas.*
- *To encourage the students to excel in the co-curricular and extra-curricular activities to impart social & ethical values and leadership quality.*

Program Educational Objectives (PEOs)

After successful completion of the program, the graduates will be

- *Professionals in design, analysis and evaluation of Mechanical components and systems using state-of-the-art modern tools.*
- *Expertise in Design, Thermal, Materials & Manufacture streams of Mechanical Engineering and carryout research and innovations.*
- *Work effectively and ethically in allied fields of Mechanical Engineering.*
- *Work in a team with good communication skills to achieve objectives with keen on lifelong learning.*

Program Specific Outcomes (PSOs)

At the end of the program, the student

- *Acquire knowledge in Hydraulics & Pneumatics, PID controllers and Automation process.*
- *Excel in Principles of Engineering Design, Analysis and Manufacturing of Mechanical Components to meet the Industrial requirements.*

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LIST OF COURSES

III / IV Semester Courses			
Sl. No.	**Course Code**	**Course Title**	**Sem**
BASIC SCIENCE COURSES			
1	23BSME201	Engineering Mathematics-III	III
2	23BSCC202	Engineering Mathematics-IV	IV
PROFESSIONAL CORE COURSES			
3	23MEPC203	Strength of Materials	III
4	23MEPC204	Metal Processing and Machining	III
5	23MEPC205	Thermal Engineering -I	III
6	23MEPC206	Digital Measurement Systems	III
7	23MEPC207	Materials Characterization	III
8	23MEPC208	Theory of Machines	IV
9	23MEPC209	Fluid Mechanics & Machinery	IV
10	23MEPC210	Thermal Engineering -II	IV
11	23MEPC211	Machine Drawing and GD & T	IV
12	23MEPC212	Fluid Mechanics & Machinery laboratory	IV
HUMANITIES & SOCIAL SCIENCE COURSES			
13	23HMCC215	Universal Human Values	III
14	23HMCC216	Research Methodology & Intellectual Property Rights	IV
SKILL ENHANCEMENT COURSES			
15	23MESE251	Introduction to Python Programming	III
16	23MESE252	Decision Sciences for Mechanical Engineers	III
17	23MESE253	Fundamentals of Computational Tool	III
18	23MESE254	Introduction to Data Science	IV
19	23MESE255	Quality Engineering	IV
20	23MESE256	Mechanical Design Concepts	IV
AUDIT COURSES			
21	23AUCC221	Yoga-I	III
22	23AUCC222	Physical Education-I	III
23	23AUCC223	NSS-I	III
24	23AUCC224	Arts-I	III
25	23AUCC225	Yoga-II	IV
26	23AUCC226	Physical Education-II	IV
27	23AUCC227	NSS-II	IV
28	23AUCC228	Arts-II	IV
29	23AUCC229	Environmental Studies & Sustainability	IV

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III Semester (2023 Scheme): Mechanical Engineering

Sl. No.	Course Code	Course Title	Category	Teaching Dept.	Teaching Hours /Week			Exam Marks			Duration of Exam (SEE) in Hrs	Credits
					L	T	P	CIE	SEE	Total		
1	23BSME201	Engineering Mathematics-III	Basic Science Course	Mathematics	3	0	0	50	50	100	3	3
2	23MEPC203	Strength of Materials	Professional Core Course	ME	3	2	0	50	50	100	3	4
3	23MEPC204	Metal Processing and Machining	Professional Core Course	ME	2	0	2	50	50	100	3	3
4	23MEPC205	Thermal Engineering -I	Professional Core Course	ME	3	0	0	50	50	100	3	3
5	23MEPC206	Digital Measurement Systems	Professional Core Course	ME	3	0	2	50	50	100	3	4
6	23MEPC207	Materials Characterization	Professional Core Course - Laboratory	ME	0	1	3	50	50	100	2.5	2
7	23HMCC215	Universal Human Values	Humanities & Social Sciences	Any Dept.	2	0	0	50	50	100	2.5	2
8	23MESE25X	Skill Enhancement Course*	SE Course	ME/Any Dept.	1	0	2	50	50	100	2.5	2
9	23AUCC22X	Yoga / Physical Education / NSS / Arts**	Audit Course	Yoga Teacher/ PED/NSS Coordinator/ Cultural Coordinator	0	0	1	100	-	100	-	-
											Total	**23**

***Skill Enhancement Course(s):**

Sl. No.	Course Code	Course Title	Certification Platform
1	23MESE251	Introduction to Python Programming	MOOC's/Industry
2	23MESE252	Decision Sciences for Mechanical Engineers	MOOC's/Industry
3	23MESE253	Fundamentals of Computational Tool	MOOC's/Industry

****Yoga/ Physical Education /NSS/Arts:**

Sl. No.	Course Code	Course Title
1	23AUCC221	Yoga- I
2	23AUCC222	Physical Education-I
3	23AUCC223	NSS-I
4	23AUCC224	Arts-I

Note: ** To be offered from 3rd to 6th Semester

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IV Semester (2023 Scheme): Mechanical Engineering

Sl. No.	Course Code	Course Title	Category	Teaching Dept.	Teaching Hours /Week			Exam Marks			Duration of Exam (SEE) in Hrs	Credits
					L	T	P	CIE	SEE	Total		
1	23BSCC202	Engineering Mathematics-IV	Basic Science Course	Mathematics	3	0	0	50	50	100	3	3
2	23MEPC208	Theory of Machines	Professional Core Course	ME	3	0	2	50	50	100	3	4
3	23MEPC209	Fluid Mechanics & Machinery	Professional Core Course	ME	3	0	0	50	50	100	3	3
4	23MEPC210	Thermal Engineering -II	Professional Core Course	ME	3	0	2	50	50	100	3	4
5	23MEPC211	Machine Drawing and GD & T	Professional Core Course	ME	2	0	2	50	50	100	3	3
6	23MEPC212	Fluid Mechanics & Machinery laboratory	Professional Core Course-Laboratory	ME	0	1	3	50	50	100	2.5	2
7	23HMCC216	Research Methodology & Intellectual Property Rights	Humanities & Social Sciences	ME	2	0	0	50	50	100	2.5	2
8	23MESE25X	Skill Enhancement Course*	SE Course	ME/Any Dept.	1	0	2	50	50	100	2.5	2
9	23AUCC229	Environmental Studies & Sustainability	Audit Course	Civil Engg.	1	0	0	100	-	100	-	-
10	23AUCC22X	Yoga/ Physical Education / NSS / Arts**	Audit Course	Yoga Teacher/ PED/NSS Coordinator/ Cultural Coordinator	0	0	1	100	-	100	-	-
											Total	**23**

***Skill Enhancement Course(s):**

Sl. No.	Course Code	Course Title	Certification Platform
1	23MESE254	Introduction to Data Science	MOOC's/Industry
2	23MESE255	Quality Engineering	MOOC's/Industry
3	23MESE256	Mechanical Design Concepts	MOOC's/Industry

****Yoga/ Physical Education /NSS/Arts:**

Sl. No.	Course Code	Course Title
1	23AUCC225	Yoga-II
2	23AUCC226	Physical Education-II
3	23AUCC227	NSS-II
4	23AUCC228	Arts-II

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III Semester

IV Semester

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ENGINEERING MATHEMATICS-III			
Semester	**III**	CIE Marks	**50**
Course Code	**23BSME201**	SEE Marks	**50**
Teaching Hrs/Week (L: T:P)	**3:0:0**	Exam Hrs	**03**
Total Hrs	**42**	Credits	**03**

Course Learning Objectives: This course is designed to

1. Develop systematic understanding of Laplace transform and their applications in solving engineering and scientific problems
2. Impart the knowledge of Fourier series and its applications in solving engineering problems
3. Build a strong foundation in Fourier Transforms essential to solve real-world problems
4. Provide a comprehensive understanding of Numerical Methods for solving problems arising in science and engineering

Module 1: Laplace Transforms	**No. of Hrs: 9**

Laplace Transforms: Definition and Laplace Transform of elementary functions. Properties of Laplace Transform–Linearity, Shifting, Multiplication by t^n, Division by t, Unit-Step function, Dirac Delta function

Inverse Laplace Transforms: Definition, Inverse Laplace Transform, Convolution theorem to find the inverse Laplace Transforms, Solution of differential equations using Laplace Transforms

Module 2: Fourier Series	**No. of Hrs: 8**

Introduction to Infinite series, Convergence and Divergence, Periodic functions, Dirichlet's condition, Fourier series of periodic functions with arbitrary period, Half range Fourier series, Practical Harmonic Analysis

Module 3: Fourier Transforms and Numerical solution of ODE	**No. of Hrs: 9**

Fourier Transforms: Definition, Fourier Sine and Cosine transforms, Inverse Fourier Transforms, Inverse Fourier Cosine and Sine transforms

Solution of first and second order ordinary differential equations using Taylor series method

Module 4: Numerical methods -I	**No. of Hrs: 8**

Finite Differences, Newton's Forward & Backward Difference, Newton's Divided Difference, Lagrange's and Inverse Lagrange's Interpolation methods

Module 5: Numerical methods -II	**No. of Hrs: 8**

Solution of Polynomial and Transcendental Equations: Regula-Falsi and Newton-Raphson methods

Numerical Differentiation: Forward and Backward difference methods

Numerical integration: Simpson's $(1/3)^{rd}$ rule, $(3/8)^{th}$ rule and Romberg's method

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

1. Illustrate the fundamental concepts of Laplace Transform, Fourier series, Fourier Transform, and Numerical Methods
2. Apply suitable techniques to solve engineering and scientific problems related to Laplace Transform, and Fourier Series
3. Make use of appropriate Numerical Methods to solve engineering and scientific problems
4. Solve real-life problems related to Laplace Transform, Fourier series, Fourier Transform, and Numerical Methods
5. Employ software tool to efficiently solve engineering and scientific problems allied with Laplace transform, Fourier series, Fourier Transform, and Numerical Methods

TEXT BOOKS:

1. Dennis G Zill, "Advanced Engineering Mathematics", 7th Edition, Jones-Bartlett, 2022
2. E. Kreyszig, "Advanced Engineering Mathematics", 10th Edition, John Wiley & Sons, 2018

REFERENCE BOOKS:

1. N.P Bali and Manish Goyal, "A Textbook of Engineering Mathematics", 10th Edition, Laxmi Publications, 2022
2. S. R. K. Iyengar & R. K. Jain, "Numerical Methods", 1st Edition, New Age International (P) limited Publishers, 2020

Web links:

1. Laplace Transforms: https://ocw.mit.edu/courses/18-03-differential-equations-spring-2010/resources/lecture-19-introduction-to-the-laplace-transform/
2. Fourier Series: https://www.youtube.com/watch?v=nXEqrOt-nB8
3. Fourier Transforms: https://www.youtube.com/watch?v=1JnayXHhjlg
4. Taylor series: https://www.youtube.com/watch?v=vSKra51VJC0
5. Numerical Methods : https://archive.nptel.ac.in/courses/127/106/127106019/

Strength of Materials			
Semester	**III**	CIE Marks	**50**
Course Code	**23MEPC203**	SEE Marks	**50**
Teaching Hrs/Week (L: T: P)	**3:2:0**	Exam Hrs	**03**
Total Hrs	**64**	Credits	**04**

Course Learning Objectives: This course is designed to

1. Impart knowledge of behavior & properties of engineering materials
2. Build a strong foundation in stresses and strains developed in the member subjected to axial, bending, shear, torsion & thermal loads
3. Strengthen the essential knowledge of stresses developed in bars, compound bars, beams, shafts, and cylinders
4. Establish knowledge of shear force and bending moment concepts for beams with different loads and supports
5. Deliver the concept of column buckling principles, strain energy, and failure theories concerning the structures' analysis

Module 1: Simple Stresses and Strains	**No. of Hrs: 8+4**

Properties of materials, Stress, Strain, Shear stress & strain, Hooke's law and Factor of Safety, Tensile test diagram for brittle and ductile materials, Calculation of stresses in straight, stepped, tapered sections and composite sections, Principle of Superposition, Temperature Stresses, Volumetric Strain analysis, Von Mises Stress, Relationship between Elastic constants

Module 2: Compound Stress & Strains and Cylinders	**No. of Hrs: 8+5**

Compound Stress & Strains: Introduction to three-dimensional stress system, Stresses on inclined planes: Uni & Bi axial direct stresses and General two-dimensional stress systems, Determination of Stresses, Principal stresses, and Shearing stresses - Analytical and Graphical (Mohr's circle) method

Cylinders: Stresses in thin cylinders, Changes in dimensions of thin cylinders, Lame's equation for thick cylinders (No derivation), Thick cylinders subjected to internal and external pressures

Module 3: Shear Forces & Bending Moments and Stress in Beams	**No. of Hrs: 8+5**

Shear Forces & Bending Moments: Type of beams, loads and supports, Relationship between load, shear force & bending moment, Shear force and bending moment diagram construction for cantilever, simply supported and overhanging beams subjected to concentrated, uniformly distributed, uniformly varying loads and combination of these loads, determining point of contra flexure

Stress in Beams: The simple theory of bending, the relationship between bending stress & radius of curvature (no derivation), section modulus, bending & shear stress distribution in rectangular & circular sections. Numerical examples on Circular, I, and T section beams

Module 4: Strain Energy and Torsion	**No. of Hrs: 8+5**

Strain Energy: Strain energy due to axial, shear, bending, torsion, uniformly varying load, and impact load, Application of Castigliano's theorems

Torsion: Pure torsion, Torsion equation, Polar modulus, Power transmission of circular solid and hollow straight shafts and stepped shafts

Module 5: Theories of Failure and Columns	**No. of Hrs: 8+5**

Theories of Failure: Maximum Principal stress theory, Maximum shear stress theory, and Maximum Principal strain theory

Columns: Euler's theory, Buckling and Stability, Critical load, Columns with different end supporting conditions, Effective length of columns, Rankine's formula

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

1. Explain material properties, stress & strain relations, types of beams & loads, strain energy, and pure torsion
2. Determine the normal stresses & strains for axially loaded members, thermal stresses, principal stresses, maximum shear stresses of the bi-axial stress system, and stresses in thin & thick cylinders
3. Construct SFD and BMD for beams with different supports & static loading conditions (point load, UDL, and UVL) to obtain bending stresses & shear stress induced in different cross-sectional members
4. Compute strain energy stored in structural elements due to axial, bending, torsion & impact loads, and dimensions of the shafts subjected to pure torsion
5. Identify the failure load using different theories of failure and stability of columns for different end conditions

Textbooks:

1. Bhavikatti S.S, "Strength of Materials", 4th Edition, Vikas Publishing House, 2013
2. R C Hibbeler, "Mechanics of Materials", 11th Edition, Pearson, 2022
3. S S Rattan, "Strength of Materials", 3rd Edition, McGraw Hill, 2017

Reference Books:

1. P N Chandramouli, "Fundamentals of Strength of Materials", 1st Edition, PHI Learning Pvt. Ltd, 2012
2. R K Rajput, "Strength of Materials", 6th Edition, S. Chand Publishing, 2015
3. Ferdinand P. Beer, E. Russell Johnston, John T. Dewolf and David F. Mazurek, "Mechanics of Materials", 6th Edition, McGraw Hill, 2012
4. R.K. Bansal, "Strength of Materials", 6th Edition, Laxmi Publications, 2018

Web links:

1. Tensile test: https://eerc01-iiith.vlabs.ac.in/exp/tensile-test-experiment/, IIIT-H, Virtual Lab
2. Torsion test: https://eerc01-iiith.vlabs.ac.in/exp/torsion-test-experiment/, IIIT-H, Virtual Lab
3. Bending test: https://sm-nitk.vlabs.ac.in/exp/bending-test-mild-steel/, NITK, Virtual Lab
4. Module 1-5: https://nptel.ac.in/courses/112107146
5. Analysis of stress and strains, Torsion, Bending of beams, and Columns https://archive.nptel.ac.in/courses/105/105/105105108/

Metal Processing and Machining			
Semester	**III**	CIE Marks	**50**
Course Code	**23MEPC204**	SEE Marks	**50**
Teaching Hrs/Week (L: T: P)	**2:0:2**	Exam Hrs	**03**
Total Hrs	**50**	Credits	**03**

Course Learning Objectives: This course is designed to

1. Impart the knowledge of metal forming and Machining process
2. Develop knowledge of the mechanics of the machining process and the effect of various parameters on machining
3. Impart the fundamentals of welding processes and their applications in various industries
4. Deliver the concept of chip formation in metal cutting processes & solving related problems
5. Familiarize the cutting factors involved in milling and grinding operations

Module 1: Forming Process	**No. of Hrs: 6+4**

Outline of forging and related operations, process parameters involved, Forging Processes such as open die, closed die, Forging Operations, Calculation of Forging Force. Hot, cold, impact and hydrostatic extrusion, process parameter involved, and defects in extrusion, Calculation of Extrusion Force. Introduction to High Pressure Die Casting

Laboratory Component:

Manufacture of a hook by Forging Techniques

Module 2: Sheet Metal Operations	**No. of Hrs: 5+4**

Formability of Sheet metal, Shearing action, Shearing operations, Drawing, Spinning, Bending, Stretch forming, Embossing, Coining, Die Design, Types of Dies : Progressive & Compound dies, Die constructions, defects in sheet metal process, Numerical examples

Laboratory Component:

Evaluate formability using standard tests such as the Erichsen cupping test

Module 3: Metal Joining Process	**No. of Hrs: 5+6**

Introduction, Gas welding, Arc welding process: TIG, SMAW & MIG, Electrodes for arc welding, Electron beam welding, Laser beam welding, Solid state welding: Cold welding, ultrasonic welding, friction welding, resistance spot welding, explosion welding, diffusion bonding, Numerical examples

Laboratory Components:

1. Arc welding process
2. Gas welding process

Module 4: Metal Cutting	**No. of Hrs: 5+4**

Cutting tool materials: High-speed steel & Carbides, Cutting tool geometry, Mechanics of chip formation, Types of chips, Orthogonal and oblique cutting, Tool life, Cutting Fluids, Determination of shear plane angle, Merchant's model for orthogonal cutting, Numerical examples

Laboratory Component:

Performing orthogonal and oblique cutting experiments using a lathe or milling machine

Module 5: Machining Process	**No. of Hrs: 5+6**

Milling: Plain milling cutter nomenclature, Milling Time: Slab and face milling, Indexing: Direct, simple, compound, differential and angular indexing, Drilling: Twist drill geometry, Drilling time, Torque and thrust, Numerical examples

Grinding: Types of abrasives, bonding processes, Creep feed grinding, Designation and selection of grinding wheel, Surface Finishing Processes: Lapping, Honing & Super finishing

Laboratory Components:

1. Finishing of metal using surface grinding
2. Cutting of spur gear teeth using Horizontal Milling Machine

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

1. Explain extrusion, forging, sheet metal operations, metal joining process, metal cutting and machining process
2. Apply the process parameters & formability to determine the forming forces
3. Apply the principles of the welding process to estimate operating process parameters
4. Apply the fundamental principle of mechanics to determine cutting forces in metal cutting operations
5. Compute machining time, thrust force & torque using mathematical models

Textbooks:

1. Serope Kalpakjain & Steven R. Schmid, "Manufacturing Engineering & Technology", 7th Edition, Pearson Education (India) Private Limited, 2019
2. P N Rao, "Manufacturing Technology", Vol. 2, 4th Edition, McGraw Hill Education (India) Private Limited, 2019

Reference Books:

1. Amitabha Ghosh and Ashok Kumar Mallik, "Manufacturing Science", 2nd Edition East-West Press Limited, 2010
2. Mikell P.Groover, "Fundamental of Modern Manufacturing", 8th Edition, Wiley India, 2014
3. P.C. Sharma, "Production Technology", 4th Edition, S. Chand & Company Ltd. 2007

Web links:

1. Module 1, 3, 5: Fundamentals of Manufacturing Processes https://nptel.ac.in/courses/112107219
2. Direct Shear Test on Mild Steel Plate: https://smnitk.vlabs.ac.in/List%20of%20experiments.html, NITK, Virtual lab
3. Study the effect of process parameters in electrochemical grinding: https://mm-coep.vlabs.ac.in/exp/electrochemical-grinding/, CoE, Pune,Virtual lab

Thermal Engineering - I			
Semester	**III**	CIE Marks	**50**
Course Code	**23PCME205**	SEE Marks	**50**
Teaching Hrs/Week (L: T: P)	**3:0:0**	Exam Hrs	**03**
Total Hrs	**42**	Credits	**03**

Course Learning Objectives: This course is designed to

1. Provide fundamental knowledge of thermodynamic principles, including the Zeroth, First & Second Laws of Thermodynamics
2. Familiarize the concepts of behavior of pure substances and its application
3. Impart the knowledge of ideal and real gas behavior and their thermodynamic properties.

Module 1: Zeroth Law of Thermodynamics and Work & Heat	**No. of Hrs: 9**

Introduction: thermodynamic approaches. Examples of system boundary and control surface, Thermodynamic properties; thermodynamic process, Thermodynamic state and equilibrium

Applications of Zeroth law of thermodynamics.

Work and Heat: Mechanical work and Thermodynamic work, work and heat transfer of various processes through p-v diagrams

Module 2: First Law of Thermodynamics	**No. of Hrs: 8**

Forms of energy, energy transfer by heat and work, work done for closed systems using air and water/steam in thermodynamic processes, First law for process and cycle, Open and closed systems, steady flow and unsteady flow, cyclic and non - cyclic processes. Steady flow energy equation (SFEE)

Module 3: Second Law of Thermodynamics and Entropy	**No. of Hrs: 9**

Second Law of Thermodynamics: Second law statements and its equivalence. Applications of 2nd law in Heat engine, refrigerator and heat pump, Carnot Cycle, Efficiency and COP – Carnot theorem - Absolute thermodynamic temperature scale (3rd law of thermodynamics)

Entropy: Concept and causes - Clausius inequality - change of entropy for solids, liquids and gases in different thermodynamic processes. Principle of increase of entropy

Module 4:Exergy and Anergy	**No. of Hrs: 8**

Exergy and Anergy: Efficiency analysis of renewable energy systems, optimization of fuel consumption and reduction of emissions

Pure Substances: Compressible and incompressible fluid - Sensible heat and latent – phase diagrams of water/steam (p-v, p-T, T-v, T-s, h-s)

Module 5: Gas Mixtures	**No. of Hrs: 8**

Ideal gasses: Avogadro‟s law, Dalton‟s law of partial pressure, property equations and change of properties of gas mixture

Real gasses: Introduction, Van-der Waal's Equation of state, Van-der Waal's constants in terms of critical properties, Beattie-Bridgeman equation, Law of corresponding states, compressibility factor; compressibility chart. Difference between Ideal and real gasses

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

1. Articulate the concepts of temperature measurement, work & heat transfer, entropy, work done in open & closed system and Cyclic & non cyclic systems
2. Describe the concepts of, Exergy and Anergy, pure substances, Ideal and real gasses
3. Apply the concepts of thermodynamic properties & laws of thermodynamics for the measurement of temperature, energy transfer and compute the performance characteristics of the refrigeration & heat engines
4. Apply the knowledge of reversibility and irreversibility to find the behavior of pure substances and its application in practical problems
5. Apply ideal and real gas laws to determine thermodynamic properties of gases and gas mixtures

Textbooks:

1. P.K.Nag, “Basic and Applied Thermodynamics”, 2nd Edition, Tata McGraw Hill, 2009
2. B.K Venkanna, Swati B, “Basic Thermodynamics”, Wadavadagi PHI, New Delhi, 2011

Reference Books:

1. Yunus A. Cenegal and Michael A.Boles, “Thermodynamics - An Engineering Approach”, 9th Edition, Tata McGraw Hill publications, 2019
2. Y V C Rao, “An Introduction to Thermodynamics”, 5th Edition, Wiley Eastern, 2016
3. Dr. V Kadambi and Dr. T R Seetharam, “Applications of Thermodynamics”, Wiley Publications, 2018
4. R K Rajput, “Engineering Thermodynamics”, 5th Edition, Laxmi Publications, 2019

Web links:

1. Module 1: https://www.youtube.com/watch?v=9GMBpZZtjXM&list=PLD8E646BAB3366BC
2. Module 4: https://www.youtube.com/watch?v=gEsNWUe5Srg&list=PL3zvA_WajfGAwLuULH-L0AG9fKDgplYne&index=2

Digital Measurement Systems			
Semester	**III**	CIE Marks	**50**
Course Code	**23 MEPC206**	SEE Marks	**50**
Teaching Hrs/Week (L: T: P)	**3:0:2**	Exam Hrs	**03**
Total Hrs	**64**	Credits	**04**

Course Learning Objectives: This course is designed to

1. Impart the knowledge of principles of measurements, standards, errors and calibration methods
2. Apply measurement principles, analyze tolerances and fits, and use precision measurement instruments effectively
3. Provide an overview of different types of sensors and their applications
4. Establish the knowledge and skills to solve practical measurement problems encountered in mechanical engineering
5. Familiarization with data acquisition techniques for processing and analyzing measurement data

Module 1: Standards of Measurement — **No. of Hrs: 8+3**

Measurement Systems & Methods: Objectives of Metrology, Generalized measurement system, Static Characteristics-Accuracy, Precision, Calibration, Threshold, Sensitivity, Hysteresis, Repeatability, Linearity, Loading effect, Dynamic Characteristics- System response, Time delay, Errors in measurement, Classification of errors

Measurement Standards: Classification of standards, Line and End standards, Calibration of End bars, Numerical examples

Laboratory Components:

1. Calibrate the given micrometer and determine the % of error using a slip gauges
2. Calibrate the given load cell and determine the % of error

Module 2: Limits, Fits, Tolerance & Geometrical Measurements — **No. of Hrs: 8+9**

Limits, Fits, Tolerance: Tolerance analysis (addition & subtraction of tolerances) Interchangeability & Selective assembly, Limits of size and Tolerance. Types of Fit, System of Fits, Tolerance grade, Numerical examples on limits, fit and tolerance,

Gear Tooth Measurements: Tooth thickness measurement using gear tooth vernier caliper, Autocollimator-Applications for measuring straightness and squareness,

Computer vision-based GD&T: Key components, process, advantages

Laboratory Components:

1. Determine the Pitch, Major diameter; Minor diameter and Thread angle of given screw using Tool Makers Microscope
2. Determine the parameters of given gear by using gear tooth vernier
3. Determine the dimensions of the given template marked Θ_1 and L_1 using Profile projector
4. Determine the surface flatness of the given plate by using the Autocollimator

Module 3: Sensors for Mechanical Measurements — **No. of Hrs: 8+6**

Types of test signals, Loading of signal source, Selection of sensors and transducers

Displacement, Position and Proximity: Potentiometer sensor, Strain-gauge, Capacitive proximity sensor, Eddy current proximity sensors, Optical encoders, Hall effect sensors

Velocity and Motion: Tachogenerator, Force: Strain gauge load cell, Pressure: Tactile Sensor

Temperature: Thermistors, Thermocouples, Range Sensors: RF beacons, Light Detection and Ranging (LIDAR), Strain Measurements: Strain gauge preparation and mounting, gauge factor, Electrical resistance strain gauge

Laboratory Components:

1. Determination of position using proximity sensors
2. Determination of speed using encoders
3. Calibrate the given Thermocouple and determine the % of error of K-type thermocouple
4. Determine the young's modulus of elasticity using strain gauge

Module 4: Signal Conditioning & Digital Techniques in Mechanical Measurements	**No. of Hrs: 8+3**

Signal Conditioning: Modulation of signals, Advantages of Signal Conditioning, Input Circuitry, Filters

Digital Techniques in Mechanical Measurements: Digitizing Mechanical inputs, Fundamental digital circuit elements, Bar-Codes, Multiplexers-digital, Time division multiplexing, Computer as a measurement system, Microprocessor, Microcomputer, DACs and ADCs, Introduction to Data Acquisition Systems: Data acquisition system, Techniques for data collection, visualization

Laboratory Component:

DAQ application in mechanical engineering - Case Study

Module 5: Digital Measurements	**No. of Hrs: 8+3**

Introduction, Advantages and limitations of digital measuring tools compared to traditional methods. Digital caliper, micrometer, Laser distance meter, Protractor.

Coordinate Measuring Machine (CMM): Basic Components, Types of CMM, Coordinate Systems, Probe Technology. **Digital Surface Measurement:** Surface roughness tester-profilometer, Contact and non-contact surface measurement techniques

Digital Surface Measurement: Surface roughness testers (profilometers)

Thermal Imaging: working principle and applications

Laboratory Components:

1. Determine the mean deviation of surface roughness for a given specimen finished by different machines by using a Mechanical comparator
2. Determination of surface roughness using digital profilometer

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

1. Understand Measurement Systems, line and end Standards, Tolerance Analysis, and Advanced Measurement Techniques using gear tooth vernier calliper, Autocollimator and GD&T
2. Apply the principles of Limits, fits, tolerance in Mechanical Measurements, build dimensions using slip gauges, calibrate,and to carry out experiments to find accurate gear tooth parameters
3. Describe the principles of operation and working of sensors in mechanical measurements
4. Explain appropriate signal conditioning, digital measurement techniques and data acquisition system for mechanical measurements
5. Illustrate coordinate measuring methods, measuring surface roughness and Thermal Imaging technique

Textbooks:

1. Thomas G. Beckwith, Beckwith, "Mechanical measurements", 6th Edition, Pearson Education, 2016
2. R. K. Jain, "Engineering Metrology", 22nd Edition, Khanna Publishers, 2022
3. Maurizio Di Paolo Emilio, "Data Acquisition Systems", 1st Edition, Springer Science & Business Media, New York, 2013

Reference Books:

1. I.C. Gupta, "Engineering Metrology", 7th revised Edition, Dhanpat Rai Publications, 2013
2. Ernest O Doblin, Dhanesh N Manik, "Measurement Systems", 6th Edition, Tata McGraw Hill Education Private Limited, 2011
3. M. Mahajan, "A Textbook of Measurements and Metrology", Dhanpat Rai & Co., 2014
4. William Bolton, "Mechatronics Electronic Control Systems in Mechanical and Electrical Engineering", 6th Edition, Pearson Education, 2023

Web links:

1. Engineering Metrology: https://onlinecourses.nptel.ac.in/noc20_me94/preview , IIT-Kanpur
2. Sensors and Actuators, https://onlinecourses.nptel.ac.in/noc21_ee32/preview, IISc-Bangalore
3. Mechanical Measurements and Metrology, https://nptel.ac.in/courses/112106139 ,IIT-Madras

Materials Characterization			
Semester	**III**	CIE Marks	**50**
Course Code	**23MEPC207**	SEE Marks	**50**
Teaching Hrs/Week (L: T: P)	**0:1:3**	Exam Hrs	**2.5**
Total Hrs	**48**	Credits	**02**

Course Learning Objectives: This course is designed to

1. Impart the knowledge of various material testing techniques to determine the mechanical properties of metals and alloys
2. Familiarize scientific principles to understand the mechanical behavior of materials
3. Deliver the concept of material properties to select appropriate materials for engineering applications

Introduction to Material Characterization	**No. of Hrs: 12**

- Mechanical properties in elastic and plastic state of mild steel, and Al and their behavior through the stress-strain plot for select engineering materials under uniaxial and bending stress
- Impact resistance of the material and assessment of the ductile to brittle transition temperature in the case of mild steel
- A case study to realize and appreciate the importance ductile to brittle transition behavior of materials
- Fundamentals of wear, wear mechanisms, factors affecting wear
- Stages of Creep, applications, mechanisms, factors affecting creep
- Phase diagram, Etchants, mounting methods, ASTM grain measurement, Optical microscope.
- Basics of Heat treatment, hardness, and hardenability, background of Brinell, Rockwell and Vickers Hardness tests, comparison of hardness tests.
- Principle behind magnetic particle and dye penetration tests, methods, factors affecting test results, advantages and limitations
- Torsion and its relevance
- Description of ASTM standards involved in material testing

Experiments	**No. of Hrs: 36**

1. Conduct tensile tests of Mild steel and Aluminium specimens to determine Young's modulus, yield and ultimate strength and elongation etc
2. Study the behavior of Cast Iron under Uniaxial compressive load for obtaining its compressive strength
3. Conduct 3 point bending test for assessing the flexure strength of a rectangular cross section
4. To carry out impact test in accordance with Charpy test at various temperatures to determine the Ductile-to-Brittle transition temperature of mild steel section
5. To perform pin-on-disk wear test under dry sliding conditions with temperature recording and determine the effects of operating parameters on wear behavior
6. To conduct creep study on 60:40 lead-Sn solder alloy and determine the steady state creep rate
7. To conduct Magnetic particle test for identification of surface and near surface defects in a mild steel test specimen

8. To obtain the microstructure of steel and metal alloys following standard metallographic practices and to observe the microstructure developed in annealed, normalized, and hardened steel.
9. To identify surface defects that are open to the surface such as pinholes using dye penetration test
10. To perform torsion test on mild steel sample for determining shear modulus and shear strength

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

1. Apply standard mechanical testing techniques to various materials to determine their key mechanical properties and interpret the results in the context of material behavior.
2. Compute the mechanical properties of different materials and recommend the most suitable option for engineering applications

Textbooks:

1. Callister Jr, W.D., Rethwisch, D.G., "Materials Science and Engineering: An Introduction", 10th Edition, Hoboken, NJ: Wiley, 2018
2. George E. D., "Mechanical Metallurgy", 3rd Edition, McGraw Hill Education, 2017

Reference Book:

1. Kuhn H. and Medlin D., "ASM Handbook", ASM International, 2000

Web links:

1. Demonstrations and computations involved in material response tests such as Tensile, Compression, Torsion, Impact, Shear and Hardness https://sm-nitk.vlabs.ac.in/, NITK Virtual Lab
2. Demonstration of creep test https://mrmsmtbs-iitk.vlabs.ac.in/Introduction.html, NITK Virtual Lab
3. Specimen mounting and microstructure observation using Light and Fluorescent microscope, SEM, TEM , https://myscope.training/, Microscopy Australia

Universal Human Values			
Semester	**III**	CIE Marks	**50**
Course Code	**23HMCC215**	SEE Marks	**50**
Teaching Hours/Week (L:T: P)	**2:0:0**	Exam Hrs	**2.5**
Total Hours	**26**	Credits	**02**

Course Learning Objectives: This course is designed to

1. Impart the concepts of value education, life skills and personality
2. Create awareness about human relationship with family and society
3. Impart the knowledge on different orders in nature
4. Deliver the concept of professional ethics and value-based profession

Module 1: Introduction to Value Education	**No. of Hrs: 6**

Definition & meaning of Values, Types of values
Life skills-Overview, scope, Types, Importance of life skills, SWOT Analysis
Happiness and prosperity– Basic needs of human aspirations, Current scenario, Methods to fulfill the basic human aspirations

Module 2: Harmony in Self & Body	**No. of Hrs: 5**

Human being as co-existence of the Self and the Body, Needs, Harmony, Body as an Instrument of the Self, Strategies to enhance self-regulation and health
Empathy-Definition, Essential characteristics of empathy, Benefits of empathy, Sympathy Vs empathy

Module 3: Harmony in the Family and Society	**No. of Hrs: 5**

Family, Types of family, Family dynamics, Family life education
Harmony in the family – Basic unit of human interaction, 'Trust' – the foundational value in relationship, 'Respect' – as the right evaluation, Justice in human-to human relationship, Harmony in the society, Vision for the universal human order

Module 4: Harmony in Nature	**No. of Hrs: 5**

Introduction, Interconnectedness, Self-regulation and mutual fulfillment among the four orders of nature, Realizing existence as co-existence at all levels, Relationship of mutual fulfillment, Holistic perception of harmony in existence

Module 5: Implications of the Holistic understanding – A look at professional ethics	**No. of Hrs: 5**

Engineering ethics-Overview, Scope and Approach
Natural acceptance of human values, Definitiveness of ethical human conduct, Basis for humanistic education, Competence in professional ethics holistic technologies, Management models-case studies, Strategies for transition towards value-based life and profession

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

1. Understand the personality development through life skills & exhibiting the same
2. Realize the need of harmony in individual, family and society
3. Explain the need of harmony in nature towards co-existence
4. Understand the importance of ethics in professional life towards holistic approach

Textbooks:

1. R.R. Gaur, R. Asthana, G.P. Bagaria, "A Foundation Course in Human Values and Professional Ethics", 2nd Revised Edition, Excel Books, New Delhi, 2019
2. R.S. Naagarazan, "A Textbook on Professional Ethics and Human Values", 1st Edition, New Age International Publishers, 2006

Reference Books:

1. Nagaraj, "Jeevan Vidya: EK Parichaya", 1st Edition, Jeevan Vidya Prakashan, Amarkantak, 1999
2. A.N. Tripathi, "Human Values", 1st Edition, New Age International Publishers, New Delhi, 2004

Web links:

1. Module 1: https://www.youtube.com/watch?v=2ve49BWAJRE
2. Module 2: https://youtu.be/0ERSMkRPQBM
3. Module 3: https://youtu.be/3RAU4hreptI
4. Module 4: https://youtu.be/LwpU7N6A8fg
5. Module 5:https://youtu.be/EVWcuFXeSgk

Introduction to Python Programming			
Semester	**III**	CIE Marks	**50**
Course Code	**23MESE251**	SEE Marks	**50**
Teaching Hrs/Week (L: T: P)	**1:0:2**	Exam Hrs	**2.5**
Total Hrs	**37**	Credits	**02**

Course Learning Objectives: This course is designed to

1. Impart knowledge of Python programming language syntax, semantics, and the runtime environment
2. Familiarize general computer programming concepts like data types, conditional execution, loops & functions
3. Deliver the concept of general coding techniques using NumPy
4. Build fundamentals of general coding techniques using Matplotlib

Module 1: Basics Python Programming	**No. of Hrs: 2 + 4**

Variable and Identifiers, Data Types, Operations and Expressions, other Data Types (Tuples, Lists, Dictionary) in Python

Laboratory Components:

1. Write a program to show examples of each number data type and print their types
2. Write a program to create a list, append elements to it, and remove an element by value
3. Write a program to swap the first and last elements of a given list
4. Write a program to swap elements at specified positions in a list
5. Write a program to create a tuple, access its elements, and slice it
6. Write a program to create a dictionary, add new key-value pairs, access a value by key, and remove a key-value pair

Module 2: Decision Control Statements, Functions, Methods and Strings	**No. of Hrs: 3 + 6**

Decision Control Statements: (Sequential, Selection and Iterative Control), break statement, continue statement, Functions, Lambda function and String Method

Laboratory Components:

1. Program to demonstrate on the various loops
2. Program to check whether the given string is Symmetrical or Palindrome
3. Program to find a factorial value of a given number using “Lambda” function
4. Program to Reverse words in a given string and find the length of a string

Module 3: Numpy Library – Working with Arrays / Matrices	**No. of Hrs: 3 + 6**

Introduction to NumPy, Basics of NumPy Arrays, Computation on NumPy Arrays: Universal Functions, Aggregations, Numpy – ndarray, Matrix in NumPy

Laboratory Components:

1. Program to convert a list and tuple into arrays
2. Program to find common values between two arrays
3. Program to define a matrix and print
4. Program to perform addition of two square matrices
5. Program to perform multiplication of two square matrices

Module 4: Matplotlib Library for Python	**No. of Hrs: 3 + 4**
Figure and Axes, Line Graph, Stem Plot, Bar chart, Plotting Histogram, Scatter Plot, Stack Plot, Box Plot, Pie Chart in matplotlib **Laboratory Component:** Creating basic data visualization plots (line graph, stem plot, bar charts, Histogram, Sctter Plot, Stack Plot, Box Plot, Pic Chart) using matplotlib	
Module 5: Multiple Subplots, Matplotlib with Grid Specs	**No. of Hrs: 2 + 4**
Subplots with Matplotlib, Multiple Plots same Figure, Grid Specs – Plot Layouts, Contour Plots, Surface Plots, Polar Plots **Laboratory Component:** Create subplots, Multiple plots using grid spaces, plot layouts, contours plots	

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

1. Illustrate essential programming skills and write programs in python
2. Use library such as Numpy to solve given problems
3. Plot graphs/visualize information using library such as Matplotlib in python

Textbooks:

1. Reema Thareja, "Python Programming using Problem Solving Approach", 1st Edition, Oxford University Press, 2019
2. Ward, Grinstein, Keim, "Interactive Data Visualization: Foundations Techniques, and Applications", 2nd Edition, Natick A K Peters Ltd, 2015

Reference Books:

1. Charles R. Severance, "Python for Everybody: Exploring Data Using Python 3", 1st Edition, Create Space Independent Publishing Platform, 2016
2. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd Edition, Green Tea Press, 2015

Web links:

1. Python for Everybody: Exploring Data Using Python3: http://do1.drchuck.com/pythonlearn/EN_us/pythonlearn.pdf
2. Think Python: How to Think Like a Computer Scientist http://greenteapress.com/thinkpython2/ thinkpython2.pdf

Decision Sciences for Mechanical Engineers			
Semester	**III**	CIE Marks	**50**
Course Code	**23MESE252**	SEE Marks	**50**
Teaching Hrs/Week (L: T: P)	**1:0:2**	Exam Hrs	**2.5**
Total Hrs	**37**	Credits	**02**

Course Learning Objectives: This course is designed to
1. Familiarize the use of spreadsheet to perform various mathematical operations
2. Demonstrate the data handling and plotting graphs and charts
3. Impart knowledge of use of logical and advanced functions for decision making
4. Illustrate solving engineering equations and numerical analysis
5. Build foundation of modeling and simulation in spreadsheet environment

Module 1: Introduction to Spreadsheets — **No. of Hrs: 3 + 4**

Overview of spreadsheet software (e.g., Microsoft Excel, Google Sheets), Basic navigation and interface familiarization, Understanding basic mathematical operations in spreadsheets, Introduction to built-in functions (e.g., SUM, AVERAGE, MAX, MIN)

Laboratory Components:
1. Create a simple budget spreadsheet for a project, including income, expenses, and total balance calculations
2. Use formulas to calculate the total cost of materials for a construction project, including quantities and unit prices
3. Apply the IF function to categorize engineering components as "critical" or "non-critical" based on specified criteria

Module 2: Data Analysis, Graphs and Charts — **No. of Hrs: 3 + 6**

Sorting and filtering data, using conditional formatting to highlight specific data points, Creating various types of charts (e.g., line charts, bar charts, scatter plots), Customizing chart elements and formatting options

Laboratory Components:
1. Analyze a dataset of temperature readings and identify outliers using sorting and filtering techniques
2. Apply conditional formatting to a spreadsheet of test results to highlight values outside acceptable ranges
3. Plot a stress-strain curve for a material and customize the chart with appropriate labels and axis scaling
4. Create a bar chart to visualize the distribution of defect types in a manufacturing process, with custom colors for each category

Module 3: Advanced Functions — **No. of Hrs: 3 + 6**

Introduction to advanced functions (e.g., VLOOKUP, IF, COUNTIF), using logical functions for decision-making and data validation

Laboratory Components:
1. Implement the VLOOKUP function to retrieve material properties from a database based on material codes
2. Use the COUNTIF function to count the number of occurrences of specific criteria in a dataset of product defects

Module 4: Engineering Applications I: Numerical Analysis	**No. of Hrs: 2 + 4**
Solving engineering equations using goal seek and solver tools, applying numerical methods for root finding and optimization **Laboratory Components:** 1. Use goal seek to find the required pipe diameter to achieve a specified flow rate in a fluid system 2. Apply solver tool to optimize the dimensions of a structural beam for minimum weight given specified constraints	
Module 5: Engineering Applications II: Modeling and Simulation	**No. of Hrs: 2 + 4**
Introduction to modeling concepts in spreadsheets, building simple engineering models (e.g., beam deflection, heat transfer) **Laboratory Components:** 1. Model the deflection of a cantilever beam under a point load using beam theory equations and compare results with experimental data 2. Simulate the temperature distribution in a heat sink using basic heat transfer equations and visualize results using conditional formatting	
Course Outcomes: At the end of the course, the student will be able to 1. Demonstrate skills in using spreadsheet tools 2. Apply the basic tools of spreadsheet to perform mathematical operations, data handling and plot graphs and charts 3. Apply advanced functions and logical functions for decision making and data validation 4. Solve engineering equations and numerical problems 5. Illustrate modeling and simulation using spreadsheet	
Textbook: 1. Mc Fedries Paul, "Microsoft Excel Formulas and Functions", Microsoft Press, U.S, 2019	
Reference Books: 1. Excel Resources - 600+ Self Study Guides, Articles & Tools (wallstreetmojo.com) 2. https://www.ictlounge.com/html/year_7/esafety_part7.htm	
Web link: Decision Making with Spreadsheet, https://archive.nptel.ac.in/courses/110/107/110107157/	

Fundamentals of Computational Tool			
Semester	**III**	CIE Marks	**50**
Course Code	**23MESE253**	SEE Marks	**50**
Teaching Hrs/Week (L: T: P)	**1:0:2**	Exam Hrs	**2.5**
Total Hrs	**37**	Credits	**02**

Course Learning Objectives: This course is designed to
1. Familiarize the fundamentals of Computational tools
2. Demonstrate the application of program to curve fitting
3. Impart Linear and Nonlinear Equations solving skill
4. Illustrate solving numerical integration and differentiation problems
5. Build foundation of solving ordinary differential equations

Module 1: Introduction to Computational Programming	**No. of Hrs: 3 + 4**

Basics of Computational programming, array operations, loops and execution of control, and working with files: Scripts and functions, plotting and programming output

Laboratory Components:
1. Program to do simple arithmetic operations, array creation and manipulation
2. Program to handle loops and execution control, factorial calculation using loops
3. Program to write and read from a text file
4. Program to plot a sine wave

Module 2: Numerical Methods and Applications	**No. of Hrs: 3 + 6**

Curve Fitting: Straight line fit, Polynomial fit

Laboratory Components:
1. Program to plot Linear Regression using the Least Squares Method
2. Program to plot Polynomial Fit using the Least Squares Method

Module 3: Numerical Integration and Differentiation	**No. of Hrs: 3 + 6**

Trapezoidal method, Simpson method

Laboratory Components:
1. Use of Trapezoidal method to do numerical integration
2. Use of Simpson method to do numerical integration
3. Program to perform numerical differentiation of functions

Module 4: Linear and Nonlinear Equations	**No. of Hrs: 2 + 4**

Eigen values, Eigen vectors, Solution of linear algebraic equations using Gauss Elimination, Solution of nonlinear equation in single variable using Newton-Raphson method

Laboratory Components:
1. Apply Gauss Elimination to find the solution of linear algebraic equations
2. Apply Newton-Raphson method to find the solution of nonlinear equation

Module 5: Ordinary Differential Equations	**No. of Hrs: 2 + 4**
Introduction to ODE's, Euler's method, second order Runga-Kutta method, ODE45 algorithm in single variable and multi variables. Transforms: Discrete Fourier Transforms **Laboratory Components:** 1. Apply Euler's method and Runga-Kutta method to solve Ordinary Differential Equations 2. Solve discrete Fourier Transforms	
Course Outcomes: At the end of the course, the student will be able to 1. Demonstrate skills to implement loops, branching, control instruction and functions in programming environment 2. Illustrate programming of curve fitting, numerical differentiation and integration, solution of linear equations 3. Solve nonlinear equations using ODE 45 and Discrete Fourier Transforms	
Textbooks: 1. Agam Kumar Tyagi, "MATLAB and Simulink for Engineers", OXFORD Higher Education, 2019. 2. Dr. Shailendra Jain, "Modeling& Simulation using MATLAB – Simulink", Wiley – India, 2021	
Reference Books: 1. Won Y.Tang, Wemun Cao, Tae-Sang Ching and John Morris, "Applied Numerical Methods Using MATLAB", A John Wiley & Sons, 2021 2. Steven T. Karris, "Introduction to Simulink with Engineering Applications", Orchard Publications, 2021	
Web link: MATLAB tutorial for beginners: https://www.youtube.com/watch?v=0x4JhS1YpzI&list=PLjVLYmrlmjGcNZrPa9bRg0JVlcxLX4Mu9	

Yoga-I			
Semester	**III**	CIE Marks	**100**
Course Code	**23AUCC221**	SEE Marks	**-**
Teaching Hrs/Week (L:T: P)	**0:0:1**	Exam Hrs	**-**
Total Hrs	**13**	Credits	**-**

Course Learning Objectives: This course is designed to

1. Empower students to achieve and maintain good health
2. Promote the practice of mental hygiene
3. Facilitate students in attaining emotional stability
4. Impart moral values and higher level of consciousness

Contents	**No. of Hrs: 13**

- Yoga, its origin, history and development, Yoga, its meaning, definitions
- Different schools of yoga, Aim and Objectives of yoga, importance of prayer
- Yogic practices for common man to promote positive health
- Rules to be followed during yogic practices by practitioner
- Difference between yogic and non yogic practices
- Suryanamaskar prayer and its meaning, Need, importance and benefits of Suryanamaskar13 count, 1rounds
- Asana, Need, importance of Asana, Different types of asana, Asana its meaning by name, technique, precautionary measures and benefits of each asana
- Different types of Asanas
  a) Sitting
    1. Padmasana
    2. Vajrasana
  b) Standing
    1. Vrikshana
    2. Trikonasana
  c) Prone line
    1. Bhujangasana
    2. Shalabhasana
  d) Supine line
    1. Utthitadvipadasana
    2. Ardhahalasana
- Meaning, importance and benefits of Kapalabhati, 10 strokes/min 3 rounds
- Meaning by name, technique, precautionary measures and benefits of Pranayama AnulomaViloma

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

1. Describe the meaning, aim and objectives of Yoga
2. Perform Suryanamaskar and able to analyze its benefits
3. Exhibit the different Asanas by name, its importance, methods and benefits
4. Perform Kapalabhati
5. Perform the different types of Pranayama by its name, precautions, procedure and uses

Textbooks:

1. Ajitkumar ,"YogaPravesha in Kannada" 1st Edition, Raashtroththaana Saahithya, 2017,ISBN-13: 978-8175310124
2. BKS Iyengar, "Light on Yoga", 1st Edition, Thorsons, 2017, ISBN-13: 978-0008267919
3. Dr. M L Gharote& Dr. S K Ganguly,"Teaching Methods for Yogic practices", 1st Edition, Kaivalyadhama, 2001, ISBN-13 : 978-8189485252

Reference Book:

YaminiMuthanna, "Yoga for Children step by step", 1st Edition, Om Books International, 2022, ISBN-13: 978-9394547018

Web links:

1. My Life My Yoga: https://youtu.be/KB-TYlgd1wE
2. Adiyoga: https://youtu.be/aa-TG0Wg1Ls

Physical Education-I			
Semester	**III**	CIE Marks	**100**
Course Code	**23AUCC222**	SEE Marks	-
Teaching Hrs/Week (L: T: P)	**0:0:1**	Exam Hrs	-
Total Hrs	**13**	Credits	-

Course Learning Objectives: This course is designed to

1. Impart the fundamental concepts and skills of Physical Education, Health, Nutrition and Fitness
2. Familiarization of health-related Exercises, Sports for overall growth and development
3. Build a strong foundation for the professionals in Physical Education and Sports

Contents **No. of Hrs: 13**

- Definitions & components of Physical Fitness and Life Style
- Meaning and Definitions of Physical Fitness and Life Style
- Physical activity for engineers: stress management & injury prevention
- Components of fitness: cardiovascular endurance, muscular strength & endurance, flexibility, body composition (Lectures & Assessments)
- FITT principle (Frequency, Intensity, Time, Type) of exercise planning (Lectures)
- Fitness assessments: BMI, flexibility tests (Practical Sessions)
- Warm-up and cool-down techniques to prevent injuries (Practical Sessions)

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

1. Explain the benefits of physical activity for academic performance, stress management, and injury prevention in engineers
2. Design a personalized fitness program utilizing the FITT principle for targeted improvement
3. Demonstrate proper warm-up and cool-down techniques to enhance performance and prevent injuries

Textbooks:

1. Muller, J. P., "Health, Exercise and Fitness", 1st Edition, Sports Publication, 2018
2. Uppal, A.K., "Physical Fitness", Friends Publication New Delhi, 1992
3. Russell R.P., "Health & Fitness through Physical Education: Human Kinematics", Human Kinetics Publishers, 1994

Reference Books:

1. Anaika , "Play Field Manual", Friends Publication New Delhi, 2005
2. Pinto John & Roshan Kumar Shetty, "Introduction to Physical Education"

Web links:

1. How to exercise with a fitness plan: https://www.youtube.com/watch?v=08ryXxjaF1o
2. Health Related Physical Fitness: https://www.youtube.com/watch?v=rc3ZDoheMQs

National Service Scheme -I			
Semester	**III**	CIE Marks	**100**
Course Code	**23AUCC223**	SEE Marks	**-**
Teaching Hrs/Week (L:T: P)	**0:0:1**	Exam Hrs	**-**
Total Hrs	**13**	Credits	**-**

Course Learning Objectives: This course is designed to

1. Develop discipline, character, brotherhood, the spirit of adventure and ideals of selfless service amongst young citizens
2. Develop youth leadership in the students
3. Induce social consciousness among students through various societal activities
4. Impart knowledge in finding practical solutions to individual and community problems

NSS -Contents	**No. of Hrs: 13**

Introduction:

- Importance and role of youth leadership, Life competencies
- Skill development and empowerment
- Innovation and personal growth

Activities:

- Organic farming
- Waste management

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

1. Understand the importance of nation building and individual contribution to the betterment of the society
2. Discover grassroots challenges of community and solve them by technological intervention
3. Create societal impact by upholding the value of one for all and all for one
4. Maintain discipline and team spirit

Textbooks:

1. Ministry of Youth Affairs & Sports, Government of India, "National Service Scheme Manual", 2022
2. Rajiv Gandhi National Institute of Youth Development, Ministry of Youth Affairs & Sports, Government of India, "Introduction Training Module for National Service Scheme Program officers", 2017
3. Gurmeet Hans, "Case material as Training Aid for field workers", TISS, 1996

Reference Books:

1. Dr. G R Bannerjee, "Social service opportunities in Hospitals", TISS, 2012
2. Ram Ahuja, "Social Problems in India", Rawat publications, 3rd Edition, 2014

Web links:

1. History of NSS: https://thebetterindia.com/140/national-service-scheme-nss/
2. NSS – an introduction: https://www.youtube.com/@nationalserviceschemeoffic4034/videos

Arts-I			
Semester	**III**	CIE Marks	**100**
Course Code	**23AUCC224**	SEE Marks	**-**
Teaching Hrs/Week (L: T: P)	**0:0:1**	Exam Hrs.	**-**
Total Hrs	**13**	Credits	**-**

Course Learning Objectives: This course is designed to

1. To impart an understanding of the creative process from initial concept to final execution
2. Create and demonstrate proficiency in a chosen arts discipline through practical application
3. Analyze and appreciate diverse art forms and styles
4. To participate in art competitions at regional, state, national, and international levels, as well as in cultural events

Contents	**No. of Hrs: 13**

Note: Student shall select any one form of arts and continue the same till 6th semester

Performing Arts (Dance)	Welcome and Brainstorming, Introduction to Performing Arts: Dance, Folk, Cinema, Basic study of Folk Dance Forms, Exploration of Coastal Karnataka Folk Forms, Introduction to Bharatanatyam/Kathak: Theory and Practical, Introduction to Western Dance: Theory and Practical - Basics of Hip Hop, Introduction to Yakshagana: Theory and Practical, Group Presentation, Evaluation
Music	Welcome and Brainstorming, Introduction to Music and its Classifications, Voice and Pitch test, Voice Culture exercises, Exercises for Pitch, Volume, Energy, and Clarity, Basic Singing Practice with Scales, Understanding Compositions and Pitch Mapping, Practice on a Specific Song, Group Presentation, Evaluation
Arts & Crafts	Welcome and Brainstorming, Introduction to Art & Craft, Lines and Shapes, Object Drawing, Colors and Gradations, Color Fusion, Sketching Basics, Paper crafts, Group Presentation, Evaluation
Theatre	Welcome and Brainstorming, Introduction to acting and theatre, Talent Hunt, Physical and Voice Exercise, Body Language in acting, eye contact and tone, Theatre Compositions, Evaluation

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

1. Capable of creating choreography and delivering live performances for an audience
2. Employ a range of acting techniques and use them to create a performance
3. Evolve into creative, effective, independent, and reflective individuals capable of making informed decisions in both process and performance
4. Acquire knowledge and comprehension of the roles and processes used in current theatre arts practice

Textbooks:

1. Bruce Benward and Marilyn Sake, “Music in Theory and Practice”, McGraw-Hill Education, 2014
2. Otto G. Ocvirk, Robert E. Stinson, Philip R. Wigg, Robert Bone, and David L. Cayton, “Art Fundamentals: Theory and Practice”, McGraw-Hill Education, 2012
3. Anne Bogart and Tina Landau, “The Viewpoints Book: A Practical Guide to Viewpoints and Composition”, Theatre Communications Group, 2004

Reference Books:

1. Jacqueline M. Smith, “Dance Composition: A practical guide to creative success in dance making”
2. Ralph Mayer, “The Artist’s handbook of method and materials”
3. Dr. Arun Bangre, “Glimpses of Indian music and dance”

Web links:

1. Audio visual catalogu: https://ccrtindia.gov.in/audio-visual-catalogue/
2. Essential Acting Lesson for Beginners: https://www.youtube.com/watch?v=GGl9Wri70aQ

ENGINEERING MATHEMATICS-IV			
Semester	**IV**	CIE Marks	**50**
Course Code	**23BSCC202**	SEE Marks	**50**
Teaching Hrs/Week (L: T: P)	**3:0:0**	Exam Hrs	**03**
Total Hrs	**42**	Credits	**03**

Course Learning Objectives: This course is designed to

1. Impart the basic knowledge on collection and presentation of data, measure of central tendency and dispersion, correlation, regression, and curve fitting for analyzing data
2. Provide a comprehensive understanding of sampling distributions, estimation methods, hypothesis testing, experimental designs, and analysis of variance along with exploring their engineering applications
3. Develop a systematic understanding of Markov chain and its application in solving Engineering and Scientific problems
4. Build a strong foundation in multivariate analysis techniques for analyzing data
5. Develop skills for analyzing data using R program

Module 1: Statistics	**No. of Hrs: 8**

Statistics: Collection & Presentation of data - Graphical & Tabular representation, Measures of Central Tendency, Dispersion, Skewness and Kurtosis

Correlation & Regression-Scatter plot, Multiple & Partial Correlation and Regression Coefficients, Curve fitting – Linear & Non-Linear

Module 2: Sampling, Estimation & Inference	**No. of Hrs: 9**

Sampling, Estimation & Inference: Population and Sample, Complete Enumeration v/s Sample Surveys – Merits, Demerits, and Applications. Sampling Distributions (t, Chi-Squared & F distributions)

Estimation-Maximum likelihood, Moment Estimators, Bayes' Estimators

Hypothesis testing - t test, z-test, Chi-Squared test for independence of attributes & Goodness of fit, Non-Parametric tests, Interval estimation

Module 3: Design of Experiments and Analysis of Variance	**No. of Hrs: 8**

Design of Experiments – Principles of experimentation in design, Basic Principle of Analysis of Variance (ANOVA), One-way ANOVA, Two-way ANOVA, Types of designs - Completely Randomized Design (CRD), Randomized Block Design (RBD), Latin Square Design (LSD), Missing plot technique, and Analysis of Covariance (ANOCOVA)

Module 4: Stochastic Process	**No. of Hrs: 7**

Stochastic Process: Types, Markov Chains, Chapman–Kolmogorov equations for n-step transition probabilities, Classification of States, Limiting Probabilities

Module 5: Multivariate Analysis	**No. of Hrs: 10**
Multivariate Analysis: Multivariate normal distribution, estimation & inference on vector parameters, Multivariate linear regression, Principal Components Analysis (PCA), Factor Analysis, Discriminant Analysis, Classification & Cluster Analysis	

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

1. Apply Statistical methods to real world data to get deeper insights useful for informed decision making
2. Estimate the parameters of a distribution and perform various tests as inferential measures
3. Plan/Conduct/Choose experiments and analyze results by applying principles of Design of Experiments
4. Model systems that evolve over time in a probabilistic manner
5. Use R program for analyzing and visualizing data

Textbooks:

1. S. C. Gupta, & V. K. Kapoor, "Fundamental of Mathematical Statistics", 12th Edition, Sultan Chand & sons, 2020
2. Ronald E. Walpole, Raymond H Myers, Sharon L Myers & Keying Ye, "Probability & Statistics for Engineers & Scientists", 9th Edition, Pearson Education, 2017
3. Richard Arnold Johnson & Dean W. Wichern, "Applied Multivariate Statistical Analysis", Pearson International, 2023

Reference Books:

1. S. C. Gupta, & V. K. Kapoor, "Fundamental of Applied Statistics", 4th Edition, Sultan Chand & sons, 2018
2. George Casella & Roger L. Berger, "Statistical Inference", 1st Edition, Cengage Learning India Pvt. Ltd., 2007
3. William J. Stewart, "Probability, Markov Chains, Queues, and Simulation", Princeton University Press, 2009
4. Sudha G. Purohit, Sharad D. Gore & Shailaja R. Deshmukh, "Statistics Using R", 2nd Edition, Narosa Publishing House, 2019
5. Shayle R. Searle & Andre I. Khuri, "Matrix Algebra: useful for Statistics", 2nd Edition, Wiley Series in Probability and Statistics, 2017

Web links:

1. Descriptive statistics: https://archive.nptel.ac.in/courses/111/104/111104120/
2. Probability and statistical inference: https://archive.nptel.ac.in/courses/111/104/111104146/
3. Sampling theory and linear regression Analysis: https://archive.nptel.ac.in/courses/111/104/111104147/
4. Stochastic process: https://archive.nptel.ac.in/courses/111/102/111102111/
5. Multivariate Analysis: https://archive.nptel.ac.in/courses/111/104/111104024/

Theory of Machines			
Semester	**IV**	CIE Marks	**50**
Course Code	**23MEPC208**	SEE Marks	**50**
Teaching Hrs/Week (L: T: P)	**3:0:2**	Exam Hrs	**03**
Total Hrs	**64**	Credits	**03**

Course Learning Objectives: This course is designed to

1. Provide knowledge of the kinematic behavior of mechanisms using graphical and analytical methods
2. Impart the fundamentals of mechanisms for speed control and stability control
3. Familiarize applying the principles of cams, gears, and flywheels for solving practical engineering problems
4. Familiarize the natural and damped frequencies of free 1-DOF mechanical systems and analyze the response under harmonic excitation

Module 1: Kinematics	**No. of Hrs: 8+6**

Introduction & importance of kinematics in design and analysis **Mechanism:** Kinematics, kinetics and dynamics- concept and examples. Basic terminology related to machines and mechanisms. Development of different mechanisms and its inversions like four bar chain mechanism, slider crank mechanism, double slider crank mechanism, etc.

Velocity and acceleration diagram: Basic concept used in solving velocity and acceleration problems. Approach to solve velocity and acceleration related to mechanisms using Relative velocity method for single slider crank mechanism and Four bar chain mechanism numerical examples

Laboratory Components:

1. Experiment of working of Four bar mechanism
2. Experiment of working of Slider Crank Mechanism

Module 2: Cams and Gyroscope	**No. of Hrs: 8+6**

Introduction, functions and types of cams and cam followers, Types of motions and displacement for different types of cam and cam followers, Construction of Roller type cam profile, Cam dynamics & analysis, Gyroscope & its applications in Car, airplane & ship

Laboratory Components:

1. Experiment on gyroscope
2. Experiment of working of Cams profile

Module 3: Power Transmission Drives	**No. of Hrs: 8+4**

Power transmission: Types of power transmission, E-Drives- Types, selection and characteristics of motor drives, drive by wire

Spur Gears: Gear terminology, law of gearing, Interference in involute gears, methods of avoiding interference, condition & expressions for minimum number of teeth to avoid interference, numerical examples

Gear Trains: Simple gear trains, compound gear trains, Epicyclic gear trains: Algebraic & tabular methods of finding velocity ratio & torque of epicyclic gear trains, Numerical examples

Laboratory Component:

Experimentation of working of Gear trains (Simple & compound) using simulink

Module 4: Mass Balancing	**No. of Hrs: 8+4**

Concepts of static & dynamic balancing, types of balancing. Balancing of rotating masses with same plane & different planes, concept of reference plane, forces due to revolving masses and Effects of unbalanced masses, Graphical method of solving balancing of revolving masses in the same planes & different planes, Numerical examples, Concept of Balancing of reciprocating masses (No numerical examples)

Laboratory Components:

1. Balancing of rotating masses in a single plane
2. Balancing of rotating masses in a multiple plane
3. Visit to Wheel balancing center

Module 5: Vibrations	**No. of Hrs: 8+4**

Free vibrations: Basic elements of vibrating system, Types of free vibrations, Longitudinal vibrations- Equilibrium method, D'Alembert's principle, natural frequency of single degree freedom systems, Damped free vibrations, Logarithmic decrement

Forced vibrations: Undamped forced vibration of spring mass system, Damped forced vibrations

Condition monitoring principles: Introduction to machinery maintenance, fundamentals of data acquisition, principles of condition monitoring, transducers for condition monitoring, fault diagnosis in rotating machines

Laboratory Component: Experiments to find natural frequency of Free and Forced, damped & undamped Vibration systems

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

1. Describe the mechanisms, cams, and gyroscope, power drives, balancing of rotating masses, vibrations & condition monitoring
2. Construct velocity and acceleration diagram for various mechanisms
3. Apply principles of power transmission, motor drives, spur gears, and gear trains to compute velocity ratio and torque in mechanical and electric drive systems
4. Apply principles of static and dynamic balancing to perform single-plane and multi-plane balancing of rotating masses
5. Compute natural frequency and vibration response of 1-DOF systems under free and forced conditions

Textbooks:

1. Sadhu Singh, "Theory of Machines: Kinematics and Dynamics", 3rd Edition, Pearson education India, 2011
2. S.Ratan, "Theory of Machines", Tata McGraw Hill, New Delhi, 2017

Reference Books:

1. Shah & Jadvani, "Theory of Machines", Dhanpatray and sons, New Delhi, 2020
2. S. Graham Kelly, "Mechanical Vibrations: Theory and Applications", 1st Edition, Cenage publications, 2015

Web links:

1. Theory of machines : https://archive.nptel.ac.in/courses/112/106/112106270/
2. Gear calculations : https://khkgears.net/new/gear_knowledge/abcs_of_gears-b/basic_gear_terminology_calculation.html
3. Dynamics of machines: https://archive.nptel.ac.in/courses/112/104/112104114/
4. Mechanics of Machine 1 & 2:
   i) https://mm-nitk.vlabs.ac.in/List%20of%20experiments.html, NITK Virtual Lab
   ii) https://mm2-nitk.vlabs.ac.in/List%20of%20experiments.html, NITK Virtual Lab
5. Dynamics of Machine: https://dom-nitk.vlabs.ac.in/List%20of%20experiments.html, NITK Virtual Lab
6. Mechanical Vibrations: https://mdmv-nitk.vlabs.ac.in/List%20of%20experiments.html, NITK Virtual Lab

Fluid Mechanics & Machinery			
Semester	**IV**	CIE Marks	**50**
Course Code	**23MEPC209**	SEE Marks	**50**
Teaching Hrs/Week (L: T: P)	**3:0:0**	Exam Hrs	**03**
Total Hrs	**40**	Credits	**03**

Course Learning Objectives: This course is designed to

1. Impart the knowledge of properties of fluids to solve the problems on hydrostatic forces on surfaces
2. Establish the concepts of fluid flow, momentum equations, theories governing fluid dynamics and various flow measuring instruments
3. Deliver the concept of fluid flow to solve the problems on flow inside a circular pipe, flat plate, major and minor losses
4. Formulate the concept of energy transfer using Euler's turbine equation and analyze the various design parameters of hydraulic turbines to maximize the efficiency
5. Familiarize the working principle of steam turbines and centrifugal pumps

Module 1: Introduction to Fluid Mechanics	**No. of Hrs: 8**

Properties of fluid & fluid pressure: Introductory concepts and definitions, properties of fluids and its classification. Pascal's law of pressure, pressure variation in static fluid, Absolute, gauge, atmospheric and vacuum pressures

Hydrostatic Forces on Surfaces: Hydrostatic pressure on plane (Vertical/horizontal/Inclined surfaces) submerged bodies

Module 2: Fluid dynamics and fluid flow measurement	**No. of Hrs: 8**

Fluid Dynamics: General energy and momentum equation. Euler's equation, Bernoulli's equation for real fluids assumptions and limitations

Fluid Flow Measurement: Application of Bernoulli's theorem such as venturimeter, orifice meter, pitot tube. Coriolis flow meter, turbine flow meter, ultrasonic flow meter, vortex flow meter

Module 3: Flow Through Pipes	**No. of Hrs: 8**

Laminar Flow: Flow through circular pipe, between parallel plates. Practical application of laminar flow

Turbulent Flow: Frictional losses in pipe flow, Minor Energy losses- Loss of head due to sudden enlargement, contraction. Loss of head at the entrance, exit of the pipe. Practical application of turbulent flow

Module 4: Introduction to Turbo machines & Hydraulic turbines	**No. of Hrs: 8**

Introduction, Energy Transfer In Turbomachine: Definition of a turbo machine. Parts, Classification, Comparison with positive displacement machine. Euler Turbine equation, alternate form of Euler turbine equation, components of energy transfer, degree of reaction, Utilization factor, relationship between utilization factor and degree of reaction

Hydraulic Turbines: Classification, turbine (Pelton, Francis and Kaplan turbine) components, design, turbine efficiency

Module 5: Steam Turbine and Centrifugal Pump	**No. of Hrs: 8**

Steam Turbine: Impulse staging, need for compounding, types of compounding, analysis of single (Impulse & reaction) & multistage stage turbines

Centrifugal Pumps: Working principle, Terminology, Types of casing, Pump losses, Efficiencies, Work done, Minimum starting speed, Priming, Cavitation, NPSH, Multistage centrifugal pumps

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

1. Describe the principles governing fluid statics, fluid dynamics, flow measurement techniques, and flow through pipes under laminar and turbulent conditions
2. Apply the principles of fluid statics and fluid dynamics to solve problems involving hydrostatic forces, pressure variation, energy and momentum equations
3. Apply the concept of fluid flow to solve the problems on flow inside a circular pipe, flat plate, major and minor losses
4. Articulate the principles of energy transfer in turbomachines and the working of hydraulic turbines, steam turbines, and centrifugal pumps
5. Apply the concepts of velocity triangles to compute the performance characteristics of hydraulic turbines, steam turbines, and centrifugal pumps

Textbooks:

1. Dr. R K Bansal, "Fluid Mechanics and Hydraulic Machines", 10th Edition, Laxmi publications, 2019
2. M. S. Govinda Gowda and A. M. Nagaraj, "Turbo machines", 7th Edition, M. M. Publications, 2012
3. V. Kadambi and Manohar Prasad, "An Introduction to Energy Conversion", Volume III, New Age International Publisher, 2005

Reference Books:

1. S. M. Yahya, "Turbines, Compressors & Fans" 2nd Edition, Tata McGraw Hill, 2002
2. S. L. Dixon, "Fluid Mechanics & Thermodynamics of Turbomachinery", Elsevier, 2005
3. R.K. Rajput "Fluid Mechanics and Hydraulic machines", S.Chand & Company Ltd, 2016
4. Cimbala, J.M Cengel Y A, "Fluid Mechanics: Fundamentals and Applications", McGraw-Hill, 2010
5. Frank M White, "Fluid Mechanics", 8th Edition, McGraw-Hill, 2016

Web links:

1. Introduction to Fluid Mechanics and Fluid Engineering: www.nptel.ac.in/courses/112105183, IIT Kharagpur
2. Introduction to Turbomachinery: https://onlinecourses.nptel.ac.in/noc21_me127/preview, IIT Kanpur
3. Fluid Mechanics lab: https://fm-nitk.vlabs.ac.in/, NITK Virtual Lab

Thermal Engineering - II			
Semester	**IV**	CIE Marks	**50**
Course Code	**23MEPC210**	SEE Marks	**50**
Teaching Hrs/Week (L: T: P)	**3:0:2**	Exam Hrs	**03**
Total Hrs	**64**	Credits	**04**

Course Learning Objectives: This course is designed to

1. Impart knowledge on the working principles of air standard cycles, combustion phenomena in I.C. engines, and the operation of gas power cycles and jet propulsion systems
2. Familiarize the principles and applications of vapour power cycles
3. Provide knowledge of the principles, components, and performance parameters of refrigeration systems, along with psychrometric processes and Heating, Ventilation, and Air-Conditioning (HVAC) systems

Module 1: Air Standard Cycles and I.C.Engines	**No. of Hrs: 8+9**

Air standard cycles: Otto cycle, Diesel cycle, Air standard efficiency and mean effective pressure calculations, Comparison of Otto and Diesel cycles

I.C.Engines: Classification of IC engines, Combustion of SI engine and CI engine, Detonation and factors affecting detonation, Performance analysis of I.C Engines, Heat balance, Morse test

Laboratory Components:

1. Performance Tests and Heat balance test on Four stroke Diesel Engine
2. Performance Tests and Heat balance test on Four stroke Petrol Engine
3. Morse test on Multi Cylinder Petrol Engine

Module 2: Gas Power Cycles	**No. of Hrs: 8+3**

Gas power Cycles: Gas turbine (Brayton) cycle; description and analysis. Regenerative, Intercooling and reheating in gas turbine cycles

Jet Propulsion cycles: Turbojet, Turboprop, Turbofan, Ram Jet, Rocket, Pulse Jet, Ram Rocket

Laboratory Component:

Analysis of Gas power cycles using MATLAB

Module 3: Vapour Power Cycles	**No. of Hrs: 8+3**

Carnot cycle, Rankine cycle, Reheat Rankine cycle, – Performance calculations, Regenerative Rankine Cycle with one open or closed feedwater heater (Qualitative treatment), Concept of cogeneration

Laboratory Component:

Analysis of Vapour power cycles using MATLAB

Module 4: Refrigeration Cycles	**No. of Hrs: 8+6**

Vapour Compression Refrigeration cycle with superheating and sub-cooling, Performance calculations and applications, Working principle of Vapour Absorption Refrigeration System, Refrigerants and its properties, Types of compressors

Laboratory Component:

Performance Test on a Vapour Compression Refrigeration

Module 5: Heating Ventilation and Air- conditioning Systems	**No. of Hrs: 8+3**

Air- conditioning Systems: Components of AC, Classification of AC – window AC, Split AC, Central AC, Package AC, Fundamentals and scope of HVAC, Cooling system of AC

Study of Psychrometrics: Psychrometric properties, Psychrometric Processes - heating, cooling, humidification dehumidification, adiabatic mixing, Applications in air-conditioning

Laboratory Component:

Performance Test on a Vapour Compression Refrigeration Test Rig

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

1. Articulate the working principles and performance characteristics of air standard cycles, gas power cycles, vapour power cycles, and internal combustion engines
2. Apply thermodynamic relations to compute performance parameters of air standard cycles, gas turbine cycles and vapour power cycles
3. Explain the working principles, components, and performance characteristics of refrigeration cycles and air-conditioning systems, including psychrometric properties and processes used in HVAC applications
4. Apply thermodynamic and psychrometric principles to compute the performance parameters of vapour compression, vapour absorption refrigeration systems and air-conditioning systems.
5. Analyze the performance characteristics of internal combustion engines, gas and vapour power cycles, and vapour compression refrigeration systems through experimental tests and evaluations.

Textbooks:

1. P.K. Nag, “Engineering Thermodynamics”, 6th Edition, Tata McGraw Hill, 2018
2. Yunus A. Cenegal and Michael A.Boles, “Thermodynamics - An Engineering Approach”, 9th Edition, Tata McGraw Hill, 2019

Reference Books:

1. Kenneth A. Kroosand Merle C. Potter, “Thermodynamics for engineers”, Cengage Learning, 2019
2. Michael J, Moran, Howard N. Shapiro, “Principles of Engineering Thermodynamics”, 9th Edition, Wiley, 2019
3. M. L. Mathur & Sharma, “I.C.Engines”, Dhanpat Rai & sons-India, 2010

Web links:

1. Module 1: https://ciechanow.ski/internal-combustion-engine/
2. Module 2: https://www.youtube.com/watch?v=AwbhbN20xl8&list=PLwdnzlV3ogoVJnW1S9GgOKYj5heOzl1dnIntroductory
3. Module 3: https://www.youtube.com/watch?v=M9tJUzXhUsk

Machine Drawing and GD&T			
Semester	**IV**	CIE Marks	**50**
Course Code	**23MEPC211**	SEE Marks	**50**
Teaching Hrs/Week (L: T: P)	**2:0:2**	Exam Hrs	**03**
Total Hrs	**50**	Credits	**03**

Course Learning Objectives: This course is designed to

1. Familiarize the concepts of limits, tolerance and fits and indicate them on machine drawings and to make drawings using orthographic projections
2. Impart the knowledge of thread forms, different screwed fasteners
3. Establish the knowledge of joints and couplings
4. Develop and interpret drawings of machine components leading to the preparation of assembly drawings manually and using CAD packages

Module 1: Threads and Fasteners — **No. of Hrs: 8+3**

Introduction of graphic user interface of the software. Generate 2D views of the 3D modeled machine components and extract the sectional views

GD&T: Introduction to Limits, Fits & Tolerances, Deviations, Methods of placing limit dimensions, machining symbols, types of fits with symbols and applications, geometrical tolerances on drawings, Standards followed in the industry, Tolerance Stack up calculation with examples

Screw threads and Thread forms: Terminology of thread forms. Sectional views of threads: ISO Metric (Internal & External), BSW (Internal and External), Square, ACME and Sellers thread, and American Standard thread

Screwed fasteners: Square-headed bolt and nut with washer (assembly), Hexagonal headed bolt and nut with washer (assembly)

Laboratory Components:

1. Model the machine component and extract to 2D
2. Show examples of common drawing conventions, such as hidden lines, center lines, and section views involved in fasteners and rivets

Module 2: Joints and couplings — **No. of Hrs: 10+9**

Assembly of Joints and couplings (with GD&T) using a 3D environment

Joints: Like Cotter joint (socket and spigot type), knuckle joint (pin joint type)

Couplings: Like flanged coupling (Unprotected type) and universal coupling

Laboratory Component:

Model and assemble the parts of joints and couplings and motion simulation of mechanical systems

Module 3: Assembly Drawings — **No. of Hrs: 8+12**

Drawing Basics-Detailing Drawings. Explode a 3D model for a drawing; create a drawing sheet and views, Add geometry and dimensions to a drawing, Add GD & T text, Tables and BOM, Model and assemble the following machine elements

1. Simple Mechanism Assembly (Clutch)
2. Lifting Device (Screw Jack- Bottle type)
3. Electric Motor Assembly
4. Robotics (Robot Arm assembly)
5. Flexible Machine Elements (Pulley Support Assembly or Belt Roller assembly)

Laboratory Components:

Development of production drawings using CAD software under a 3D environment

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

1. Model the machine components and construct the different thread forms and fasteners in 2D and 3D
2. Model joints & couplings, visualize their dimensions & draft the assembly drawings in 2D
3. Apply the visualization skills and develop the assembly drawings using part drawings

Textbooks:

1. K L Narayana, P Kannaiah, K Venkata Reddy, "Machine Drawing", 3rd Edition, New Age International Publishers, 2019
2. N D Bhatt, "Machine Drawing", 50th Edition, Charotar Publishing House Pvt. Ltd., 2016
3. K R Gopalakrishna, "Machine drawing", 18th Edition, Subhas Stores, 2004

Reference Books:

1. PS. Gill, "A Text Book of Machine Drawing", 17th Edition, S. K. Kataria & Sons, 2004
2. S.Trymbakaa Murthy, "A Textbook of Computer Aided Machine Drawing", CBS Publishers, 2007
3. Harry Peck, "Design for Manufacture", Pitman Publishers, 1973

Web links:

1. Engineering Graphics & Design: https://archive.nptel.ac.in/courses/112/102/112102304/#
2. Orthographic Projections: https://nptel.ac.in/courses/112104172
3. Selection of fits, Geometrical tolerances: https://www.youtube.com/watch?v=rbk28swIiHU

Fluid Mechanics & Machinery Laboratory			
Semester	**IV**	CIE Marks	**50**
Course Code	**23MEPC212**	SEE Marks	**50**
Teaching Hrs/Week (L: T: P)	**0:1:3**	Exam Hrs	**2.5**
Total Hrs	**48**	Credits	**02**

Course Learning Objectives: This course is designed to

1. Impart the knowledge on different flow measuring devices in closed and open channels
2. Familiarize the concept of flow through pipes to find major & minor losses
3. Deliver the concept on hydraulic turbines and pumps to draw performance characteristics

Introduction to fluid mechanics & machinery — **No. of Hrs: 12**

Viscosity of a fluid, Application of Bernoulli's principle using different flow measuring devices, flow measurement using notches in an open channel, validation of Bernoulli's theory through experimentation, different types of flow i.e. Laminar, turbulent flow visualization, Concept of flow through pipes to find major & minor loses for a pipe having different diameters, different materials and different roughness, Concept of hydraulic turbines, Working principle of centrifugal pumps

List of Experiments — **No. of Hrs: 36**

1. Determination of viscosity of oil using Redwood and Saybolt viscometer
2. Determination of discharge by using different flow meters (orifice plate, venture meter)
3. Determination of discharge by using rectangular/triangular notches in an open channel
4. Verification of Bernoulli's equation
5. Flow visualization using Reynolds experiment
6. Determination of head loss in pipes and pipe fittings having different diameters, different materials and different roughness
7. Performance test on Pelton turbine and draw main and operating characteristics
8. Performance test on Franci's turbine and draw main and operating characteristics
9. Performance test on Kaplan turbine and draw main and operating characteristics(Virtual Labs)
10. Performance test on single / multi-stage centrifugal pump

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

1. Determine the discharge through pipe using different flow measuring devices
2. Experiment on friction through pipes, impact of jet on vanes
3. Experiment on hydraulic turbines and pumps to draw performance characteristics

Textbooks:

1. Dr. R K Bansal, "Fluid Mechanics and Hydraulic Machines", 10th Edition, Laxmi publications, 2019
2. M. S. Govinda Gowda and A. M. Nagaraj, "Turbo machines", 7th Edition, M. M. Publications, 2012
3. V. Kadambi and Manohar Prasad, "An Introduction to Energy Conversion" Volume III, New Age International Publisher, 2005

Reference Books:

1. S. M. Yahya, "Turbines, Compressors & Fans" 2nd Edition, Tata McGraw Hill Co. Ltd, 2002
2. S. L. Dixon, "Fluid Mechanics & Thermodynamics of Turbomachinery", Elsevier, 2005
3. R.K. Rajput "Fluid Mechanics and Hydraulic machines", S.Chand & Company Ltd, 2016
4. Cimbala, J.M Cengel Y A, "Fluid Mechanics: Fundamentals and Applications", McGraw-Hill, 2010
5. Frank M White, "Fluid Mechanics", 8th Edition, McGraw-Hill, 2016

Web links:

1. Introduction to Fluid Mechanics and Fluid Engineering: www.nptel.ac.in/courses/112105183, IIT Kharagpur
2. Introduction to Turbomachinery: https://onlinecourses.nptel.ac.in/noc21_me127/preview, IIT Kanpur
3. Fluid Mrchanics lab: https://fm-nitk.vlabs.ac.in/, NITK Virtual Lab

Research Methodology & Intellectual Property Rights			
Semester	**IV**	CIE Marks	**50**
Course Code	**23HMCC216**	SEE Marks	**50**
Teaching Hrs/Week (L:T: P)	**2:0:0**	Exam Hrs	**2.5**
Total Hrs	**26**	Credits	**02**

Course Learning Objectives: This course is designed to

1. Impart knowledge on basics of research
2. Discuss the concepts of Intellectual Property Rights

Module 1: Introduction, Literature Review and Technical Reading	**No. of Hrs: 7**

Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Importance of Knowing How Research is Done, Research Process, Criteria of Good Research

New and Existing Knowledge, Analysis and Synthesis of Prior Art, Bibliographic Databases, Effective Search: The Way Forward, Introduction to Technical Reading, Conceptualizing Research, Critical and Creative Reading, Taking Notes While Reading, Reading Mathematics and Algorithms, Reading a Datasheet

Module 2: Research Design	**No. of Hrs: 5**

What is a Research Problem? Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, Meaning of Research Design, Need for Research Design, features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs

Module 3: Ethics in Engineering Research & Technical Writing	**No. of Hrs: 5**

Ethics in Engineering Research Practice, Types of Research Misconduct, Ethical Issues Related to Authorship, Free Writing and Mining for Ideas, Attributes and Reasons of Technical Writing, Writing Strategies, Journal Paper: Structure and Approach, Language Skills, Writing Style, and Editing, Rules of Mathematical Writing, Publish Articles to Get Cited, or Perish, IMRaD Guidelines, COPE Guidelines

Module 4: Introduction to Intellectual Property	**No. of Hrs: 4**

Role of IP in the Economic and Cultural Development of the Society, IP Governance, IP as a Global Indicator of Innovation, Origin of IP History of IP in India- Copyrights, Patents, Trademarks, Geographical Indications, Trade secrets, Semiconductor Integrated circuits and layout designs, Plant varieties, Industrial Design

Module 5: Process of Patenting	**No. of Hrs: 5**

Prior Art Search, Choice of Application to be Filed, Patent Application Forms. Jurisdiction of Filing Patent Application, Publication, Pre-grant Opposition, Examination. Grant of a Patent. Validity of Patent Protection, Post-grant Opposition, Commercialization of a Patent

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

1. Apply the basic research principles and methodologies
2. Review the Literature, Technical Reading, Attributions and Citations
3. Understand Various Intellectual Property Rights
4. Draft patent application

Textbooks:

1. C.R Kothari "Research MethodologyMethods and Techniques" 2nd Edition, Newage international, 2009
2. Dipankar Deb, Rajeeb Dey, Valentina E. Balas,"Engineering Research Methodology A Practical Insight for Researchers",1st Edition, Springer Nature, 2019
3. Prof. Rupinder Tewari Ms. MamtaBhardwa, "Intellectual Property A Primer for Academia", Publication Bureau Panjab University Chandigarh, 2021

Reference Books:

1. David V. Thiel,"Research Methods for Engineers", 1st Edition, Cambridge University Press, 2014
2. William G. Zikmund, Barry J. Babin, Jon C Carr, Mitch Griffin, "Business Research Methods", 9th Edition, Cengage India Private Limited, 2013
3. "WIPO Intellectual Property Handbook", WIPO Publication

Web links:

1. Research Methodology Course: https://onlinecourses.nptel.ac.in/noc24_ge41/preview
2. Module 4,5: https://www.ipindia.gov.in/
3. Module 4,5: https://www.wipo.int/
4. Refence Management tool: https://desktop-download.mendeley.com/download/Getting_Started_Guide.pdf
5. IMRad Guidelines: https://writingcenter.gmu.edu/writing-resources/imrad/writing-an-imrad-report
6. COPE Guidelines: https://publicationethics.org/files/u7141/1999pdf13.pdf

Introduction to Data Science			
Semester	**IV**	CIE Marks	**50**
Course Code	**23MESE254**	SEE Marks	**50**
Teaching Hrs/Week (L: T: P)	**1:0:2**	Exam Hrs	**2.5**
Total Hrs	**38**	Credits	**02**

Course Learning Objectives: This course is designed to
1. Understand the fundamentals of concept learning and hypothesis generation
2. Gain proficiency in data preprocessing techniques and data visualization methods
3. Develop a comprehensive understanding of regression models
4. Acquire knowledge and practical skills in Support Vector Machines (SVMs)
5. Master the concepts of neural networks

Module 1: Introduction to Concept Learning — **No. of Hrs: 4+4**

Concept learning, general hypothesis and specific hypothesis, FIND-S Algorithm

Laboratory Components:
1. Apply FIND-S Algorithm to determine the general hypothesis for a given data set
2. Conduct candidate elimination algorithm for the provided classification data set

Module 2: Data Pre-Processing and Data Visualization — **No. of Hrs: 4+4**

Introduction to Data Preprocessing, Handling Missing Values, Feature Engineering, and Splitting the Dataset. Introduction to Data Visualization, Exploratory Data Analysis, Visualizing Data Distributions and Relationships

Laboratory Components:
1. Undertake data preprocessing to handle Missing Values by identifying and managing missing data points using appropriate techniques
2. Convert categorical variables into numerical values using suitable techniques and create new features from existing data

Module 3: Training Models: Regression — **No. of Hrs: 4+4**

Introduction to regression, simple linear regression and polynomial regression, applications of regression models

Laboratory Components:
1. Implement Simple Linear Regression for various applications
2. Explore polynomial regression and use it for data sets involving non-linear relationship between the dependent and independent variables

Module 4: Support Vector Machine — **No. of Hrs: 3+4**

Introduction to Support Vector Machines, Linear SVM for Classification, SVM for Regression, applications of SVM Models

Laboratory Component:

Use SVM for binary classification on the provided dataset to predict class labels for new instances based on the trained model's decision boundary and support vectors

Module 5: Neural Network — **No. of Hrs: 4+4**

Introduction to Neural Networks, Supervised, Deep Learning (RNN, CNN) Feedforward Neural Networks

Laboratory Component:

Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data set

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

1. Apply the AI algorithms to generate general hypothesis
2. Preprocess datasets by handling missing values, and develop skills in visualizing data distributions
3. Make use of simple linear and, polynomial regression to gain proficiency in evaluating regression models
4. Utilize linear SVMs for classification tasks
5. Apply neural network models for predicting outcomes

Textbooks:

1. Joel G., "Data Science from scratch: First Principles with python", 2nd Edition, O'Reilly Media, 2019
2. McKinney W., "Python for Data Analysis: Data Wrangling with Pandas, Numpy, and IPython", 2nd Edition, O'Reilly Media, 2017
3. Stuart R. and Peter N., "Artificial Intelligence: A Modern Approach,", 4th Edition, Pearson Education, India, 2020
4. Ian G., Yoshua B. and Aaron C., "Deep Learning", 1st Edition, The MIT Press, 2016

Reference Books:

1. Aurélien G., "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow", 3rd Edition, Shroff Publishers & Distributors Pvt. Ltd., 2002
2. Andrew NG, "Machine Learning Yearning: Technical Strategy for AI Engineers, In the Era of Deep Learning", deeplearning.ai
3. Jake V., "Python Data Science Handbook: Essential Tools for Working with Data", 1st Edition, Shroff Publishers & Distributors Pvt. Ltd., 2016

Quality Engineering			
Semester	**IV**	CIE Marks	**50**
Course Code	**23MESE255**	SEE Marks	**50**
Teaching Hrs/Week (L: T: P)	**1:0:2**	Exam Hrs	**2.5**
Total Hrs	**38**	Credits	**02**

Course Learning Objectives: This course is designed to

1. Differentiate between various types of errors and gauges/comparators
2. Illustrate the principles of length standards and their application in linear and angular measurements
3. Describe the impact of surface finish on product performance
4. Interpret statistical charts and apply sampling techniques for acceptance testing based on industry standards
5. Recommend appropriate inspection and validation practices based on case studies from various industries

Module 1: Metrology Fundamentals	**No. of Hrs: 4+4**

Basic concepts: Measurement and inspection; Role of metrology in quality assurance; Errors; Length standards; Gauges and comparators; Linear and angular measurements; Fits and tolerances

Laboratory Components:

1. Calibration of Pressure Gauge
2. Calibration of Load cell

Module 2: Advanced Measurement Techniques	**No. of Hrs: 4+4**

Measurement Practices: Optical metrology and laser interferometers; Measurement of flatness, straightness and form errors; Surface finish measurements

Laboratory Components:

1. Measurements using Optical Projector / Tool makers' Microscope'
2. Measurements of Screw thread parameters using wire method

Module 3: Precision Measurement	**No. of Hrs: 3+4**

CMM; Vision applications in Metrology; Nano-measurements

Laboratory Components:

1. Measurement of angle using Sine Centre / Sine bar / bevel protractor
2. Calibration of Micrometer using slip gauges

Module 4: Statistical Quality Control (SQC) Tools	**No. of Hrs: 4+4**

Statistical Methodologies: Graphical methods, Statistical control charts, Regression analysis, Analysis of variance, Sampling and acceptance

Laboratory Components:

1. Application of statistical parameter using Minitab
2. Application of DOE

Module 5: Standards & Practices for Quality Assurance	**No. of Hrs: 3+4**
Standards and Certifications: BIS, ISO, SAE, ASME, ASTM, IEEE. **Laboratory Components:** 1. Case studies: Inspection and Validation practices adopted in various industries. 2. SPC charts	
Course Outcomes: At the end of the course, the student will be able to 1. Identify and explain fundamental principles of measurement science, uncertainty, and its control methods 2. Select the appropriate tools or dimensional measurements and justify the chosen measurement approach 3. Interpret data from different measurement techniques to evaluate product conformance. 4. Apply statistical methods to quality data and evaluate process control effectiveness 5. Examine case studies of inspection practices in various industries and propose improvements to existing practices	
Textbooks: 1. Beckwith, T. G., Marangoni, R. D. and Lienhard, J. H., "Mechanical Measurements", 6th Edition, Pearson Higher Education, 2007 2. Jain, R. K., "Engineering Metrology", Khanna Publishers, 20th Reprint, 2014	
Reference Books: 1. Whitehouse, D. J., "Hand Book of Surface and Nanometrology", 2nd Edition, CRC Press, 2010 2. Smith, G. T., "Industrial Metrology", Springer, 2002	
Web links: 1. Quality Engineering and Management, https://onlinecourses.swayam2.ac.in/nou21_me04/preview, Swayam, online course 2. Quality design and control, https://nptel.ac.in/courses/110105088, IIT Karagpur, NPTEL	

Mechanical Design Concepts			
Semester	**IV**	CIE Marks	**50**
Course Code	**23MESE256**	SEE Marks	**50**
Teaching Hrs/Week (L: T: P)	**1:0:2**	Exam Hrs	**2.5**
Total Hrs	**38**	Credits	**02**

Course Learning Objectives: This course is designed to

1. Define key concepts in mechanics and differentiate between different types of material behavior
2. Explain the relationships between characteristics of planar mechanisms and illustrate the principles of stress and strain analysis
3. Obtain the forces acting on mechanisms and apply appropriate failure theories to predict material behavior
4. Design of non-permanent joints using threaded fasteners
5. Interpret case studies of motion analysis and machine design and evaluate the effectiveness of different design approaches

Module 1: Mechanics of Planar Motion	**No. of Hrs: 4+4**

Kinematics and Dynamics: Introduction to mechanisms; position, velocity and acceleration of planar mechanisms; dynamics of planar mechanisms; case studies

Laboratory Components:

1. Design virtually useful Planar Mechanism
2. Analyze all kinematic data: linear and angular displacement, velocity and acceleration

Module 2: Strength of Materials Fundamentals	**No. of Hrs: 4+4**

Stress and Strain – axially loaded members; torsion of circular bars; bending of prismatic beams

Laboratory Components:

1. Ansys tutorial on stress-strain visualization
2. Ansys tutorial on combined load conditions analysis

Module 3: Predicting Material Failure	**No. of Hrs: 3+4**

Failure Theories – failure of ductile and brittle materials under static loading; mechanism of fatigue failures; fatigue failure models

Laboratory Components:

1. Experiments on failure of ductile and brittle materials under static loading
2. Fatigue failure models

Module 4: Mechanical Joint Design	**No. of Hrs: 4+4**

Machine Elements – Design of non-permanent joints - threaded fasteners, mechanics of power screws

Laboratory Components:

1. Design of bolts and nuts
2. Analysis of power screw mechanisms

Module 5: Joining and Gearing Systems	**No. of Hrs: 3+4**

Design of permanent joints – welding; gears – nomenclature, force analysis, Lewis bending equation, design of spur and helical gears

Laboratory Components:

1. Arc and Gas welding of butt weld and T-Joint and assessment of joint strength and its integrity
2. Gear design concepts using Ansys

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

1. Identify and explain the fundamental principles of mechanics of materials and kinematics
2. Solve for forces, stresses, and strains in mechanical components
3. Apply appropriate analytical methods to predict the behavior of mechanisms and select suitable materials for mechanical components
4. Design mechanical components considering material properties and justify the chosen design decisions based on engineering principles
5. Evaluate existing designs of machines and mechanisms for their effectiveness

Textbooks:

1. Norton, R.L., "Machine Design – an Integrated Approach", 5th Edition, Pearson education Inc., 2018
2. Shigley, J. E., Mischke, C. R., and Budynas, R. G., "Mechanical Engineering Design", 7th Edition, Tata McGraw Hill, 2004

Reference Books:

1. Juvinall R. C. and K. M. Marshek, "Fundamentals of Machine Component Design", 5th Edition, Wiley-India, 2011
2. Spotts M. F., Shoup T. E., and Hornberger L. E., "Design of Machine Elements", 8th Edition, Pearson education Inc., 2003

Environmental Studies & Sustainability			
Semester	**IV**	CIE Marks	**100**
Course Code	**23AUCC229**	SEE Marks	**-**
Teaching Hrs/Week (L:T: P)	**1:0:0**	Exam Hrs	**-**
Total Hrs	**13**	Credits	**-**

Course Learning Objectives: This course is designed to

1. Create environmental awareness among the students
2. Provide knowledge on different types of pollution and their impacts in the environment
3. Enable the learners to understand the environmental management plan and socio-economic skills for sustainable development
4. Know about the major challenges in Environmental Issues and Evaluate possible solutions

Module 1: Ecosystems and Biodiversity	**No. of Hrs: 2**

Ecosystems: Value of Forest, Desert, Wetlands, River, Oceanic and Lake
Biodiversity: Types, Value, Hot-spots, Threats and Conservation of biodiversity, Forest Wealth and Deforestation

Module 2: Sustainable Energy Resources	**No. of Hrs: 2**

Energy Resources: Types of Energy, Conventional Sources and Non-Conventional Sources, Renewable Energy Sources: Hydrogen, Solar, OTEC, Tidal, Wind, Geothermal, Biomass and Bio Fuels

Module 3: Environmental Pollution and Sustainable Waste Management	**No. of Hrs: 3**

Environmental Pollution: Surface and Ground Water Pollution, Noise pollution, Air Pollution and Carbon Trading
Sustainable Waste Management & Public Health Aspects: Bio-medical Waste, Solid Waste, Hazardous Waste, E-waste, Industrial and Municipal Sludge

Module 4: Global Environmental Concerns	**No. of Hrs: 3**

Population Growth, Climate Change, Ground Water Depletion/Recharging, Ozone Depletion, Radon and Fluoride problem in drinking water, Disaster Management, Resettlement and Rehabilitation of People

Module 5: Environmental Pollution Mitigation Tools	**No. of Hrs: 3**

Remote Sensing& G.I.S., Environment Impact Assessment, Environmental Management Systems, ISO14001, Green Credit Program, Waste Audits, Environmental Stewardship - NGOs

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

1. Describe the principles of ecology and environmental issues of air, land and water on a global scale
2. Explain their environmental knowledge and observation skills to analysis of a problem or question related to the sustainable environment and energy
3. Illustrate the Global environmental concerns and the individual responsibility to protect environment with environmental protection laws and education for sustainable environment
4. Outline the strategies, technologies, and methods for sustainable management of environmental systems and for the remediation or restoration of degraded environment

Textbooks:

1. Benny Joseph, "Environmental Studies", 2nd Edition, Tata Mcgraw-Hill, 2012
2. Erach Bharucha, "Environmental Studies",1st Edition, University Grant Commission and Bharati Vidyapeeth Institute of Environmental Education and Research, Pune, 2004

Reference Books:

1. B. S Chauhan, "Environmental Studies", 1st Edition, Laxmi Publications Pvt. Ltd.,2019
2. S M Prakash, "Environmental Studies", 3rd Edition, Pristine Publishing House, Mangalore, 2018
3. Aloka Debi,"Environmental Science and Engineering", 2nd Edition, Universities Press (India) Pvt. Ltd, 2012
4. R. J. Ranjit Daniels and Jagadish Krishnaswamy, "Environmental Studies", 1st Edition, Wiley India Private Ltd., New Delhi, 2009
5. M.Ayi Reddy, "Environmental Science and Technology", 1st Edition, BS Publications, 2007

Web links:

1. Environmental Studies Module 1: https://www.youtube.com/watch?v=siGaqKXCmg8
2. Question Bank| Environmental Studies: https://www.youtube.com/watch?v=F9uwkhoT3MQ
3. Environmental Science and Engineering Module 1-5: https://www.youtube.com/watch?v=Y5B1nWYle40

Yoga-II			
Semester	**IV**	CIE Marks	**100**
Course Code	**23AUCC225**	SEE Marks	**-**
Teaching Hrs/Week (L:T: P)	**0:0:1**	Exam Hrs	**-**
Total Hrs	**13**	Credits	**-**

Course Learning Objectives: This course is designed to

1. Empower students to achieve and maintain good health
2. Promote the practice of mental hygiene
3. Facilitate students in attaining emotional stability
4. Impart moral values and higher level of consciousness

Contents	**No. of Hrs: 13**

- Ashtanga Yoga, its need and importance

- Yama : Ahimsa, satya, asteya, brahmacarya, aparigrahaNiyama :shoucha, santosh, tapa, svaadhyaya, Eshvarapranidhan etc.,.

- Suryanamaskar13 count- 2 rounds of practice
- Asana, Need, importance of Asana, Different types of asana, Asana its meaning by name, technique, precautionary measures and benefits of each asana
- Different types of Asanas
  a) Sitting
    1. Sukhasana
    2. Paschimottanasana
  b) Standing
    1. ArdhakatiChakrasana
    2. ParshvaChakrasana
  c) Prone line
    1. Dhanurasana
    2. Sarpasana
  d) Supine line
    1. Halasana
    2. KarnaPeedasana
- Meaning, importance and benefits of Kapalabhati. 20 strokes/min 3 rounds
- Meaning, Need, importance of Pranayama, Different types, Meaning by name, technique, precautionary measures and benefits of each Pranayama
    1. Suryanuloma –Viloma
    2. Chandranuloma-Viloma
    3. Suryabhedana
    4. Chandra Bhedana
    5. Nadishodhana

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

1. Describe the meaning, aim and objectives of Yoga
2. Perform Suryanamaskar and able to analyze its benefits
3. Exhibit the different Asanas by name, its importance, methods and benefits
4. Perform Kapalabhati
5. Perform the different types of Pranayama by its name, precautions, procedure and uses

Textbooks:

1. Ajitkumar ,"YogaPravesha in Kannada" 1st Edition, Raashtroththaana Saahithya, 2017,ISBN-13: 978-8175310124
2. BKS Iyengar, "Light on Yoga", 1st Edition, Thorsons, 2017, ISBN-13: 978-0008267919
3. Dr. M L Gharote& Dr. S K Ganguly,"Teaching Methods for Yogic practices", 1st Edition, Kaivalyadhama, 2001, ISBN-13 : 978-8189485252

Reference Book:

YaminiMuthanna, "Yoga for Children step by step", 1st Edition, Om Books International, 2022, ISBN-13: 978-9394547018

Web links:

1. My Life My Yoga: https://youtu.be/KB-TYlgd1wE
2. Adiyoga: https://youtu.be/aa-TG0Wg1Ls

Physical Education-II			
Semester	**IV**	CIE Marks	**100**
Course Code	**23AUCC226**	SEE Marks	-
Teaching Hrs/Week (L: T: P)	**0:0:1**	Exam Hrs	-
Total Hrs	**13**	Credits	-

Course Learning Objectives: This course is designed to

1. Impart the fundamental concepts and skills of Physical Education, Health, Nutrition and Fitness
2. Familiarization of health-related Exercises, Sports for overall growth and development
3. Build a strong foundation for the professionals in Physical Education and Sports

Contents	**No. of Hrs: 13**

- Training Components: Strength, Speed, Endurance, Flexibility, Agility & Coordinative abilities
- Basic rules and strategies of chosen team sports. (Practical Sessions)
- Causes & Prevention of Sports Injuries: Sprain, Strain, Cramps, Fractures and Dislocation
- Specific Games (Any one to be selected by the student)

Basic Training

Basket ball	Dribbling with both hands - Layup shot - Chest pass - Proper footwork and body positioning - Basic jump shot technique
Cricket	Holding the bat grip - Stance and footwork - Basic batting shots (defense & hitting) - Bowling grip and action - Fielding techniques (catching & throwing)
Football	Dribbling with both feet - Passing with accuracy (short and long) - Controlling the ball (laces, inside of foot) - Shooting technique - Stopping the ball - Basic heading technique
Hockey	Dribbling the ball with a stick - Stopping the ball with the stick - Basic passing techniques (forehand, backhand) - Shooting technique (push shot, flick shot) - Body positioning and balance
Table Tennis	Holding the paddle grip - Forehand and backhand grip changes - Basic strokes (forehand drive, backhand push) - Footwork and positioning - Serving technique (underhand serve)
Throwball	One-handed chest pass - Two-handed overhead pass - Pivoting with the ball Footwork and movement - Shooting technique (one-handed and two-handed throws) - Catching the ball safely
Volleyball	Overhand serve - Proper hand setting technique (bump pass) - Forearm pass
Badminton	Holding the racquet grip : Forehand , backhand, universal and panhandle grip changes ,Basic serves (high serve, low serve), Stance and Strokes

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

1. Design a basic training program incorporating various training components to improve specific physical fitness aspects
2. Identify common sports injuries, explain their causes, and implement preventative measures
3. Perform in the selected sports or athletic events

Textbooks:

1. Muller J. P., "Health, Exercise and Fitness", 1st Edition, Sports Publication, 2018
2. Uppal A.K., "Physical Fitness", Friends Publication New Delhi, 1992
3. Russell R.P., "Health & Fitness through Physical Education: Human Kinematics", Human Kinetics Publishers, 1994

Reference Books:

1. Anaika, "Play Field Manual", Friends Publication New Delhi, 2005
2. IAAF Manual
3. Pinto John & Roshan Kumar Shetty, "Introduction to Physical Education"

Web links:

1. Football: https://www.youtube.com/watch?v=wvlztaJYKYI
2. Basketball Basics: https://www.youtube.com/watch?v=d0z7QqblJaM
3. Cricket with the correct grip: https://www.youtube.com/watch?v=UxX4IQL03UU
4. Basics of Dribbling: https://www.youtube.com/watch?v=naEccnjzLxM
5. Karate Training: https://www.youtube.com/watch?v=br89-xhWezs

National Service Scheme-II			
Semester	**IV**	CIE Marks	**100**
Course Code	**23AUCC227**	SEE Marks	-
Teaching Hrs/Week (L:T: P)	**0:0:1**	Exam Hrs	-
Total Hrs	**13**	Credits	-

Course Learning Objectives: This course is designed to

1. Develop discipline, character, brotherhood, the spirit of adventure and ideals of selfless service amongst young citizens
2. Develop youth leadership in the students
3. Induce social consciousness among students through various societal activities
4. Impart knowledge in finding practical solutions to individual and community problems

NSS -Contents	**No. of Hrs: 13**

Introduction:

- Youth development programmes
- Health, hygiene and sanitation awareness programs
- Peer leadership training

Activities:

- Social and economic activities to support the society
- Water conservation – awareness sessions on water conservation, rain water harvesting, maintaining the surroundings, safeguarding water sources, etc.

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

1. Understand the importance of nation building and individual contribution to the betterment of the society
2. Discover grassroots challenges of community and solve them by technological intervention
3. Create societal impact by upholding the value of one for all and all for one
4. Maintain discipline and team spirit

Textbooks:

1. Ministry of Youth Affairs & Sports, Government of India, "National Service Scheme Manual", 2022
2. Rajiv Gandhi National Institute of Youth Development, Ministry of Youth Affairs & Sports, Government of India, "Introduction Training Module for National Service Scheme (NSS) Program officers", 2017
3. Gurmeet Hans, "Case material as Training Aid for field workers" TISS, 1996

Reference Books:

1. Dr. G R Bannerjee, Social service opportunities in Hospitals, TISS, 2012
2. Ram Ahuja, Social Problems in India, Rawat publications, 3rd Edition2014

Web links:

1. History of NSS : https://thebetterindia.com/140/national-service-scheme-nss/
2. NSS – an introduction: https://www.youtube.com/@nationalserviceschemeoffic4034/videos

Arts-II			
Semester	**IV**	CIE Marks	**100**
Course Code	**23AUCC228**	SEE Marks	**-**
Teaching Hrs/Week (L: T: P)	**0:0:1**	Exam Hrs	**-**
Total Hrs	**13**	Credits	**-**

Course Learning Objectives: This course is designed to

1. To impart an understanding of the creative process from initial concept to final execution
2. Create and demonstrate proficiency in a chosen arts discipline through practical application
3. Analyze and appreciate diverse art forms and styles
4. To participate in art competitions at regional, state, national, and international levels, as well as in cultural events

Contents	**No. of Hrs: 13**

Note: Student shall continue the arts form selected in previous semester

Performing Arts (Dance)	Orientation, Head to Toe Exercise, Contemporary /filmy dance, Basic expression and choreography, Zumba and aerobics, Dance practice and Group Performance, Evaluation
Music	Orientation, Introduction to Musical Instruments, Basic Instrumental Practice, Singing Genres Demo, Niche Mapping, Folk Singing with instrument, Group Song Practice, Group Presentation, Evaluation
Arts & Crafts	Orientation, Sketching lifestyle and modelling, Pencil Shading-practical, Brush/Crayon Techniques, Charcoal Drawing, watercolor practical, collage, Group Presentation, Evaluation
Theatre	Orientation, Realistic Acting: input and output applications, Stylized Acting, Absurd acting, Group Rehearsal, Basics of Costume Design, Prop Usage, Group Presentation, Evaluation

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

1. To be capable of creating choreography and delivering live performances for an audience
2. Employ a range of acting techniques and use them to create a performance
3. Evolve into creative, effective, independent, and reflective individuals capable of making informed decisions in both process and performance
4. Acquire knowledge and comprehension of the roles and processes used in current theatre arts practice

Textbooks:

1. Bruce Benward and Marilyn Sake, “Music in Theory and Practice”, McGraw-Hill Education, 2014
2. Otto G. Ocvirk, Robert E. Stinson, Philip R. Wigg, Robert Bone, and David L. Cayton, “Art Fundamentals: Theory and Practice”, McGraw-Hill Education, 2012
3. Anne Bogart and Tina Landau, “The Viewpoints Book: A Practical Guide to Viewpoints and Composition”, Theatre Communications Group, 2004

Reference Books:

1. Jacqueline M. Smith, "Dance Composition: A practical guide to creative success in dance making"
2. Ralph Mayer, "The Artist's handbook of method and materials"
3. Dr. Arun Bangre, "Glimpses of Indian music and dance"

Web link:

Audio visual catalogue: https://ccrtindia.gov.in/audio-visual-catalogue/