

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 **Centers 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.*

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
NON-CREDIT MANDATORY COURSES			
21	23NMCC221	Yoga-I	III
22	23NMCC222	Physical Education-I	III
23	23NMCC223	NSS-I	III
24	23NMCC224	Arts-I	III
25	23NMCC225	Yoga-II	IV
26	23NMCC226	Physical Education-II	IV
27	23NMCC227	NSS-II	IV
28	23NMCC228	Arts-II	IV
29	23NMCC229	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	23NMCC22X	Yoga / Physical Education / NSS / Arts**	Non-Credit Mandatory Course	Yoga Teacher/ PED/NSS Coordinator/ Cultural Coordinator	0	0	1	100	-	100	-	-
Total											23	



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*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	23NMCC221	Yoga- I
2	23NMCC222	Physical Education-I
3	23NMCC223	NSS-I
4	23NMCC224	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	23NMCC229	Environmental Studies & Sustainability	Non-Credit Mandatory Course	Civil Engg.	1	0	0	100	-	100	-	-
10	23NMCC22X	Yoga/ Physical Education / NSS / Arts**	Non-Credit Mandatory Course	Yoga Teacher/ PED/NSS Coordinator/ Cultural Coordinator	0	0	1	100	-	100	-	-
Total											23	



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*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	23NMCC225	Yoga-II
2	23NMCC226	Physical Education-II
3	23NMCC227	NSS-II
4	23NMCC228	Arts-II



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III Semester

Sl. No.	Course Code	Course title	Page No.
1	23BSME201	Engineering Mathematics-III	1
2	23MEPC203	Strength of Materials	3
3	23MEPC204	Metal Processing and Machining	5
4	23MEPC205	Thermal Engineering -I	7
5	23MEPC206	Digital Measurement Systems	9
6	23MEPC207	Materials Characterization	12
7	23HMCC215	Universal Human Values	14
8	23MESE25X	Skill Enhancement Course	16-21
9	23NMCC22X	Yoga/Physical Education/NSS/Arts	22-27

IV Semester

Sl. No.	Course Code	Course title	Page No.
1	23BSCC202	Engineering Mathematics-IV	28
2	23MEPC208	Theory of Machines	30
3	23MEPC209	Fluid Mechanics & Machinery	33
4	23MEPC210	Thermal Engineering -II	35
5	23MEPC211	Machine Drawing and GD & T	37
6	23MEPC212	Fluid Mechanics & Machinery laboratory	39
7	23HMCC216	Research Methodology & Intellectual Property Rights	41
8	23MESE25X	Skill Enhancement Course	43-48
9	23NMCC229	Environmental Studies & Sustainability	49
10	23NMCC22X	Yoga/Physical Education/NSS/Arts	51-57

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			
<ol style="list-style-type: none"> 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
<p>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</p> <p>Inverse Laplace Transforms: Definition, Inverse Laplace Transform, Convolution theorem to find the inverse Laplace Transforms, Solution of differential equations using Laplace Transforms</p>			
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
<p>Fourier Transforms: Definition, Fourier Sine and Cosine transforms, Inverse Fourier Transforms, Inverse Fourier Cosine and Sine transforms</p> <p>Solution of first and second order ordinary differential equations using Taylor series method</p>			
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
<p>Solution of Polynomial and Transcendental Equations: Regula-Falsi and Newton-Raphson methods</p> <p>Numerical Differentiation: Forward and Backward difference methods</p> <p>Numerical integration: Simpson's (1/3)rd rule, (3/8)th rule and Romberg's method</p>			



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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=1JnayXHhjlq>
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
<p>Course Learning Objectives: This course is designed to</p> <ol style="list-style-type: none"> 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
<p>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</p> <p>Cylinders: Stresses in thin cylinders, Changes in dimensions of thin cylinders, Lamé's equation for thick cylinders (No derivation), Thick cylinders subjected to internal and external pressures</p>			
Module 3: Shear Forces & Bending Moments and Stress in Beams			No. of Hrs: 8+5
<p>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</p> <p>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</p>			
Module 4: Strain Energy and Torsion			No. of Hrs: 8+5
<p>Strain Energy: Strain energy due to axial, shear, bending, torsion, uniformly varying load, and impact load, Application of Castigliano's theorems</p> <p>Torsion: Pure torsion, Torsion equation, Polar modulus, Power transmission of circular solid and hollow straight shafts and stepped shafts</p>			



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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	
<ol style="list-style-type: none">1. Explain material properties, stress & strain relations, types of beams & loads, strain energy, and pure torsion2. 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 cylinders3. 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 members4. Compute strain energy stored in structural elements due to axial, bending, torsion & impact loads, and dimensions of the shafts subjected to pure torsion5. Identify the failure load using different theories of failure and stability of columns for different end conditions	
Textbooks:	
<ol style="list-style-type: none">1. Bhavikatti S.S, "Strength of Materials", 4th Edition, Vikas Publishing House, 20132. R C Hibbeler, "Mechanics of Materials", 11th Edition, Pearson, 20223. S S Rattan, "Strength of Materials", 3rd Edition, McGraw Hill, 2017	
Reference Books:	
<ol style="list-style-type: none">1. P N Chandramouli, "Fundamentals of Strength of Materials", 1st Edition, PHI Learning Pvt. Ltd, 20122. R K Rajput, "Strength of Materials", 6th Edition, S. Chand Publishing, 20153. Ferdinand P. Beer, E. Russell Johnston, John T. Dewolf and David F. Mazurek, "Mechanics of Materials", 6th Edition, McGraw Hill, 20124. R.K. Bansal, "Strength of Materials", 6th Edition, Laxmi Publications, 2018	
Web links:	
<ol style="list-style-type: none">1. Tensile test: https://eerc01-iiith.vlabs.ac.in/exp/tensile-test-experiment/, IIIT-H, Virtual Lab2. Torsion test: https://eerc01-iiith.vlabs.ac.in/exp/torsion-test-experiment/, IIIT-H, Virtual Lab3. Bending test: https://sm-nitk.vlabs.ac.in/exp/bending-test-mild-steel/, NITK, Virtual Lab4. Module 1-5: https://nptel.ac.in/courses/1121071465. 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
<p>Course Learning Objectives: This course is designed to</p> <ol style="list-style-type: none"> 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
<p>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</p> <p>Laboratory Component: Manufacture of a hook by Forging Techniques</p>			
Module 2: Sheet Metal Operations			No. of Hrs: 5+4
<p>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</p> <p>Laboratory Component: Evaluate formability using standard tests such as the Erichsen cupping test</p>			
Module 3: Metal Joining Process			No. of Hrs: 5+6
<p>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</p> <p>Laboratory Components:</p> <ol style="list-style-type: none"> 1. Arc welding process 2. Gas welding process 			
Module 4: Metal Cutting			No. of Hrs: 5+4
<p>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</p> <p>Laboratory Component: Performing orthogonal and oblique cutting experiments using a lathe or milling machine</p>			

Module 5: Machining Process	No. of Hrs: 5+6
<p>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</p> <p>Grinding: Types of abrasives, bonding processes, Creep feed grinding, Designation and selection of grinding wheel, Surface Finishing Processes: Lapping, Honing & Super finishing</p> <p>Laboratory Components:</p> <ol style="list-style-type: none"> 1. Finishing of metal using surface grinding 2. Cutting of spur gear teeth using Horizontal Milling Machine 	
<p>Course Outcomes: At the end of the course, the student will be able to</p> <ol style="list-style-type: none"> 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 	
<p>Textbooks:</p> <ol style="list-style-type: none"> 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 	
<p>Reference Books:</p> <ol style="list-style-type: none"> 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 	
<p>Web links:</p> <ol style="list-style-type: none"> 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	23MEPC205	SEE Marks	50
Teaching Hrs/Week (L: T: P)	3:0:0	Exam Hrs	03
Total Hrs	42	Credits	03
<p>Course Learning Objectives: This course is designed to</p> <ol style="list-style-type: none"> 1. Impart the knowledge of thermodynamic systems and its equilibrium and zeroth law of thermodynamics 2. Strengthen the essential knowledge of heat & work transfer and various forms of energy 3. Deliver the concepts of the second law of thermodynamics and entropy 4. Establish the understanding of concepts of behavior of pure substances and its application 5. Convey the knowledge of behavior of Ideal and real gasses and its difference 			
Module 1: Zeroth Law of Thermodynamics and Work & Heat			No. of Hrs: 9
<p>Introduction: thermodynamic approaches. Examples of system boundary and control surface, Thermodynamic properties; thermodynamic process, Thermodynamic state and equilibrium</p> <p>Applications of Zeroth law of thermodynamics.</p> <p>Work and Heat: Mechanical work and Thermodynamic work, work and heat transfer of various processes through p-v diagrams</p>			
Module 2: First Law of Thermodynamics			No. of Hrs: 8
<p>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)</p>			
Module 3: Second Law of Thermodynamics and Entropy			No. of Hrs: 9
<p>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)</p> <p>Entropy: Concept and causes - Clausius inequality - change of entropy for solids, liquids and gases in different thermodynamic processes. Principle of increase of entropy</p>			
Module 4: Exergy and Energy			No. of Hrs: 8
<p>Exergy and Energy: Efficiency analysis of renewable energy systems, optimization of fuel consumption and reduction of emissions</p> <p>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)</p>			

Module 5: Gas Mixtures	No. of Hrs: 8
<p>Ideal gasses: Avogadro's law, Dalton's law of partial pressure, property equations and change of properties of gas mixture</p> <p>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</p>	
<p>Course Outcomes: At the end of the course, the student will be able to</p> <ol style="list-style-type: none"> 1. Explain the concepts of temperature measurement, work & heat transfer, work done in open & closed system and Cyclic & non cyclic systems, entropy, Exergy and Anergy, pure substances, Ideal and real gasses 2. Apply the concepts of thermodynamic properties & laws of thermodynamics for the measurement of temperature, energy transfer and solve the refrigeration & heat engines problems 3. Apply the knowledge of reversibility and irreversibility to find the behavior of pure substances and its application in practical problems 4. Apply the law of gasses to find the various thermodynamic properties 	
<p>Textbooks:</p> <ol style="list-style-type: none"> 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 3. Dr. V Kadambi and Dr. T R Seetharam, "Applications of Thermodynamics", Wiley Publications, 2018 	
<p>Reference Books:</p> <ol style="list-style-type: none"> 1. Yunus A. Cengel 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. R K Rajput, "Engineering Thermodynamics", 5th Edition, Laxmi Publications, 2019 	
<p>Web links:</p> <ol style="list-style-type: none"> 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
<p>Course Learning Objectives: This course is designed to</p> <ol style="list-style-type: none"> 1. Impart the knowledge of principles of measurement 2. Develop the knowledge on various metrology techniques for precise measurements 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
<p>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</p> <p>Measurement Standards: Classification of standards, Line and End standards, Calibration of End bars, Numerical examples</p> <p>Laboratory Components:</p> <ol style="list-style-type: none"> 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
<p>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</p> <p>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</p> <p>Laboratory Components:</p> <ol style="list-style-type: none"> 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
<p>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</p> <p>Velocity and Motion: Tachogenerator, Force: Strain gauge load cell, Pressure: Tactile Sensor</p>			

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
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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
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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. Explain the importance of static and dynamic characteristics of a measurement system
2. Apply the principles of Limits, fits, tolerance in Mechanical Measurements 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
<p>Course Learning Objectives: This course is designed to</p> <ol style="list-style-type: none"> 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
<ul style="list-style-type: none"> • 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
<ol style="list-style-type: none"> 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
<p>Course Learning Objectives: This course is designed to</p> <ol style="list-style-type: none"> 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			
<p>Course Outcomes: At the end of the course, the student will be able to</p> <ol style="list-style-type: none"> 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
<p>Course Learning Objectives: This course is designed to</p> <ol style="list-style-type: none"> 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			
<p>Laboratory Components:</p> <ol style="list-style-type: none"> 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			
<p>Laboratory Components:</p> <ol style="list-style-type: none"> 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			
<p>Laboratory Components:</p> <ol style="list-style-type: none"> 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 			



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Module 4: Matplotlib Library for Python	No. of Hrs: 3 + 4
<p>Figure and Axes, Line Graph, Stem Plot, Bar chart, Plotting Histogram, Scatter Plot, Stack Plot, Box Plot, Pie Chart in matplotlib</p> <p>Laboratory Component: Creating basic data visualization plots (line graph, stem plot, bar charts, Histogram, Scatter Plot, Stack Plot, Box Plot, Pie Chart) using matplotlib</p>	
Module 5: Multiple Subplots, Matplotlib with Grid Specs	No. of Hrs: 2 + 4
<p>Subplots with Matplotlib, Multiple Plots same Figure, Grid Specs – Plot Layouts, Contour Plots, Surface Plots, Polar Plots</p> <p>Laboratory Component: Create subplots, Multiple plots using grid spaces, plot layouts, contours plots</p>	
<p>Course Outcomes: At the end of the course, the student will be able to</p> <ol style="list-style-type: none"> 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 	
<p>Textbooks:</p> <ol style="list-style-type: none"> 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 	
<p>Reference Books:</p> <ol style="list-style-type: none"> 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 	
<p>Web links:</p> <ol style="list-style-type: none"> 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
<p>Course Learning Objectives: This course is designed to</p> <ol style="list-style-type: none"> 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
<p>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)</p> <p>Laboratory Components:</p> <ol style="list-style-type: none"> 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
<p>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</p> <p>Laboratory Components:</p> <ol style="list-style-type: none"> 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
<p>Introduction to advanced functions (e.g., VLOOKUP, IF, COUNTIF), using logical functions for decision-making and data validation</p> <p>Laboratory Components:</p> <ol style="list-style-type: none"> 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 			



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Module 4: Engineering Applications I: Numerical Analysis	No. of Hrs: 2 + 4
<p>Solving engineering equations using goal seek and solver tools, applying numerical methods for root finding and optimization</p> <p>Laboratory Components:</p> <ol style="list-style-type: none"> 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
<p>Introduction to modeling concepts in spreadsheets, building simple engineering models (e.g., beam deflection, heat transfer)</p> <p>Laboratory Components:</p> <ol style="list-style-type: none"> 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 	
<p>Course Outcomes: At the end of the course, the student will be able to</p> <ol style="list-style-type: none"> 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 	
<p>Textbook:</p> <ol style="list-style-type: none"> 1. Mc Fedries Paul, “Microsoft Excel Formulas and Functions”, Microsoft Press, U.S, 2019 	
<p>Reference Books:</p> <ol style="list-style-type: none"> 1. Excel Resources - 600+ Self Study Guides, Articles & Tools (wallstreetmojo.com) 2. https://www.ictlounge.com/html/year_7/esafety_part7.htm 	
<p>Web link: Decision Making with Spreadsheet, https://archive.nptel.ac.in/courses/110/107/110107157/</p>	

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
<p>Course Learning Objectives: This course is designed to</p> <ol style="list-style-type: none"> 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
<p>Basics of Computational programming, array operations, loops and execution of control, and working with files: Scripts and functions, plotting and programming output</p> <p>Laboratory Components:</p> <ol style="list-style-type: none"> 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
<p>Curve Fitting: Straight line fit, Polynomial fit</p> <p>Laboratory Components:</p> <ol style="list-style-type: none"> 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
<p>Trapezoidal method, Simpson method</p> <p>Laboratory Components:</p> <ol style="list-style-type: none"> 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
<p>Eigen values, Eigen vectors, Solution of linear algebraic equations using Gauss Elimination, Solution of nonlinear equation in single variable using Newton-Raphson method</p> <p>Laboratory Components:</p> <ol style="list-style-type: none"> 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
<p>Introduction to ODE's, Euler's method, second order Runge-Kutta method, ODE45 algorithm in single variable and multi variables. Transforms: Discrete Fourier Transforms</p> <p>Laboratory Components:</p> <ol style="list-style-type: none"> 1. Apply Euler's method and Runge-Kutta method to solve Ordinary Differential Equations 2. Solve discrete Fourier Transforms 	
<p>Course Outcomes: At the end of the course, the student will be able to</p> <ol style="list-style-type: none"> 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 	
<p>Textbooks:</p> <ol style="list-style-type: none"> 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 	
<p>Reference Books:</p> <ol style="list-style-type: none"> 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 	
<p>Web link: MATLAB tutorial for beginners: https://www.youtube.com/watch?v=0x4JhS1Ypzi&list=PLjVLYmrlmjGcNZrPa9bRg0JVlclX4Mu9</p>	

Yoga-I			
Semester	III	CIE Marks	100
Course Code	23NMCC221	SEE Marks	-
Teaching Hrs/Week (L:T: P)	0:0:1	Exam Hrs	-
Total Hrs	13	Credits	-
<p>Course Learning Objectives: This course is designed to</p> <ol style="list-style-type: none"> 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
<ul style="list-style-type: none"> • 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 Suryanamaskar 13 count, 1 rounds • 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 <ol style="list-style-type: none"> a) Sitting <ol style="list-style-type: none"> 1. Padmasana 2. Vajrasana b) Standing <ol style="list-style-type: none"> 1. Vrikshana 2. Trikonasana c) Prone line <ol style="list-style-type: none"> 1. Bhujangasana 2. Shalabhasana d) Supine line <ol style="list-style-type: none"> 1. Utthitadvipadasana 2. Ardhalasana • Meaning, importance and benefits of Kapalabhati, 10 strokes/min 3 rounds • Meaning by name, technique, precautionary measures and benefits of Pranayama Anuloma Viloma 			
<p>Course Outcomes: At the end of the course, the student will be able to:</p> <ol style="list-style-type: none"> 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, Raashthrothhaana 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	23NMCC222	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			
<ol style="list-style-type: none"> 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	
<ul style="list-style-type: none"> • 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			
<ol style="list-style-type: none"> 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:			
<ol style="list-style-type: none"> 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:			
<ol style="list-style-type: none"> 1. Anaika , “Play Field Manual”, Friends Publication New Delhi, 2005 2. Pinto John & Roshan Kumar Shetty, “Introduction to Physical Education” 			
Web links:			
<ol style="list-style-type: none"> 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	23NMCC223	SEE Marks	-
Teaching Hrs/Week (L:T: P)	0:0:1	Exam Hrs	-
Total Hrs	13	Credits	-
<p>Course Learning Objectives: This course is designed to</p> <ol style="list-style-type: none"> 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
<p>Introduction:</p> <ul style="list-style-type: none"> • Importance and role of youth leadership, Life competencies • Skill development and empowerment • Innovation and personal growth <p>Activities:</p> <ul style="list-style-type: none"> • Organic farming • Waste management 			
<p>Course outcomes: At the end of the course, the student will be able to</p> <ol style="list-style-type: none"> 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 			
<p>Textbooks:</p> <ol style="list-style-type: none"> 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 			
<p>Reference Books:</p> <ol style="list-style-type: none"> 1. Dr. G R Bannerjee, “Social service opportunities in Hospitals”, TISS, 2012 2. Ram Ahuja, “Social Problems in India”, Rawat publications, 3rd Edition, 2014 			
<p>Web links:</p> <ol style="list-style-type: none"> 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	23NMCC224	SEE Marks	-
Teaching Hrs/Week (L: T: P)	0:0:1	Exam Hrs.	-
Total Hrs	13	Credits	-
<p>Course Learning Objectives: This course is designed to</p> <ol style="list-style-type: none"> 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	
<p>Note: Student shall select any one form of arts and continue the same till 6th semester</p>			
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		
<p>Course Outcomes: At the end of the course, the student will be able to</p> <ol style="list-style-type: none"> 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 			
<p>Textbooks:</p> <ol style="list-style-type: none"> 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 			



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

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://cctindia.gov.in/audio-visual-catalogue/>
2. Essential Acting Lesson for Beginners: <https://www.youtube.com/watch?v=GGI9Wri70aQ>

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
<p>Course Learning Objectives: This course is designed to</p> <ol style="list-style-type: none"> 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
<p>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</p>			
Module 2: Sampling, Estimation & Inference			No. of Hrs: 9
<p>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</p>			
Module 3: Design of Experiments and Analysis of Variance			No. of Hrs: 8
<p>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)</p>			
Module 4: Stochastic Process			No. of Hrs: 7
<p>Stochastic Process: Types, Markov Chains, Chapman–Kolmogorov equations for n-step transition probabilities, Classification of States, Limiting Probabilities</p>			

Module 5: Multivariate Analysis	No. of Hrs: 10
<p>Multivariate Analysis: Multivariate normal distribution, estimation & inference on vector parameters, Multivariate linear regression, Principal Components Analysis (PCA), Factor Analysis, Discriminant Analysis, Classification & Cluster Analysis</p>	
<p>Course Outcomes: At the end of the course, the student will be able to</p> <ol style="list-style-type: none"> 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 	
<p>Textbooks:</p> <ol style="list-style-type: none"> 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 	
<p>Reference Books:</p> <ol style="list-style-type: none"> 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 	
<p>Web links:</p> <ol style="list-style-type: none"> 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
<p>Course Learning Objectives: This course is designed to</p> <ol style="list-style-type: none"> 1. Impart knowledge of machines, mechanisms and to analyze a mechanism for displacement, velocity and acceleration at any point in a moving link 2. Deliver the concept of a force-motion relationship in components subjected to external forces and analysis of standard mechanisms and the theory of gears & gear trains 3. Strengthen the knowledge of undesirable effects of imbalances resulting from prescribed motions in mechanism 4. Impart the fundamentals of principles in mechanisms used for speed control and stability control 5. Familiarize the natural and damped frequencies of free 1-DOF mechanical systems and to analyze the vibrational motion of 1-DOF mechanical systems under harmonic excitation conditions 			
Module 1: Kinematics			No. of Hrs: 8+6
<p>Introduction & importance of kinematics in design and analysis</p> <p>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.</p> <p>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</p> <p>Laboratory Components:</p> <ol style="list-style-type: none"> 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
<p>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</p> <p>Laboratory Components:</p> <ol style="list-style-type: none"> 1. Experiment on gyroscope 2. Experiment of working of Cams profile 			
Module 3: Power Transmission Drives			No. of Hrs: 8+4
<p>Power transmission: Types of power transmission, E-Drives- Types, selection and characteristics of motor drives, drive by wire</p>			

<p>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</p> <p>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</p> <p>Laboratory Component: Experimentation of working of Gear trains (Simple & compound) using simulink</p>	
Module 4: Mass Balancing	No. of Hrs: 8+4
<p>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)</p> <p>Laboratory Components:</p> <ol style="list-style-type: none"> 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
<p>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</p> <p>Forced vibrations: Undamped forced vibration of spring mass system, Damped forced vibrations</p> <p>Condition monitoring principles: Introduction to machinery maintenance, fundamentals of data acquisition, principles of condition monitoring, transducers for condition monitoring, fault diagnosis in rotating machines</p> <p>Laboratory Component: Experiments to find natural frequency of Free and Forced, damped & undamped Vibration systems</p>	
<p>Course Outcomes: At the end of the course, the student will be able to</p> <ol style="list-style-type: none"> 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. Determine the gear ratio & torque required for e-drives and its applications 4. Experiment with the balancing of masses for the rotating system 5. Determine natural frequency of free & forced vibrations 	
<p>Textbooks:</p> <ol style="list-style-type: none"> 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 	
<p>Reference Books:</p> <ol style="list-style-type: none"> 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			
<ol style="list-style-type: none"> 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
<p>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</p> <p>Hydrostatic Forces on Surfaces: Hydrostatic pressure on plane (Vertical/horizontal/Inclined surfaces) submerged bodies</p>			
Module 2: Fluid dynamics and fluid flow measurement			No. of Hrs: 8
<p>Fluid Dynamics: General energy and momentum equation. Euler's equation, Bernoulli's equation for real fluids assumptions and limitations</p> <p>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</p>			
Module 3: Flow Through Pipes			No. of Hrs: 8
<p>Laminar Flow: Flow through circular pipe, between parallel plates, Practical application of laminar flow</p> <p>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</p>			
Module 4: Introduction to Turbo machines & Hydraulic turbines			No. of Hrs: 8
<p>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</p> <p>Hydraulic Turbines: Classification, turbine (Pelton, Francis and Kaplan turbine) components, design, turbine efficiency</p>			

Module 5: Steam Turbine and Centrifugal Pump	No. of Hrs: 8
<p>Steam Turbine: Impulse staging, need for compounding, types of compounding, analysis of single (Impulse & reaction) & multistage stage turbines</p> <p>Centrifugal Pumps: Working principle, Terminology, Types of casing, Pump losses, Efficiencies, Work done, Minimum starting speed, Priming, Cavitation, NPSH, Multistage centrifugal pumps</p>	
<p>Course Outcomes: At the end of the course, the student will be able to</p> <ol style="list-style-type: none"> 1. Solve the problems on hydrostatic forces on surfaces using properties of fluids 2. Apply the concept of fluid flow, momentum equations, theories governing fluid dynamics to solve the problems on Bernoulli's application 3. Apply the concept of fluid flow to solve the problems on flow inside a circular pipe, flat plate, major and minor losses 4. Apply the concept of energy transfer using Euler's turbine equation and analyze the various design parameters of hydraulic turbines to maximize the efficiency 5. Analyze the velocity triangles to evaluate the performance characteristics of steam turbine and centrifugal Pumps 	
<p>Textbooks:</p> <ol style="list-style-type: none"> 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 	
<p>Reference Books:</p> <ol style="list-style-type: none"> 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 	
<p>Web links:</p> <ol style="list-style-type: none"> 1. Introduction to Fluid Mechanics and Fluid Engineering: www.nptel.ac.in/courses/112105183, IIT Kharagpur 2. Introduction to Turbo machinery: 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
<p>Course Learning Objectives: This course is designed to</p> <ol style="list-style-type: none"> 1. Impart the knowledge of working of air standard cycle and combustion phenomenon in I. C. Engines 2. Establish the concepts of working of gas power cycles and various jet propulsion cycles used in aerospace and propulsion systems 3. Convey the principles and applications of vapour power cycles 4. Deliver the principles, components, and performance parameters of refrigeration systems 5. Provide the psychrometric processes and Heating Ventilation & Air- conditioning Systems 			
Module 1: Air Standard Cycles and I.C. Engines			No. of Hrs: 8+9
<p>Air standard cycles: Otto cycle, Diesel cycle, Air standard efficiency and mean effective pressure calculations, Comparison of Otto and Diesel cycles</p> <p>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</p> <p>Laboratory Components:</p> <ol style="list-style-type: none"> 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
<p>Gas power Cycles: Gas turbine (Brayton) cycle; description and analysis. Regenerative, Intercooling and reheating in gas turbine cycles</p> <p>Jet Propulsion cycles: Turbojet, Turboprop, Turbofan, Ram Jet, Rocket, Pulse Jet, Ram Rocket</p> <p>Laboratory Component:</p> <p>Analysis of Gas power cycles using MATLAB</p>			
Module 3: Vapour Power Cycles			No. of Hrs: 8+3
<p>Carnot cycle, Rankine cycle, Reheat Rankine cycle, – Performance calculations, Regenerative Rankine Cycle with one open or closed feedwater heater (Qualitative treatment), Concept of cogeneration</p> <p>Laboratory Component:</p> <p>Analysis of Vapour power cycles using MATLAB</p>			
Module 4: Refrigeration Cycles			No. of Hrs: 8+6
<p>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</p> <p>Laboratory Component:</p> <p>Performance Test on a Vapour Compression Refrigeration</p>			

Module 5: Heating Ventilation and Air- conditioning Systems	No. of Hrs: 8+3
<p>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</p> <p>Study of Psychrometrics: Psychrometric properties, Psychrometric Processes - heating, cooling, humidification dehumidification, adiabatic mixing, Applications in air-conditioning</p> <p>Laboratory Component: Performance Test on a Vapour Compression Refrigeration Test Rig</p>	
<p>Course Outcomes: At the end of the course, the student will be able to</p> <ol style="list-style-type: none"> 1. Explain the principles of thermodynamics and their application to various engineering systems such as I.C. engines, Gas power plant, Jet propulsion, Steam power plants and Refrigeration & Air-conditioning 2. Perform thermodynamic analysis of air standard cycles to determine efficiency and performance of I.C. engines 3. Apply the thermodynamic principles of gas power cycles and its modifications 4. Determine the performance of steam power plants 5. Find the performance of refrigeration systems and their applications in various fields 6. Apply the psychrometric processes to determine the efficiency of Air conditioning for HVAC systems 	
<p>Textbooks:</p> <ol style="list-style-type: none"> 1. P.K. Nag, “Engineering Thermodynamics”, 6th Edition, Tata McGraw Hill, 2018 2. Yunus A. Cengel and Michael A.Boles, “Thermodynamics - An Engineering Approach”, 9th Edition, Tata McGraw Hill, 2019 3. Dr. V Kadambi and Dr. T R Seetharam, “Applications of Thermodynamics”, Wiley Publications, 2018 	
<p>Reference Books:</p> <ol style="list-style-type: none"> 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 	
<p>Web links:</p> <ol style="list-style-type: none"> 1. Module 1: https://ciechanow.ski/internal-combustion-engine/ 2. Module 2: https://www.youtube.com/watch?v=AwbhbN20xl8&list=PLwdnzlV3ogoVJnW1S9GgOKYj5heOz11dnIntroductory 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
<p>Course Learning Objectives: This course is designed to</p> <ol style="list-style-type: none"> 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
<p>Introduction of graphic user interface of the software. Generate 2D views of the 3D modeled machine components and extract the sectional views</p> <p>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</p> <p>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</p> <p>Screwed fasteners: Square-headed bolt and nut with washer (assembly), Hexagonal headed bolt and nut with washer (assembly)</p> <p>Laboratory Components:</p> <ol style="list-style-type: none"> 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
<p>Assembly of Joints and couplings (with GD&T) using a 3D environment</p> <p>Joints: Like Cotter joint (socket and spigot type), knuckle joint (pin joint type)</p> <p>Couplings: Like flanged coupling (Unprotected type) and universal coupling</p> <p>Laboratory Component:</p> <p>Model and assemble the parts of joints and couplings and motion simulation of mechanical systems</p>			
Module 3: Assembly Drawings			No. of Hrs: 8+12
<p>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</p> <ol style="list-style-type: none"> 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) <p>Laboratory Components:</p> <p>Development of production drawings using CAD software under a 3D environment</p>			

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 Kanniah, 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			
<ol style="list-style-type: none"> 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 losses 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
<ol style="list-style-type: none"> 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 Francis'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			
<ol style="list-style-type: none"> 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:			
<ol style="list-style-type: none"> 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 Mechanics 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			
<ol style="list-style-type: none"> 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
<p>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</p> <p>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</p>			
Module 2: Research Design			No. of Hrs: 5
<p>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</p>			
Module 3: Ethics in Engineering Research & Technical Writing			No. of Hrs: 5
<p>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</p>			
Module 4: Introduction to Intellectual Property			No. of Hrs: 4
<p>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</p>			
Module 5: Process of Patenting			No. of Hrs: 5
<p>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</p>			

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 Methodology Methods 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. Mamta Bhardwa, “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
<p>Course Learning Objectives: This course is designed to</p> <ol style="list-style-type: none"> 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
<p>Concept learning, general hypothesis and specific hypothesis, FIND-S Algorithm</p> <p>Laboratory Components:</p> <ol style="list-style-type: none"> 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
<p>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</p> <p>Laboratory Components:</p> <ol style="list-style-type: none"> 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
<p>Introduction to regression, simple linear regression and polynomial regression, applications of regression models</p> <p>Laboratory Components:</p> <ol style="list-style-type: none"> 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
<p>Introduction to Support Vector Machines, Linear SVM for Classification, SVM for Regression, applications of SVM Models</p> <p>Laboratory Component:</p> <p>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</p>			
Module 5: Neural Network			No. of Hrs: 4+4
<p>Introduction to Neural Networks, Supervised, Deep Learning (RNN, CNN) Feedforward Neural Networks</p> <p>Laboratory Component:</p> <p>Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data set</p>			

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
<p>Course Learning Objectives: This course is designed to</p> <ol style="list-style-type: none"> 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
<p>Basic concepts: Measurement and inspection; Role of metrology in quality assurance; Errors; Length standards; Gauges and comparators; Linear and angular measurements; Fits and tolerances</p> <p>Laboratory Components:</p> <ol style="list-style-type: none"> 1. Calibration of Pressure Gauge 2. Calibration of Load cell 			
Module 2: Advanced Measurement Techniques			No. of Hrs: 4+4
<p>Measurement Practices: Optical metrology and laser interferometers; Measurement of flatness, straightness and form errors; Surface finish measurements</p> <p>Laboratory Components:</p> <ol style="list-style-type: none"> 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
<p>CMM; Vision applications in Metrology; Nano-measurements</p> <p>Laboratory Components:</p> <ol style="list-style-type: none"> 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
<p>Statistical Methodologies: Graphical methods, Statistical control charts, Regression analysis, Analysis of variance, Sampling and acceptance</p> <p>Laboratory Components:</p> <ol style="list-style-type: none"> 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.	
<p>Laboratory Components:</p> <ol style="list-style-type: none"> 1. Case studies: Inspection and Validation practices adopted in various industries. 2. SPC charts 	
<p>Course Outcomes: At the end of the course, the student will be able to</p> <ol style="list-style-type: none"> 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 	
<p>Textbooks:</p> <ol style="list-style-type: none"> 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 	
<p>Reference Books:</p> <ol style="list-style-type: none"> 1. Whitehouse, D. J., “Hand Book of Surface and Nanometrology”, 2nd Edition, CRC Press, 2010 2. Smith, G. T., “Industrial Metrology”, Springer, 2002 	
<p>Web links:</p> <ol style="list-style-type: none"> 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
<p>Course Learning Objectives: This course is designed to</p> <ol style="list-style-type: none"> 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			
<p>Laboratory Components:</p> <ol style="list-style-type: none"> 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			
<p>Laboratory Components:</p> <ol style="list-style-type: none"> 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			
<p>Laboratory Components:</p> <ol style="list-style-type: none"> 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			
<p>Laboratory Components:</p> <ol style="list-style-type: none"> 1. Design of bolts and nuts 2. Analysis of power screw mechanisms 			

Module 5: Joining and Gearing Systems	No. of Hrs: 3+4
<p>Design of permanent joints – welding; gears – nomenclature, force analysis, Lewis bending equation, design of spur and helical gears</p>	
<p>Laboratory Components:</p> <ol style="list-style-type: none"> 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 	
<p>Course Outcomes: At the end of the course, the student will be able to</p> <ol style="list-style-type: none"> 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 	
<p>Textbooks:</p> <ol style="list-style-type: none"> 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 	
<p>Reference Books:</p> <ol style="list-style-type: none"> 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	23NMCC229	SEE Marks	-
Teaching Hrs/Week (L:T: P)	1:0:0	Exam Hrs	-
Total Hrs	13	Credits	-
<p>Course Learning Objectives: This course is designed to</p> <ol style="list-style-type: none"> 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 conservation of biodiversity importance on a global scale
2. Differentiate Conventional and Nonconventional energy sources and also to propose methods to minimize wastage of energy
3. Describe the Global environmental concerns and the individual responsibility to protect environment for sustainable environment
4. Describe the strategies for mitigation of Environmental issues and remediation / 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	23NMCC225	SEE Marks	-
Teaching Hrs/Week (L:T: P)	0:0:1	Exam Hrs	-
Total Hrs	13	Credits	-
<p>Course Learning Objectives: This course is designed to</p> <ol style="list-style-type: none"> 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
<ul style="list-style-type: none"> • Ashtanga Yoga, its need and importance • Yama : Ahimsa, satya, asteya, brahmacharya, 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 <ol style="list-style-type: none"> a) Sitting <ol style="list-style-type: none"> 1. Sukhasana 2. Paschimottanasana b) Standing <ol style="list-style-type: none"> 1. ArdhakatiChakrasana 2. ParshvaChakrasana c) Prone line <ol style="list-style-type: none"> 1. Dhanurasana 2. Sarpasana d) Supine line <ol style="list-style-type: none"> 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 <ol style="list-style-type: none"> 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, Raashthrothhaana 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	23NMCC226	SEE Marks	-
Teaching Hrs/Week (L: T: P)	0:0:1	Exam Hrs	-
Total Hrs	13	Credits	-
<p>Course Learning Objectives: This course is designed to</p> <ol style="list-style-type: none"> 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	
<ul style="list-style-type: none"> • 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) 			
<u>Basic Training</u>			
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	23NMCC227	SEE Marks	-
Teaching Hrs/Week (L:T: P)	0:0:1	Exam Hrs	-
Total Hrs	13	Credits	-
<p>Course Learning Objectives: This course is designed to</p> <ol style="list-style-type: none"> 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
<p>Introduction:</p> <ul style="list-style-type: none"> • Youth development programmes • Health, hygiene and sanitation awareness programs • Peer leadership training <p>Activities:</p> <ul style="list-style-type: none"> • 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. 			
<p>Course outcomes: At the end of the course, the student will be able to</p> <ol style="list-style-type: none"> 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 			
<p>Textbooks:</p> <ol style="list-style-type: none"> 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 			
<p>Reference Books:</p> <ol style="list-style-type: none"> 1. Dr. G R Bannerjee, Social service opportunities in Hospitals, TISS, 2012 2. Ram Ahuja, Social Problems in India, Rawat publications, 3rd Edition 2014 			
<p>Web links:</p> <ol style="list-style-type: none"> 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	23NMCC228	SEE Marks	-
Teaching Hrs/Week (L: T: P)	0:0:1	Exam Hrs	-
Total Hrs	13	Credits	-
<p>Course Learning Objectives: This course is designed to</p> <ol style="list-style-type: none"> 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		
<p>Course Outcomes: At the end of the course, the student will be able to</p> <ol style="list-style-type: none"> 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:			
<ol style="list-style-type: none"> 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 			



MANGALORE INSTITUTE OF TECHNOLOGY & ENGINEERING

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Autonomous Institute affiliated to VTU, Belagavi, Approved by AICTE, New Delhi

Accredited by NAAC with A+ Grade & ISO 9001:2015 Certified Institution

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://certindia.gov.in/audio-visual-catalogue/>