BE SCHEME & SYLLABUS

Second Year
(III and IV Semester)

With effect from 2022-23

Mechanical Engineering

ST JOSEPH ENGINEERING COLLEGE

AN AUTONOMOUS INSTITUTION

Vamanjoor, Mangaluru - 575028

MOTTO

Service & Excellence

VISION

To be a global premier Institution of professional education and research.

MISSION

- Provide opportunities to deserving students of all communities, the Christian students in particular for quality professional education.
- Design and deliver curricula to meet the national and global changing needs through student-centric learning methodologies.
- Attract, nurture and retain the best faculty and technical manpower.
- Consolidate the state-of-art infrastructure and equipment for teaching and research activities.
- Promote all round personality development of the students through interaction with alumni, academia and industry.
- Strengthen the Educational Social Responsibilities (ESR) of the institution.

ST JOSEPH ENGINEERING COLLEGE

An Autonomous Institution

Vamanjoor, Mangaluru - 575028

Affiliated to VTU – Belagavi & Recognized by AICTE New Delhi
NBA – Accredited: B.E. (CSE, ECE, EEE, ME and CIV) & MBA
NAAC – Accredited with A+

B.E. SCHEME & SYLLABUS
(With effect from 2022-23)

MECHANICAL ENGINEERING

SECOND YEAR
(III and IV Semester)

AUTONOMY AND ACCREDITATION

St Joseph Engineering College (SJEC) is an Autonomous Institute under Visvesvaraya Technological University (VTU), Belagavi, Karnataka State, and is recognized by the All-India Council for Technical Education (AICTE), New Delhi. SJEC is registered under the trust "Diocese of Mangalore, Social Action Department".

The SJEC has been conferred Fresh Autonomous Status from the Academic Year 2021-22. The college was granted autonomy by the University Grants Commission (UGC) under the UGC Scheme for Autonomous Colleges 2018 and conferred by VTU. The UGC Expert Team had visited the college on 28-29 November 2021 and rigorously assessed the college on multiple parameters. The fact that only a handful of engineering colleges in the state have attained Autonomous Status adds to the college's credibility that has been on a constant upswing. Autonomy will make it convenient for the college to design curricula by recognizing the needs of the industry, offering elective courses of choice and conducting the continuous assessment of its students.

At SJEC, the Outcome-Based Education (OBE) system has been implemented since 2011. Owing to OBE practised at the college, SJEC has already been accredited by the National Board of Accreditation (NBA). Five of the UG programs, namely Computer Science & Engineering, Mechanical Engineering, Electronics and Communication Engineering, Electrical & Electronics Engineering and Civil Engineering and MBA programs, have accreditation from the NBA.

Also, SJEC has been awarded the prestigious A+ grade by the National Assessment and Accreditation Council (NAAC) for five years. With a Cumulative Grade Point Average (CGPA) of 3.39 on a 4-point scale, SJEC has joined the elite list of colleges accredited with an A+ grade by NAAC in its first cycle. The fact that only a small percentage of the Higher Education Institutions in India have bagged A+ or higher grades by NAAC adds to the college's credibility that has been on a constant upswing.

The college is committed to offering quality education to all its students, and the accreditation by NAAC and NBA reassures this fact. True to its motto of "Service and Excellence", the college's hard work has resulted in getting this recognition, which has endorsed the academic framework and policies that the college has been practising since its inception. The college has been leveraging a flexible choice-based academic model that gives students the freedom to undergo learning in respective disciplines and a transparent and continuous evaluation process that helps in their holistic development.

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ABOUT THE DEPARTMENT

The Department of Mechanical Engineering was established in the year 2002 with the vision of nurturing technically competent and socially responsible Engineering Professionals. Alma mater to more than 1700 Graduate Engineers over the past 17 glorious years; the Mechanical Engineering Department, SJEC, strives to prepare students for careers across a broad range of industries such as automotive, manufacturing, materials and metallurgy, oil and gas, and aeronautical. Mechanical Engineering encompasses learning the application of physical principles of heat, force, conservation of mass and energy, design of mechanisms and machine elements, system design, manufacturing and maintenance of industrial machinery, etc. Thrust is laid on teaching CAD/CAM tools along with latest design tools, to keep the students abreast with modern technologies in the discipline of Mechanical Engineering. The Department offers Undergraduate (B.E.), Post Graduate (M.Sc. in Engineering by Research), and Doctoral (Ph.D.) programme; with an annual intake of 120 candidates for B.E. Course. The Department of Mechanical Engineering at SJEC is one of the few Departments in the region to secure NBA Accreditation since 2013 and the Department has also got permanent affiliation status from VTU Belagavi from 2019-20 to 2024-25.

DEPARTMENT VISION

To be a value-based department committed to excellence in teaching and research, nurturing technically competent and socially responsible engineering professionals

DEPARTMENT MISSION

- Providing state-of-the-art technical knowledge in Mechanical Engineering.
- Promoting research, education and training in frontier areas of Mechanical Engineering.
- Facilitating faculty development through quality improvement programmes.
- Initiating collaboration with industries, research organizations and institutes for internship, joint research and consultancy.
- Instilling social and ethical values in students, staff and faculty through personality development programmes.
- Developing innovation in engineering and technology in order to provide beneficial service to the local community.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

1. Graduates will engage in designing, manufacturing, testing, operating and/or maintaining systems in the field of Mechanical Engineering and allied industries.

2. Graduates will be able to communicate and perform effectively in both individual and team-based project environments, including multi-disciplinary settings.

3. Graduates will apply knowledge and skills considering ethical practices, societal, economic and environmental factors and/or pursue higher education and research.

4. Graduates will develop the practice of continuously updating themselves with the latest knowledge and information in their field of specialization.

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and engineering specialization to the solution of complex engineering problems.
2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. Conduct investigations on complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and the synthesis of information to provide valid conclusions.
5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and a leader in a team, to manage projects and in multidisciplinary environments.
12. Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

Graduates of the Mechanical Engineering program are able to

PSO1: Take up research programs on contemporary areas of Mechanical engineering.

PSO2: Gain competence to face various competitive examinations and succeed in seeking the best opportunities in the corporate world and higher studies.

III Semester (B.E. - Mechanical Engineering)													
SI. No	**Course and Course Code**		**Course Title**	**Teaching Department**	**Paper Setting Board**	**Teaching Hours/Week**			**Examination**				**Credits**
						Theory Lecture	**Tutorial**	**Practical/ Drawing**	**Duration in hours**	**CIE Marks**	**SEE Marks**	**Total Marks**	
						L	**T**	**P**					
1	PCC	22MEC31	Mechanics of Materials	ME	ME	2	2	-	03	50	50	100	3
2	IPCC	22MEC32	Manufacturing Process (Integrated)	ME	ME	3	-	2	03	50	50	100	4
3	IPCC	22MEC33	Material Science and Engineering (Integrated)	ME	ME	3	-	2	03	50	50	100	4
4	PCC	22MEC34	Basic Thermodynamics	ME	ME	2	2	-	03	50	50	100	3
5	ESC	22MEC35X	ESC/ETC/PLC	ME	ME	3	-	-	03	50	50	100	3
6	PCCL	22MEC36L	Computer Aided Machine Drawing	ME	ME	-	-	2	03	50	50	100	1
7	HSMC	22UHV37	Universal Human Values - II	COM	COM	2	-	-	02	50	50	100	2
		22BFE37	Biology for Engineers	COM	COM								
8	AEC/SDC	22IEP38	IoT Enabled Prototyping	COM	COM	-	-	2	02	50	50	100	1
9	MNCC	22ITB39A / 22ITC39B	Industry Oriented Training – Business Etiquettes/ Industry Oriented Training – Computing Skills	COM	COM	-	-	2	02	50	-	50	-
					Total	15	4	10	24	**450**	**400**	**850**	**21**

22MEC35X : Engineering Science Course/Emerging Technology Course/Programming Language Course			
22MEC351	Electric and Hybrid Vehicle Technology	22MEC353	Energy and Environment
22MEC352	Smart Materials and Systems	22MEC354	Industrial Safety

IV Semester (B.E. - Mechanical Engineering)													
SI. No	**Course and Course Code**		**Course Title**	**Teaching Department**	**Paper Setting Board**	**Teaching Hours/Week**			**Examination**				**Credits**
						Theory Lecture	**Tutorial**	**Practical/ Drawing**	**Duration in hours**	**CIE Marks**	**SEE Marks**	**Total Marks**	
						L	**T**	**P**					
1	PCC	22MEC41	Applied Thermodynamics	ME	ME	2	2	-	03	50	50	100	3
2	IPCC	22MEC42	Machining Science and Metrology (Integrated)	ME	ME	3	-	2	03	50	50	100	4
3	IPCC	22MEC43	Fluid Mechanics (Integrated)	ME	ME	2	2	2	03	50	50	100	4
4	PCC	22MEC44	Kinematics of Machines	ME	ME	3	-	-	03	50	50	100	3
5	ESC	22MEC45X	ESC/ETC/PLC	ME	ME	3	-	-	03	50	50	100	3
6	PCCL	22MEC46L	Mechanical Measurements and Metrology Lab	ME	ME	-	-	2	03	50	50	100	1
7	HSMC	22UHV47	Universal Human Values – II	COM	COM	2	-	-	02	50	50	100	2
	HSMC	22BFE47	Biology for Engineers	COM	COM								
8	AEC/SDC	22CTE48	Computational Tools for Engineers	COM	COM	-	-	2	03	50	50	100	1
9	AEC/SDC	22ITB49A / 22ITC49B	Industry Oriented Training – Business Etiquettes/ Industry Oriented Training – Computing Skills	COM	COM	-	-	2	02	50	-	50	-
					Total	15	4	10	24	**450**	**400**	**850**	**21**

22MEC45X : Engineering Science Course/Emerging Technology Course/Programming Language Course			
22MEC451	Non-Traditional Machining	22MEC453	Micro Electro Mechanical Systems
22MEC452	Statistical Quality Control	22MEC454	Automation and Robotics

III Semester

Mechanics of Materials			
Course Code	**22MEC31**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	2:2:0	SEE	3 Hours
Total Hours	40 hours Theory	Credits	03

Course Learning Objectives: The objective of the course is to

- Compute different types of stresses, strain, strain energy developed in the member subjected to axial, bending, shear, torsion & thermal loads.
- Compute and analyze the stress distributions in thick & thin cylinders.
- Analyze the shear stresses and bending stresses developed in beams having different cross sections by developing the shear force and bending moment diagrams.
- Evaluate the shear stresses induced in shafts subjected to torque while transmitting rotational power.
- Utilize the equation of crippling load using Euler's theory for analysing columns subjected to buckling load.

Module-1 Stresses and Strains (8 hours)

Stresses and Strains: Introduction, Hooke's stress-strain concepts, Factor of safety, Calculation of stresses in straight, Stepped, and tapered sections, Composite sections, Thermal Stresses, Shear stress and shear strain, Lateral strain, and Poisson's ratio. Elastic constants and relations between them.

Module-2 Analysis of Stress and Strain, Cylinders (10 hours)

Analysis of Stress and Strain: Generalized state of stress, Principal stresses and maximum shear stresses, and its inclinations, Mohr's circle, Theories of Failures (Principal Stress Theory, Shear Stress Theory)

Cylinders: Thin cylinder: Hoop's stress, maximum shear stress, circumferential and longitudinal strains, Thick cylinders: Lames equations.

Module-3 Shear Force and Bending Moment, Deflection of Beams (10 hours)

Shear Force and Bending Moment: Introduction to shear force and bending moment diagram, point of contra flexure and point of maximum bending moment, Relationship between loads, shear forces and bending moments, Shear force and bending moments of cantilever beams, simply supported, and over hanging beams subjected to concentrated loads, moment, uniformly distributed / varying loads.

Deflection of Beams Differential equation for deflection, equation for deflection, slope, moment, double integration method for point loads on cantilever and simply support beams, UDL, Macaulay's method

Module-4 Bending and Shear Stresses in Beams, Torsion (8 hours)

Bending and Shear Stresses in Beams: Introduction, theory of simple bending, assumptions in simple bending, bending equation. shearing stresses in beams, shear stress across rectangular, circular, and symmetrical I and T sections.

Torsion: Introduction, derivation of torsion equation for circular shafts, torsional rigidity and pola modulus Power transmitted by a Circular solid and hollow shaft

Module-5 Columns, Strain Energy (8 hours)

Columns: Introduction, short and long columns. Euler's theory; Assumptions, Derivation for Euler's Buckling load for different end conditions, Limitations of Euler's theory

Strain Energy: Strain energy due to normal stresses, Shear stresses, Modulus of resilience, Strain energy due to bending and torsion, Von Misses theory of failure.

Course Outcomes: At the end of the course the student will be able to:	
22MEC31.1	Design simple mechanical structures such as bars, shafts and beams subjected to static loads with considerations of allowable stresses and factor of safety.

22MEC31.2	Apply the concepts to evaluate the designs of existing structures such as columns, beams, shafts, and cylinders to assess the stresses induced and deflections suffered.
22MEC31.3	Apply the shear stresses and bending stresses developed in beams having different cross sections, draw the shear force and bending moment diagrams.
22MEC31.4	Choose appropriate theories of failure to design simple components regarding dimensions, stresses, and factor of safety.
22MEC31.5	Conduct the Tensile test and determine the Young's modulus of mild steel through stress strain curve using virtual lab platform.
22MEC31.6	Apply the fundamentals of Mechanics of Materials to answer GATE exam questions.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Mechanics of Materials	James M. Gere	Cengage	9,2014
2	Fundamentals of Strength of Materials	P N Chandramouli	PHI Learning Pvt. Ltd	2013
3	Strength of Materials	R. Subramanian	Oxford	3,2016
4	Strength of Material	R K Rajput	S Chand & Company Pvt. Ltd	6,2015
Reference Books				
1	Strength of Materials	S. S. Rattan	McGraw Hill	3, 2017
2	Mechanics of Materials	Ferdinand Beer, Russell Johnston	McGraw Hill	2014
3	Mechanics of Material	R. C. Hibbeler	Pearson	9,2018
4	Strength of Materials	S. S. Bhavikatti	Vikas Publications	2021

Web links and Video Lectures (e-Resources):

- http://nptel.ac.in/courses/112107147/ (accessed on 17/10/2022)
- https://ocw.mit.edu/courses/mechanical-engineering/2-001-mechanics-materials-i- fall-2006/ (accessed on 31/05/2021)

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22MEC31.1	-	-	3	-	2	-	-	-	-	-	-	2	-	-
22MEC31.2	3	-	-	-	-	2	-	-	-	-	-	-	2	-
22MEC31.3	2	-	-	-	2	-	2	-	-	-	-	-	-	-
22MEC31.4	-	-	2	-	-	-	2	2	-	-	-	-	-	-
22MEC31.5	-	-	3	-	2	-	-	2	-	-	-	-	-	-
22MEC31.6	-	--	-	-	-	-	-	-	-	-	-	2	3	-

1: Low 2: Medium 3: High

Manufacturing Process			
Course Code	**22MEC32**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:2	SEE	3 Hours
Total Hours	40 hours Theory + 10 Lab slots	Credits	04

Course Learning Objectives: The objective of the course is to

- Outline different casting processes and their steps.
- Categorize and prioritize furnaces and casting techniques.
- Explain metallurgical aspects during the solidification of metal and alloys.
- Assess various joining processes used in manufacturing.
- Investigate the metallurgical aspects of welding and different NDT testing methods

Module-1 Patterns, Sand Molding, Cores and Gating (08 Hours)

Introduction & basic materials used in the foundry:
Introduction: Definition, Classification of manufacturing processes. Metals casting classification, factors that determine the selection of a casting alloy.
Patterns: Definition, classification, materials used for the pattern, various pattern allowances and their importance.
Sand moulding: Types of base sand, requirement of base sand, Binder, Additives, preparation of sand moulds. Moulding machines- Jolt type, squeeze type and Sand slinger. Sands and moulds- Green sand, core sand, dry sand, sweep mould, CO2 mould, shell mould, investment mould, plaster mould, cement bonded mould**.**
Cores and gating: Definition, need, types. Method of making cores, Concept of gating (top, bottom, parting line, horn gate) and risers (open, blind) - Functions and types.
Fettling and cleaning of castings: Basic steps involved, Sand Casting defects- causes, features and remedies, advantages & limitations of the casting process**.**

Module-2 Melting & Metal Mold Casting Methods (08 hours)

Melting furnaces: Classification of furnaces, Gas fired pit furnace, Resistance furnace, Coreless induction furnace, electric arc furnace, constructional features & working principle of cupola furnace.
Casting using metal moulds: Gravity die casting, pressure die casting, centrifugal casting, squeeze casting, slush casting, thixocasting, and continuous casting processes**.**

Module-3 Metal Forming & Working Processes (08 hours)

Metal Forming Processes: Introduction to metal forming process: Mechanical behaviour of metals in elastic and plastic deformation, stress-strain relationships, Yield criteria, Application to tensile testing, strain rate and temperature in metal working; Hot deformation, Cold working and annealing.
Metal Working Processes: Fundamentals of metal working, Analysis of bulk forming processes like forging, rolling, extrusion, wire drawing by slab method.
Sheet metal processes: Sheet metal forming process (Die and punch assembly, Blanking, piercing, bending etc., Dies: Compound and Progressive die), High Energy rate forming processes.

Module-4 Welding Process, Special Types of Welding (08 hours)

Welding process: Definition, Principles, classification, application, advantages & limitations of welding. Arc welding: Metal arc welding (MAW), Flux Shielded Metal Arc Welding (FSMAW), Inert Gas Welding (TIG & MIG) Submerged Arc Welding (SAW) and Atomic Hydrogen Welding (AHW). Gas Welding: Principle, Oxy-Acetylene welding, oxy-hydrogen welding, air-acetylene welding, Gas cutting, powder cutting.
Special types of welding: Resistance welding, Seam welding, Butt welding, Spot welding, Projection welding, Friction welding, Explosive welding, Thermit welding, Laser welding and Electron beam welding.
Soldering and brazing: Definition, Principle and applications.

Module-5 Metallurgical Aspects in Welding, Non-Destructive Testing Methods (08 hours)
Metallurgical aspects in welding: Structure of welds, Formation of different zones during welding, Heat Affected Zone (HAZ), Parameters affecting HAZ. Effect of carbon content on structure and properties of steel, Shrinkage in welds & Residual stresses. Concept of electrodes, filler rod and fluxes. Welding defects- causes & remedy**.** **Non-Destructive Testing Methods:** Methods used for inspection of casting and welding: Visual, magnetic particle, dye penetrant test, ultrasonic, radiography and eddy current.

PRACTICAL MODULE

List of Practice Experiments: 2 hours each

1. Testing of moulding sand and core sand: Compression, Shear and Tensile tests on Universal Sand Testing Machine.
2. To determine the permeability number of green sand, core sand and raw sand.
3. To determine the Grain Fineness Number (GFN) of Base Sand.
4. Mould preparation using two moulding boxes (hand cut moulds) and using patterns (Single piece pattern and Split pattern).
6. Welding Practice: Preparation of L-Joint, T-Joint, Butt joint, V-Joint and Lap joints on M.S. flats using Arc Welding Equipment.
7. To study the effect of heat affected zone on the microstructure of steel weldments.
8. Preparing forged models involving upsetting, drawing and bending operations.
9. Sheet metal punch/die design and layout optimization

Demonstration Experiments for CIE

10. To study the defects of Cast and Welded components using Non-destructive tests like: a) Ultrasonic flaw detection b) Magnetic crack detection c) Dye penetration testing
11. To analyse the material flow and solidification simulation using Auto-Cast software

Course Outcomes: At the end of the course the student will be able to:	
22MEC32.1	Classify and categorize sands, patterns, cores and gating systems for developing sand moulds.
22MEC32.2	Compare and assess different types of melting furnaces and casting methods.
22MEC32.3	Demonstrate skills in preparation of forging models involving upsetting, drawing and bending operations.
22MEC32.4	Assess the various joining processes used in manufacturing based on applications.
22MEC32.5	Investigate the metallurgical aspects of welding.
22MEC32.6	Assess the applications of various NDT Testing Methods.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Manufacturing Science	Ghosh, A. and Mallik, A. K	East-West Press	2017
2.	Welding Processes and Technology	Parmar R. S	Khanna Publishers	2007
3	Manufacturing Technology- Foundry, Forming and Welding	P.N.Rao	Tata McGraw Hill	3, 2022

Reference Books				
1	Principles of metal casting	Rechard W. Heine, Carl R. Loper Jr., Philip C. Rosenthal	Tata McGraw Hill Education Private Limited	2009
2	Manufacturing Process-I	Dr. K. Radhakrishna	Sapna Book House	5, 2009
3	Process and Materials of Manufacturing	Roy A	Lindberg Pearson Edu	4, 2006
4	Manufacturing Engineering and Technology	Serope Kalpakjian Steuen. R Sechmid	Pearson Education Asia	7, 2018

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/112107083/
- https://nptel.ac.in/courses/112107090/
- https://www.coursera.org/lecture/circular-economy/aluminium-from-mine-to-metal- casting-OgzTQ

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22MEC32.1	-	2	-	-	-	2	-	-	-	-	-	2	-	-
22MEC32.2	-	-	-	-	-	-	2	-	-	-	-	2	-	-
22MEC32.3	-	3	-	-	-	-	-	-	-	-	-	2	-	2
22MEC32.4	-	-	-	-	-	2	2	-	-	-	-	-	-	2
22MEC32.5	-	-	-	3	-	-	2	-	-	-	-	-	-	-
22MEC32.6	-	-	-	3	-	-	2	-	-	-	-	-	-	-

1: Low 2: Medium 3: High

Material Science and Engineering			
Course Code	**22MEC33**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:2	SEE	3 Hours
Total Hours	40 hours Theory + 10 Lab slots	Credits	04

Course Learning Objectives: The objective of the course is to

- To relate and compare the structure and behaviour of materials common for mechanical engineering applications.
- To explore the mechanical properties of metals and their alloys, polymers, ceramics, smart materials and composites.
- To interpret the effect of heat treatment on material properties by heat treatment.
- To relate the selection of materials for different applications.
- To study and interpret various failure modes of materials

Module-1 Structure of Materials (08 Hours)

Introduction: Classification of materials, crystalline and non-crystalline solids, atomic bonding Crystal Structure: Crystal Lattice, Unit Cell, Planes and directions in a lattice, Planar Atomic Density, packing of atoms and packing fraction, Classification and Coordination of voids, Bragg's Law.

Imperfections in Solids: Types of imperfections, Point defects: vacancies, interstitials, line defects, 2-D and 3D-defects, Concept of free volume in amorphous solids. Plastic deformation of single crystal by slip and twinning, Mechanisms of strengthening in metals.

Creep: Description of the phenomenon with examples, three stages of creep, creep properties, Stress relaxation. Concept of fracture toughness, numerical on diffusion, strain and stress relaxation.

Module-2 Alloy Systems (08 Hours)

Concept of formation of alloys: Types of alloys, solid solutions, factors affecting solid solubility (Hume Rothery rules).

Phase diagrams: Eutectic, and Eutectoid systems, Lever rule (Numerical), Intermediate phases, Gibb's phase rule, Effect of non-equilibrium cooling, Coring and Homogenization. Iron-Carbon (Cementite) diagram, Common alloy steels, Stainless steel, Tool steel, Specifications of steels. Mechanism of solidification, Homogeneous and Heterogeneous nucleation, Crystal growth, cast metal structures, Solidification of Steels and Cast irons

Module-3 Heat Treatment, Ferrous and Non-Ferrous Alloys (08 Hours)

Heat Treatment, Ferrous and Non-Ferrous Alloys: Heat treating of metals: Time- Temperature-Transformation (TTT) curves, Continuous Cooling Transformation (CCT) curves, Annealing: Recovery, Recrystallization and Grain growth, Types of annealing, Normalizing, Hardening, Tempering, Martempering & Austempering.

Surface hardening methods: Concept of hardenability, Factors affecting hardenability. Carburizing, cyaniding, nitriding, flame hardening and induction hardening, age hardening of aluminium-copper alloys and PH steels. Ferrous materials: Properties, Compositions and uses of Grey cast iron and steel.

Module-4 Ceramics, Plastics and Composite Materials (08 Hours)

Ceramics, Plastics and Composite Materials: Types, fundamentals, processing and applications.

Powder Metallurgy: Introduction, Powder Production Techniques: Different Mechanical and Chemical methods, Characterization of powders (Particle Size & Shape Distribution), Powder Shaping: Particle Packing Modifications, Lubricants & Binders, Powder Compaction & Process, Sintering and Application of Powder Metallurgy.

Module-5 Materials Selection (08 Hours)
Materials Selection: The need for material selection in design, and the evolution of Engineering materials. **The Design Process and Materials Data:** Types of design, design tools and materials data, processes of obtaining materials data, materials databases **Engineering Materials and Their Properties:** The classes of engineering materials and their structure, material properties: mechanical properties, functional properties. **Material Selection Charts:** Selection criteria for materials, material property Charts, deriving property limits and material indices.

PRACTICAL MODULE

List of Practice Experiments: 2 hours each

1. Performing various mechanical testing like Tension, Compression, Shear and Bending tests using Universal Testing Machine (UTM).
2. Performing Rockwell, Brinell and Vickers's hardness Tests on different materials.
3. Performing impact test study using Izod and Charpy Impact tests.
4. To study the effect of Heat treatment on the behavior of materials.
5. Specimen preparation for macro and micro structural examinations and study of the macrostructure and microstructure of a sample metal/ alloys.
6. To study the crystal structure of a given Cast Iron, Mild steel, Aluminium and Copper/Brass specimens and study the crystal imperfections in a given Cast Iron, Mild steel and Aluminium specimens.
7. To conduct a wear test on Mild steel/ Cast Iron/Aluminium/ Copper to find the volumetric wear rate and coefficient of friction.

Demo Experiments

8. Demonstration of a Fatigue Test.
9. Study the properties of various types of plastics.

Course Outcomes: At the end of the course the student will be able to:	
22MEC33.1	Interpret the relationship between structure and properties of commonly applicable engineering materials.
22MEC33.2	Evaluate the importance of phase diagrams and phase transformations.
22MEC33.3	Inspect the effect of heat treatment and surface treatment processes on the properties of materials.
22MEC33.4	Analyze the properties of composites, ceramics and plastics in the context of society, environment and sustainability.
22MEC33.5	Discuss the importance of the design process and material data in material selection.
22MEC33.6	Summarize environment-friendly emerging materials for engineering applications.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Material science and Engineering: An Introduction	William D. Callister	Wiley	3, 2006
2	Materials Selection in Mechanical Design	Ashby, M.F	Elsevier	2022
3	Materials Science and Engineering	V. Raghavan	Prentice Hall India	2, 2002

Reference Books				
1	Mechanical Metallurgy	George Ellwood Dieter	McGraw-Hill	3, 2007
2	Materials Science and Engineering	V. Raghavan	Prentice Hall India	2, 2002
3	Powder Metallurgy-Science, Technology and Applications	P. C. Angelo and R. Subramanian	Prentice Hall India	2009

Web links and Video Lectures (e-Resources):

- msmsjec.blogspot.in (Accessed on 19/10/2022)
- https://swayam.gov.in/nd1_noc20_mm13(Accessed on 19/10/2022)
- https://onlinecourses.nptel.ac.in/noc19_mm02/(Accessed on 19/10/2022)

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22MEC33.1	-	-	-	3	-	-	-	-	-	-	-	-	-	2
22MEC33.2	-	-	-	-	-	-	2	-	-	-	-	2	-	-
22MEC33.3	-	-	-	3	-	-	-	-	-	-	-	2	-	2
22MEC33.4	-	-	-	-	-	2	3	-	-	-	-	-	-	-
22MEC33.5	-	-	-	-	-	3	2	-	-	-	-	-	-	-
22MEC33.6	-	-	-	-	-	2	3	-	-	-	-	1	-	-

1: Low 2: Medium 3: High

Basic Thermodynamics			
Course Code	**22MEC34**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	2:2:0	SEE	3 Hours
Total Hours	40 hours Theory	Credits	03

Course Learning Objectives: The objective of the course is to

- Learn about thermodynamic system and its equilibrium
- Understand various forms of energy - heat transfer and work
- Study the basic laws of thermodynamics including, zeroth law, first law and second law.
- Interpret the behavior of pure substances and its application in practical problems.
- Study of Ideal and real gases and evaluation of thermodynamic properties

Module-1 Fundamental Concepts & Definitions (8 hours)

Fundamental Concepts & Definitions: Thermodynamic definition and scope, Microscopic and Macroscopic approaches. Some practical applications of engineering thermodynamic Systems, Characteristics of system boundary and control surface, examples. Thermodynamic properties; definition and units, intensive, extensive properties, specific properties, pressure, specific volume, Thermodynamic state, state point, state diagram, path and process, quasi-static process, cyclic and non-cyclic; processes;

Thermodynamic equilibrium; definition, mechanical equilibrium; diathermic wall, thermal equilibrium, chemical equilibrium, Zeroth law of thermodynamics, Temperature; concepts, scales, international fixed points and measurement of temperature. Constant volume gas thermometer, constant pressure gas thermometer, mercury in glass thermometer.

Module-2 Work and Heat , First Law of Thermodynamics (8 hours)

Work and Heat: Mechanics, definition of work and its limitations. Thermodynamic definition of work; examples, sign convention. Displacement work; as a part of a system boundary, as a whole of a system boundary, expressions for displacement work in various processes through p-v diagrams. Shaft work; Electrical work. Other types of work. Heat; definition, units and sign convention. Problems.

First Law of Thermodynamics: Joules experiments, equivalence of heat and work. Statement of the First law of thermodynamics, extension of the First law to non - cyclic processes, energy, energy as a property, modes of energy, Extension of the First law to control volume; steady flow energy equation(SFEE), important numericals

Module-3 Second Law of Thermodynamics (8 hours)

Second Law of Thermodynamics: Limitations of first law of thermodynamics, Thermal reservoir, heat engine and heat pump: Schematic representation, efficiency and COP. Reversed heat engine, schematic representation, importance and superiority of a reversible heat engine and irreversible processes, internal and external reversibility. Kelvin - Planck statement of the Second law of Thermodynamics; PMM I and PMM II, Clausius statement of Second law of Thermodynamics, Equivalence of the two statements; Carnot cycle, Carnot principles. Problems

Entropy: Clausius inequality, Statement- proof, Entropy- definition, a property, change of entropy, entropy as a quantitative test for irreversibility, principle of increase in entropy, entropy as a coordinate.

Module-4 Availability and Pure Substances (8 hours)

Availability, Irreversibility and General Thermodynamic relations. Introduction, Availability (Exergy), Unavailable energy, Relation between increase in unavailable energy and increase in entropy. Maximum work, maximum useful work for a system and control volume, irreversibility.

Pure Substances: P-T and P-V diagrams, triple point and critical points. Sub-cooled liquid, saturated liquid, mixture of saturated liquid and vapor, saturated vapor and superheated vapor states of pure substance with water as example. Enthalpy of change of phase (Latent heat). Dryness fraction (quality), T-S and H-S diagrams, representation of various processes on these diagrams. Steam tables and its use. Throttling calorimeter, separating and throttling calorimeter

Module-5 Ideal & Real Gases (8 hours)
Ideal gases: Ideal gas mixtures, Daltons law of partial pressures, Amagat's law of additive volumes, evaluation of properties of perfect and ideal gases, Air- Water mixtures and related properties. **Real gases –** 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 gases

Course Outcomes: At the end of the course the student will be able to:	
22MEC34.1	Explain fundamentals of thermodynamics and evaluate energy interactions across the boundary of thermodynamic systems.
22MEC34.2	Apply the concept of First law on closed and open system to analyze the problems.
22MEC34.3	Evaluate the feasibility of cyclic and non-cyclic processes using 2nd law of thermodynamics.
22MEC34.4	Apply the knowledge of entropy, reversibility and irreversibility to solve numerical problems and apply 1st law of thermodynamics to closed and open systems and determine quantity of energy transfers and change in properties.
22MEC34.5	Interpret the behavior of pure substances and its application in practical problems.
22MEC34.6	Recognize differences between ideal and real gases and evaluate thermodynamic properties of ideal and real gas mixtures using various relations.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Basic and Applied Thermodynamics	P.K.Nag,	Tata McGraw Hill	2nd Ed., 2002
2	Basic Engineering Thermodynamics	A.Venkatesh	Universities Press	2008
3	Basic Thermodynamics	B.K Venkanna, Swati B. Wadavadagi	PHI, New Delhi	2010
Reference Books				
1	Thermodynamics- An Engineering Approach	YunusA.Cenegal and Michael A.Boles	Tata McGraw Hill publications	2002
2	An Introduction to Thermodynamics	Y.V.C.Rao	Wiley Eastern	1993
3	Engineering Thermodynamics	.B.Jones and G.A.Hawkins	John Wiley and Sons.	1986

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/112105123
- https://nptel.ac.in/courses/112104113
- https://nptel.ac.in/courses/112108148
- https://archive.nptel.ac.in/courses/112/105/112105123/

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22MEC34.1	-	2	1	-	-	-	-	-	-	-	-	-	-	-
22MEC34.2	-	2	-	-	-	-	-	-	-	-	-	-	-	-
22MEC34.3	-	2	-	-	-	-	-	-	-	-	-	-	-	-
22MEC34.4	-	2	-	-	-	-	-	-	-	-	-	-	-	-
22MEC34.5	-	2	-	-	-	-	-	-	-	-	-	-	-	-
22MEC34.6	-	2	-	-	-	-	-	-	-	-	-	-	-	2

1: Low 2: Medium 3: High

Electric and Hybrid Vehicle Technology			
Course Code	**22MEC351**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 hours Theory	Credits	03

Course Learning Objectives: The objective of the course is to

- Explain the basics of electric and hybrid electric vehicles, their architecture, technologies and fundamentals.
- Explain plug – in hybrid electric vehicle architecture, design and component sizing and the power electronics devices used in hybrid electric vehicles.
- Analyze various electric drives suitable for hybrid electric vehicles.
- Discuss different energy storage technologies used for hybrid electric vehicles and their control

Module-1 Introduction to Hybridization of the Automobile (8 hours)

Introduction: Sustainable Transportation, A Brief History of HEVs, Why EVs Emerged and Failed, Architectures of HEVs, Interdisciplinary Nature of HEVs, State of the Art of HEVs, Challenges and Key Technology of HEVs.

Hybridization of the Automobile: Vehicle Basics, Basics of the EV, Basics of the HEV, Basics of Plug-In Hybrid Electric Vehicle (PHEV), Basics of Fuel Cell Vehicles (FCVs).

Module-2 HEV Fundamentals and Plug-in HEVs (8 hours)

HEV Fundamentals: Introduction, Vehicle Model, Vehicle Performance, EV Powertrain Component Sizing, Series Hybrid Vehicle and Parallel Hybrid Vehicle.

Plug-in Hybrid Electric Vehicles: Introduction to PHEVs, PHEV Architectures, Equivalent Electric Range of Blended PHEVs, Fuel Economy of PHEVs, Power Management of PHEVs, Component Sizing of EREVs, Component Sizing of Blended PHEVs, Vehicle-to-Grid Technology.

Module-3 Energy Storage System and Fuel cells (8 hours)

Batteries, Ultra capacitors, Fuel Cells, and Controls: Introduction, Different batteries for EV, Battery Characterization, Comparison of Different Energy Storage Technologies for HEVs, Battery Charging Control, Charge Management of Storage Devices, Flywheel Energy Storage System, Hydraulic Energy Storage System, Fuel Cells and Hybrid Fuel Cell Energy Storage System and Battery Management System.

Module-4 Electric Machines and Drives in HEVs (8 hours)

Introduction, BLDC motors, Induction Motor Drives, Permanent Magnet Motor Drives, Switched Reluctance Motors, Doubly Salient Permanent Magnet Machines, Design and Sizing of Traction Motors, Thermal Analysis and Modelling of Traction Motors.

Module-5 Energy Management Strategies (8 hours)

Integration of Subsystems: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor

Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicle, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy strategies.

Course Outcomes: At the end of the course the student will be able to:	
22MEC351.1	Explain the basics of electric and hybrid electric vehicles, their architecture, technologies and fundamentals.
22MEC351.2	Analyze the use of different power electronics devices and electrical machines in hybrid electric vehicles.
22MEC351.3	Explain the use of different energy storage devices used for hybrid electric vehicles, their technologies and control.

22MEC351.4	Interpret working of different configurations of electric vehicles and its components.
22MEC351.5	Describe the hybrid vehicle configuration, performance analysis methods and Energy Management strategies in HEVs.
22MEC351.6	Compare different energy management strategies used in electric and hybrid vehicle.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Hybrid Electric Vehicles	Chris Mi, M. Abul Masrur	John Wiley & Sons Inc.	2, 2018
2	Electric and Hybrid Vehicles	Husain Iqbal	CRC Press .	2, 2021
3	Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles	Sheldon S. Williamson	Springer	1, 2013
Reference Books				
1	Power Sources for Electric Vehicles	B D McNicol and D A J Rand	Elsevier Publications .	1, 1998
2	Build Your Own Electric Vehicle	Seth Leitman	MC Graw Hill	1, 2013.
3	Electric Vehicle Technology	James Larminie and John Lowry	Wiley Publications	1, 2003

Web links and Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/108/103/108103009/

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22MEC351.1	2	3	-	-	-	-	-	-	-	-	-	-	-	-
22MEC351.2	3	3	-	-	-	-	-	-	-	-	-	-	-	2
22MEC351.3	2	3	-	2	-	-	-	-	-	-	-	-	-	-
22MEC351.4	2	3	3	-	-	-	-	-	-	-	-	-	-	-
22MEC351.5	-	-	2	3	-	-	-	-	-	-	-	-	-	-
22MEC351.6	-	-	2	-	-	-	-	-	-	-	-	3	-	-

1: Low 2: Medium 3: High

Smart Materials and Systems			
Course Code	**22MEC352**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE	3 Hours
Total Hours	40 hours	Credits	03

Course Learning Objectives:

This course will enable students to:

- Study various types of smart materials used in engineering applications.
- Study basics of smart sensors, actuators deployed in engineering application.
- Understand the coupling properties and underlying physical phenomena of different active materials.
- Describe the basic principles and mechanisms of the stimuli-response for the most important smart materials.
- Propose improvement on the design, analysis, manufacturing, and application issues involved in integrating smart materials and devices under various engineering structures and products.
- Demonstrate knowledge and understanding of the physical principles underlying the behaviour of Shape Memory Alloy and piezoelectric materials.

Module-1 Smart Materials and Structures (8 Hours)

Preamble: Relevance of material science in day today activities, Importance of materials in industrial, defence and research application and its economic implications.

Smart Materials and Structures: Introduction to Smart Materials, need of smart materials, types of smart materials, difference between smart materials and structure, components of smart materials, properties of smart materials, advantages and disadvantages of smart materials, applications of smart structures.

Module-2 Shape Memory Alloys (8 Hours)

Shape Memory Alloys: Introduction shape memory alloys, Shape memory effect, Processing, and characteristics. Experimental Phenomenology: one way and two-way memory, advantages and disadvantages and applications

Module-3 Piezoelectric Smart Materials & MEMS(8 Hours)

Piezoelectric Smart Materials: Introduction, Inchworm Linear motor, Properties of Piezoelectric materials, Applications, Comparison of major sensing and actuation methods.

MEMS: Introduction to MEMS, Intrinsic characteristics, advantages and disadvantages of MEMS, applications.

Module-4 Fiber Optics and Biomimetic (8 Hours)

Fiber Optics: Introduction, Physical Phenomenon, Characteristics, Fibre optic strain sensors (types only), Optical fibres as load bearing elements, Crack detection applications.

Biomimetic: Characteristics of Natural structures. Fibre reinforced: Organic matrix natural composites, Natural creamers, Mollusks. Biomimetic sensing.

Module-5 ER and MR Fluids (8 Hours)

Electro rheological (ER) and Magneto rheological (MR) Fluids: Mechanisms and Properties, Characteristics, Fluid composition and behaviour, Application of ER and MR fluids (Only Brakes, Clutches and Dampers).

Environmental and sustainable concerns: Lead free smart materials for energy harvesting applications.

Course Outcomes: At the end of the course the student will be able to:	
22MEC352.1	Describe the physical phenomenon, properties, and characteristics of various smart materials.
22MEC352.2	Comprehend on the physical principles underlying the behaviour of Shape Memory Alloy and piezoelectric materials.
22MEC352.3	Identify and analyse various smart materials and components for their properties based on the applications.
22MEC352.4	Summarize the latest developments in the field of smart materials and system.
22MEC352.5	Develop a comprehensive understanding of the coupling properties and underlying physical phenomena exhibited by diverse active materials.
22MEC352.6	Discuss on environmental and sustainable concerns with respect to smart material.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Smart Structures –Analysis and Design	A.V.Srinivasan	Cambridge University Press, New York	2001
2	Smart Materials and Structures	M. V. Gandhi and B. S. Thompson	Chapmen & Hall, London	1992
Reference Books				
1	Smart Structures: Physical Behaviour, Mathematical Modelling and Applications	P. Gauenzi	Wiley	2009
2	Piezoelectric Sensorics: Force, Strain, Pressure, Acceleration and Acoustic Emission Sensors, Materials and Amplifiers	G. Gautschi	Springer, Berlin, New York	2002
3	Analysis and Performance of Fiber Composites	B. D. Agarwal, and L. J. Broutman	John Wiley & Sons	2015
4	Engineering aspects of Shape memory Alloys	T. W. Duerig, K. N. Melton, D. Stockel, C, Mayman	Butterworth - Heinemann	1990

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=4dhxLIGhSLI&list=PLzbbKPlEi_QlCXRH4twxcMWFQM8CCzx1G

(As on 12 July 2023)

- https://nptel.ac.in/courses/112104173 (As on 12 July 2023)
- https://archive.nptel.ac.in/courses/112/104/112104251/ (As on 12 July 2023)

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22MEC352.1	2	-	-	-	-	-	-	-	-	-	-	-	-	-
22MEC352.2	-	2	-	-	-	-	-	-	-	-	-	-	-	-
22MEC352.3	-	-	-	2	-	-	-	-	-	-	-	-	2	-
22MEC352.4	-	-	-	-	-	-	1	-	-	-	-	-	-	1
22MEC352.5	-	-	-	-	-	-	-	-	-	-	-	1	-	2
22MEC352.6	-	-	-	-	-	-	-	-	-	-	-	1	-	-

1: Low 2: Medium 3: High

Energy and Environment			
Course Code	**22MEC353**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 hours Theory	Credits	03

Course Learning Objectives: The objective of the course is to

- Analyze key energy trends in India, including demand, electricity generation, access to modern energy, and production and trade.
- Examine factors influencing India's energy development: economy, demographics, policy, energy prices, social, environmental aspects, and investment.
- Evaluate thermal energy storage methods, energy-saving strategies, and solutions for energy management and grid stability.
- Assess the importance of environmental studies, scope, and the need for public awareness in environmental protection.
- Compare ecosystems, energy flow, structure, and functioning using food chains, webs, and ecological pyramids.
- Examine causes, effects, and control measures of environmental pollution: air, water, soil, marine, noise, thermal, and nuclear hazards.

Module 1 Basic Introduction to Energy (8 Hours)

Basic Introduction to Energy: Energy and power, forms of energy, primary energy sources, energy flows, world energy production and consumption, Key energy trends in India: Demand, Electricity, Access to modern energy, Energy production and trade, Factors affecting India's energy development: Economy and demographics Policy and institutional framework, Energy prices and affordability, Social and environmental aspects, Investment.

Module 2 Energy Management (8 Hours)

Energy storage systems: Thermal energy storage methods, Energy saving, Thermal energy storage systems. **Energy Management:** Principles of Energy Management, Energy demand estimation, Energy pricing. **Energy Audit:** Purpose, Methodology with respect to process Industries, Characteristic method employed in Certain Energy Intensive Industries. **Economic Analysis:** Scope, Characterization of an Investment Project.

Module 3 Environment (8 Hours)

Environment: Introduction, Multidisciplinary nature of environmental studies- Definition, scope and importance, Need for public awareness. **Ecosystem:** Concept, Energy flow, Structure and function of an ecosystem. Food chains, food webs and ecological pyramids, Forest ecosystem, Grassland ecosystem, Desert ecosystem and Aquatic ecosystems, Ecological succession.

Module 4 Environmental Pollution (8 Hours)

Environmental Pollution: Definition, Cause, effects and control measures of - Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution and nuclear hazards, Solid waste Management, Disaster management Role of an individual in prevention of pollution, Pollution case studies.

Module 5 Social Issues and the Environment (8 Hours)

Social Issues and the Environment: Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies. Wasteland reclamation, Consumerism and waste products, Environment Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act, Issues involved in enforcement of environmental legislation.

Course Outcomes: At the end of the course the student will be able to:	
22MEC353.1	Analyze India's energy trends and their impact on economy, policy, and population.
22MEC353.2	Evaluate energy storage systems and recommend energy-saving strategies.
22MEC353.3	Assess ecosystem dynamics and interdependence in different environments.
22MEC353.4	Analyze causes and consequences of environmental pollution, proposing effective control measures.
22MEC353.5	Develop strategies to address climate change and global environmental challenges.
22MEC353.6	Evaluate the effectiveness of environmental legislation and propose improvements.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Energy Management Audit & Conservation	Barun Kumar De	Vrinda Publication	2, 2010
2	Environment Pollution Control Engineering	C S Rao	New Age International	2, 2015
Reference Books				
1	Energy Management	Murphy, W. R	Elsevier 2007	2007
2	Energy Management Principles	Smith, C. B	Pergamum Press	2007

Web links and Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/109/101/109101171/
- https://www.mckinsey.com/capabilities/sustainability/our-insights/decarbonising-india-charting-a-pathway-for-sustainable-growth
- https://www.coursera.org/learn/environmental-science#modules
- Air Act: https://www.indiacode.nic.in/bitstream/123456789/1389/1/Prevwater1981__41.pdf
- Water Act: https://cpcb.nic.in/upload/home/water-pollution/WaterAct-1974.pdf
- https://sustainabilityeducationacademy.com/courses/free-online-energy-audit-course/

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22MEC353.1	-	-	-	-	-	3	-	-	-	-	-	-	-	-
22MEC353.2	-	-	-	-	3	-	-	-	-	-	-	-	-	-
22MEC353.3	-	-	-	-	-	3	-	-	-	-	-	-	-	-
22MEC353.4	-	-	-	-	-	2	-	-	-	-	-	-	-	-
22MEC353.5	-	-	-	-	-	-	3	-	-	-	-	-	-	-
22MEC353.6	-	-	-	-	-	-	-	2	-	-	-	-	-	-

1: Low2: Medium 3: High

Industrial Safety			
Course Code	**22MEC354**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 Hours Theory	Credits	03

Course Learning Objectives: The objective of the course is to

- Understand fundamental concepts and terminology of industrial safety, including hazard identification and risk assessment.
- Analyze workplace hazards and propose appropriate control measures for risk mitigation.
- Comprehend safety regulations, international acts, and environmental measures for pollution control.
- Apply computer-aided hazard analysis to improve safety in industrial settings.

Module-1 Introduction to Safety (8 hours)

Introduction to Safety: Terms used: accident, safety, hazard, safe, safety devices, safety guard, security, precaution, caution, appliance, slip, trip, fall. Ladders and scaffolding. Unsafe acts, reason for accidents, MSDS (material safety data sheet), computer Aided Hazard Analysis, International acts and standards OSHA, WHO. Environment act, control and abatement of environmental Pollution-Biomedical waste. Lockout and tag out procedures. Safe material handling and storage. Risk analysis quantification.

Case studies: Student should identify the unsafe acts near their surroundings like housekeeping, lab as well as industrial layouts, road safety, campus layout, safety signs.

Module-2 Fire Safety (8 hours)

Fire Safety: Introduction, toxicity of products of combustion – vapour clouds – flash fire – jet fires – pool fires – auto ignition, sources of ignition. Class A, B, C, D and E fire. Fire triangle, Fire extinguishers, Fire hazard and analysis, prevention of fire. Fire protection and loss prevention, steps after occurrence of fire. notice-first aid for burns, Portable fire extinguishers. Fire detection, fire alarm and firefighting systems. Safety sign boards, instruction on portable fire extinguishers.

Case studies: Demonstration of fire extinguishers, visit to local firefighting stations. Visit to fire accident sites to analyze the cause of fire and its prevention for future.

Module-3 Mechanical Safety (8 hours)

Mechanical Safety: PPE, safety guards, Mechanical hazards, workplace hazards, Forklift hazard control Safety while working with machine tools like lathe, drill press, power and band saws, grinding machines. Safety during welding, forging and pressing. Safety while handling Material, compressed gas cylinders, corrosive substance, waste drum and containers.

Case studies: Visit to machine shop, workshops, foundry lab and local industries to record the practical observation and report the same with relevant figures and comments.

Module-4 Electrical Safety (8 hours)

Electrical Safety: Introduction to electrical safety, Indian standards on electrical safety, Electric hazards, effect of electric current on human body, causes of electrical accidents, prevention of electric accidents, PPE used. Protection systems: Fuse, circuit breakers and overload relays – protection against over voltage and under voltage. Electric shock. Primary and secondary electric shocks, AC and DC current shocks. Safety precautions against shocks. Safety precautions in small and residential building installations. Safety procedures in electric plant.

Case studies: To visit electrical sub stations, local distribution systems, observe and share the experience and report.

Module-5 Chemical Safety and Other Safety (8 hours)

Chemical Safety and Other Safety Checks: Introduction to Chemical safety, Labelling of chemicals, acid hoods. Handling of acids, eye washers and showers. Safety thinking, accident investigation, safety policy of the company, safety, loss prevention and control, check list for LPG installations, safety precautions using CNG, fire prevention and safety audit, confined space entry, risk assessment.

Case studies: To visit chemical laboratory of the college and other chemical industries like LPG , CNG facilities and report.

Course Outcomes: At the end of the course the student will be able to:	
22MEC354.1	Recognize and mitigate workplace hazards using appropriate controls.
22MEC354.2	Demonstrate emergency preparedness and response skills, including the use of fire extinguishers and first aid techniques.
22MEC354.3	Implement safety protocols for machinery and equipment, ensuring the use of safety guards and proper material handling.
22MEC354.4	Apply electrical and chemical safety measures to prevent accidents and injuries.
22MEC354.5	Conduct safety inspections and audits to assess compliance and propose corrective actions.
22MEC354.6	Communicate effectively and collaborate with others to promote a culture of safety in the workplace.

Sl. No.	**Title of the Book**	**Name of Author/s**	**Name of the Publisher**	**Edition & Year**
Textbooks				
1	Industrial Safety and Management	L M Deshmukh	McGraw Hill Education (India) Private Limited	2017
2	Fire Prevention Hand Book	Derek, James	Butter Worth's and Company, London	1986
3	Electrical Safety, fire safety and safety management	S.Rao, R K Jain and Saluja	Khanna Publishers	1997
4	Industrial health and safety management	A.M.Sarma	Himalya publishing house	2, 2016
5	Chemical process Industrial safety	K S N Raju	McGraw Hill Education (India) private Limited.	2014
6	Environmental Engineering	Gerard Kiely	McGraw Hill Education (India) private Limited	2006
Reference Books				
1	The Environment Act (Protection) 1986	Commercial Law Publishers (India) Pvt. Ltd. New Delhi.		2022nd Edition (31 December 2021)
2	Water (Prevention and control of pollution) act 1974	Commercial Law publishers (India) Pvt. Ltd., New Delhi.		1 January 2021

Web links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/noc20_mg43/preview
- https://www.udemy.com/course/industrial-safety-processes/

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22MEC354.1	-	2	-	-	-	-	-	-	-	-	-	-	-	-
22MEC354.2	-	-	-	-	-	2	-	-	-	-	-	-	-	-
22MEC354.3	-	-	-	-	-	-	2	-	-	-	-	-	-	-
22MEC354.4	2	-	-	-	-	-	-	-	-	-	-	-	-	-
22MEC354.5	-	-	-	2	-	-	-	-	-	-	-	-	-	-
22MEC354.6	-	-	-	-	-	-	-	-	-	2	-	-	-	-

1: Low 2: Medium 3: High

Computer Aided Machine Drawing			
Course Code	**22MEC36L**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Practical	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	0:0:2	SEE	3 Hours
Total Hours	10 Lab slots	Credits	01

Course Learning Objectives: The objective of the course is to

- To acquire the knowledge of limits, tolerance and fits and indicate them on machine drawings.
- To make drawings using orthographic projections and sectional views
- To impart knowledge of thread forms, fasteners, keys, joints, couplings and clutches.
- To understand and interpret drawings of machine components leading to the preparation of assembly drawings manually and using CAD packages..

Module 1 Introduction to Computer-Aided Design Software (Only for CIE) 1 Hour

Introduction to Computer-Aided Design Software:
Review the graphic user interface of the software. Review the basic sketching commands and navigational commands. Practice Extrude, Revolve, Cut-out, Revolve Cut-out, Hole, Sweep, Loft, and Helix commands. Generate 2D views of the 3D modelled parts and extract the sectional views.
Limits, Fits & Tolerances:
Introduction, Fundamental 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..

Module 2 Sections of Simple and Hollow Solids (Only for CIE) 2 Hours

Sections of Simple and hollow solids: True shape of sections

Module 3 Thread Forms (only for CIE) 3 Hours

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.
Fasteners: Hexagonal headed bolt and nut with washer (assembly), square-headed bolt and nut with washer (assembly).
Rivets: Terminologies of rivets. Modelling Single and double riveted lap joints, Butt joints with single/double cover straps (Chain and zig zag using snap head rivets).

Module 4 Assembly of Joints and Couplings (3 hours)

Assembly of Joints and couplings (with GD&T) using a 2D environment
Joints: Like Cotter joint (socket and spigot), knuckle joint (pin joint).
Couplings: Like flanged coupling, universal coupling

Module 5 Assembly Drawings (5 hours)

Assembly Drawings: Using a 3D environment
(Part drawings shall be given)
Model and assemble the following machine elements.

1. Plummer block (Pedestal Bearing)
2. Rams Bottom Safety Valve
3. I.C. Engine connecting rod
4. Screw jack (Bottle type)
5. Machine vice.

Course Outcomes: At the end of the course the student will be able to:	
22MEC36L.1	Describe the concepts of limits, fits, and tolerances, to model machine components.

22MEC36L.2	Illustrate sectional views of part and assembled models.
22MEC36L.3	Compare the various thread forms, fasteners & rivets used for machine components and develop a 2D model drawing.
22MEC36L.4	Sketch the drawings of joints and couplings used in the machine members using 2D environment.
22MEC36L.5	Create the parts of machine component and assembled them appropriately using modern modelling software with 3D environment.
22MEC36L.6	Create drafting of the assembled machine components as per the conventions and requirements.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Machine Drawing	N.D.Bhat & V.M.Panchal	Charotar Publishing House,	51, 2022
2	Machine Drawing	N.Siddeshwar, P.Kannaih, V.V.S. Sastri	Tata Mc.Grawhill	2017
Reference Books				
1	A Textbook of Computer Aided Machine Drawing	S. Trymbakaa Murthy,	CBS Publishers, New Delhi	2007
2	Machine Drawing	K.R. Gopala Krishna	Subhash Publication	2011

Web links and Video Lectures (e-Resources):

- https://www.coursera.org/learn/3d-cad-fundamental
- https://www.coursera.org/learn/introduction-to-3d-modeling

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22MEC36L.1	2	2	-	-	-	-	-	-	-	-	-	-	-	-
22MEC36L.2	2	2	-	-	3	-	-	-	-	-	-	-	-	-
22MEC36L.3	2	2	-	-	3	-	-	-	-	-	-	-	-	-
22MEC36L.4	2	2	-	-	3	-	-	-	-	-	-	-	-	-
22MEC36L.5	-	2	-	-	3	-	-	-	-	2	-	-	-	-
22MEC36L.6	-	2	-	-	3	-	-	-	-	2	-	-	-	-

1: Low 2: Medium 3: High

Universal Human Values- II			
Course Code	**22UHV37**	CIE Marks	50
Teaching Hours/Week (L:T:P)	(2:0:0)	SEE Marks	50
Credits	**02**	Exam Hours	02

Course Learning Objectives: This introductory course input is intended:

1. To help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
2. To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement toward value-based living in a natural way.
3. To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature.

Module-1 Introduction to Value Education

Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education), Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Happiness and Prosperity – Current Scenario, Method to Fulfill the Basic Human Aspirations.

Activities: Sharing about Oneself, Exploring Human Consciousness and Exploring Natural Acceptance. **5 Hours**

Module-2 – Harmony in the Human Being

Understanding Human beings as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health.

Activities: Exploring Sources of Imagination in the Self, Exploring Harmony of Self with the Body and Exploring the difference of Needs of Self and Body. **5 hours**

Module 3 – Harmony in the Family and Society

Harmony in the Family – the Basic Unit of Human Interaction, 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Other Feelings, Justice in Human-to-Human Relationship, Understanding Harmony in the Society, Vision for the Universal Human Order.

Activities: Exploring the Feeling of Trust, Exploring the Feeling of Respect and Exploring the Feeling systems to fulfil Human Goal. **5 hours**

Module-4 – Harmony in the Nature/Existence

Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence.

Activities: Exploring the Four Orders of Nature and Co-existence in Existence. **5 hours**

Module-5 – Implications of the Holistic Understanding – a Look at Professional Ethics

Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics, Holistic Technologies, Production Systems and Management Models-Typical Case Studies, Strategies for Transition towards Value-based Life and Profession

Activities: Exploring Ethical Human Conduct**,** Humanistic Models in Education and steps of Transition towards Universal Human Order. **5 hours**

Course Outcomes: At the end of the course the student will be able to:	
22UHV37.1	Practice the method of self-exploration to understand the basic human aspiration.
22UHV37.2	Distinguish between needs of self and body.
22UHV37.3	Evolve a program for self-regulation and health.
22UHV37.4	Differentiate between the characteristics and activities of different orders and study the mutual fulfillment among them.
22UHV37.5	Realize sustainable solutions to the problems in society and nature.
22UHV37.6	Develop competence in professional ethics and strategies for the transition towards a value-based life/profession.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Foundation Course in Human Values and Professional Ethics	R R Gaur, R Asthana, G P Bagaria	Excel Books, New Delhi	2nd Revised Edition, 2019
2	Teachers' Manual for A Foundation Course in Human Values and Professional Ethics	R R Gaur, R Asthana, G P Bagaria	Excel Books New Delhi	2nd Revised Edition, 2019
Reference Books				
1	Jeevan Vidya: Ek Parichaya	A Nagaraj	Jeevan Vidya Prakashan Amarkantak	1999
2	Human Values	A.N. Tripathi	New Age Intl. Publishers, New Delhi	2004

Additional Resources/Web links/Video Lectures

1. The Story of Stuff (Book).
2. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
3. Small is Beautiful - E. F Schumacher.
4. Slow is Beautiful - Cecile Andrews
4. Economy of Permanence - J C Kumarappa
5. Bharat Mein Angreji Raj – Pandit Sunderlal
6. Rediscovering India - by Dharampal
7. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
8. India Wins Freedom - Maulana Abdul Kalam Azad
9. Vivekananda - Romain Rolland (English)
10. Gandhi - Romain Rolland (English)
11. UHV-I Teaching material (Presentations, Pre & Post Surveys etc.)
https://fdp-si.aicte-india.org/AicteSipUHV_download.php
12. Details of UHV-II: Universal Human Values – Understanding Harmony and Ethical Human Conduct
https://drive.google.com/file/d/1cznDaqDwKy__EKWmqJLWF94MeY4AXcsU/view?usp=sharing

13. Recorded FDP (Refresher 1 Part 1: Preparing to teach UHV-I in SIP)

https://www.youtube.com/watch?v=kejuD4faDDE&list=PLWDeKF97v9SOjS4RanhaYj4YLiImqm5pj&index=1

14. Resources, including the class notes and presentations
https://drive.google.com/drive/folders/1nh9m5ibEtvMyqekeiexAJtfbdNtmtt6-?usp=sharing

15. Hindi Recording of 5-day UHV FDP
https://www.youtube.com/playlist?list=PLWDeKF97v9SMRfe5PK1HPYnEcrrJOL6K7

16. English Recording of 5-day UHV FDP
https://www.youtube.com/playlist?list=PLWDeKF97v9SP7wSlapZcQRrT7OH0ZlGC4

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22UHV37.1						3		2						
22UHV37.2						2			3					
22UHV37.3						2		3						
22UHV37.4							3							
22UHV37.5			3				2							
22UHV37.6								3				2		

1: Low 2: Medium 3: High

Biology for Engineers			
Course Code	**22BFE37**	CIE Marks	50
Teaching Hours/Week (L:T:P)	(2:0:0)	SEE Marks	50
Credits	**02**	Exam Hours	02

Course Learning Objectives:

1. To bring awareness of biological concepts to engineering students
2. To introduce the building blocks of life and their complexity
3. To encourage interdisciplinary studies and projects
4. To appreciate the discoveries that mimic nature and its working
5. To inculcate nature-inspired design and operational principles

Module-1 **5 Hours**

Basic Cell Biology: Introduction to Biology, The cell: the basic unit of life, Expression of genetic information-protein structure and function, Cell metabolism; Cells respond to their external environments, Cells grow and reproduce, Cellular differentiation.

Module-2 **5 Hours**

Biochemistry and Molecular Aspects of Life: Biodiversity-Chemical bonds in Biochemistry; Biochemistry and Human biology, Protein synthesis -DNA; RNA, Transcription and translation factors play key roles in protein synthesis, Differences between eukaryotic and prokaryotic protein synthesis, Stem cells and their applications.

Module-3 **5 Hours**

Bioinspired Engineering based on human physiology: Circulatory system (artificial heart, pacemaker, stents), Nervous system (Artificial neural network), Respiratory system, sensory system (electronic nose, electronic tongue), Visual and auditory prosthesis (Bionic eye and cochlear implant).

Module-4 **5 Hours**

Relevance of Biology as an interdisciplinary approach: Biological observation that led to major discoveries, Echolocation (ultrasonography, sonars), Photosynthesis (photovoltaic cells, bionic leaf), Bird flying (aircraft), Lotus leaf effect (Super hydrophobic and self-cleaning surfaces), Plant burrs (Velcro).

Module-5 **5 Hours**

Bioinspired Algorithms and Applications: Genetic algorithm, Gene expression modelling, Parallel Genetic Programming: Methodology, History, and Application to Real-Life Problems, Dynamic Updating DNA Computing Algorithms, Bee-Hive: New Ideas for Developing Routing Algorithms Inspired by Honey Bee Behaviour.

Course Outcomes: At the end of the course the student will be able to:	
22BFE37.1	Discuss how the cell forms the basic building block of life
22BFE37.2	Distinguish between transcription and translation
22BFE37.3	Describe the role played by proteins within the cell
22BFE37.4	Analyze the role of bioinspired design in novel applications
22BFE37.5	Apply bioinspired design principles to other domains
22BFE37.6	Implement a simple genetic algorithm

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Text Books				
1	Biology for Engineers	Thyagarajan.S., Selvamurugan. N., Rajesh.MP, Nazeer RA, Richard W. Thilagaraj, Barathi.S., and Jaganthan.M.K	Tata McGraw Hill	2012
2	Molecular Biology	Robert Weaver	McGraw-Hill	5th Edition, 2012
Reference books				
1	Lewin's Genes XII	Jocelyn E. Krebs, Elliott S. Goldstein, Stephen T. Kilpatrick	Jones and Bartlett Learning	2017
2	Bioinspired Engineering	Jenkins, C.H.	Momentum Press	2012
3	Bio mimetics: Nature-Based Innovation	Yoseph Bar-Cohen	CRC Press	1st Edition, 2016
4	A Practical Guide to Bio-inspired Design	Hashemi Farzaneh, Helena, Lindemann, Udo	Springer	2019

Web links/Video Lectures/MOOCs

1. https://books.google.co.in/books?id=-2LNBQAAQBAJ&printsec=frontcover#v=onepage&q&f=false
2. https://www.aminotes.com/2017/02/biology-for-engineers-module-1-cocepts.html

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22BFE37.1	2					1								
22BFE37.2		1				1								
22BFE37.3	2					2								
22BFE37.4		2										2		
22BFE37.5	2											2		
22BFE37.6		2										2		

1: Low 2: Medium 3: High

IOT ENABLED PROTOTYPING			
Course Code:	**22IEP38**	CIE Marks	50
Teaching Hours/Week (L:T:P)	(0:0:2)	SEE Marks	50
Credits	**01**	Exam Hours	02

Course Learning Objectives:

1. Understand the IoT concepts such as sensing, actuation, and communication.
2. Development of Internet of Things (IoT) prototypes—including devices for sensing, actuation, processing, and communication and Protocols
3. Understand the significance of Project Management and the different techniques of planning
4. To introduce fundamental aspects of intellectual property rights, Govt. policies on IPR, and patentability search techniques.

Module 1

Internet of Things – Hardware / System Design

Introduction to IoT fundamentals, Introduction to sensors, Difference between analog and Digital sensors, Interfacing Temperature, Light and Humidity sensor with Arduino, Interfacing Motors with Arduino, A simple program to control actuator based on the analog sensor. **6 Hours**

Module 2

Internet of Things

Networking in IoT:

Introduction to wireless communication, Wifi Module ESP8266 interface with Arduino, Machine to Machine (M2M) communication using WiFi module. A simple demonstration of sensing temperature from one device and control actuator on a second device (M2M)

IoT in Web/ Cloud Platform:

Introduction to a web server - XAMPP(windows), A simple interactive web page using HTML5, Bootstrap (or CSS), and Javascript. Interfacing ESP8266 with webserver, ThingSpeak API, and MQTT protocol, A simple project to demonstrate the status of two IoT devices communicating with a Web Server. **6 Hours**

Module 3

Project Planning and Management

Project initiation, Project charter, Project planning, and implementation, Scheduling and costing, Project monitoring and control, Project closure and reports.

6 Hours

Module 4

Intellectual Property Rights

Introduction and the need for intellectual property right (IPR) – Kinds of Intellectual Property Rights, Elements of Patentability: Novelty, Non-Obviousness (Inventive Steps), Industrial Application, Non - Patentable Subject Matter, Registration Procedure, Patentability search methods, Patent landscape, Freedom-to-market, National IPR Policy, Govt. initiatives and scheme in promoting IPR. **6 Hours**

Course Project

Develop IoT-based prototypes (solutions) to solve any industrial or societal problems. The prototype building is teamwork of 3-5 students. The goals should be clearly defined and should use robust technologies and rigorous testing. **6 Hours**

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

22IEP38.1	Analyze the basics of IoT and protocols.
22IEP38.2	Develop IoT-based prototypes to solve industrial and societal problems.
22IEP38.3	Apply appropriate approaches to plan a new project and develop a project schedule.

22IEP38.4	Discuss the ethical aspects in IPR, Govt. policies on IPR, and conducting patentability searches.
22IEP38.5	Inculcate the teamwork and communication skills.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Reference Books				
1	Internet of Things (A Hands-on-Approach)	Vijay Madisetti and Arshdeep Bahga	Orient Blackswan Private Limited	1st Edition, 2015
2	Fundamentals of Intellectual Property	Dr. Kalyan C. Kankanala	Asia Law House	1st Edition, 2012
3	Project Management Absolute Beginner's Guide	Greg Horine	Pearson Education (US)	4th Edition, 2017

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22IEP38.1			**2**		**2**				**2**	**2**				
22IEP38.2			**2**								**3**			
22IEP38.3					**2**						**2**			
22IEP38.4								**1**		**2**				
22IEP38.5								**1**	**2**	**2**				

1: Low 2: Medium 3: High

Industry Oriented Training - Business Etiquettes			
Course Code	**22ITB39A**	CIE Marks	50
Teaching Hours/Week (L:T:P)	(0:0:2)	SEE Marks	-
Credits	-	Exam Hours	02

Course Learning Objectives:

6. Know the components of self-introduction
7. Develop a resume with the inclusion of core competencies
8. Involve and contribute to group discussions
9. Develop effective communication to succeed in the professional career
10. Know the etiquettes of digital communication

Module-1

Self-Introduction &Essentials of grooming

Self-Introduction: Learn the secret to introducing Yourself, Things to avoid when introducing yourself. Activity: Video record the self-introduction. **Essentials of grooming:** Creating the first impression, what does the well-dressed man wear? What does the well-dressed woman wear? Personal hygiene and habits. **4 Hours**

Module-2

Resume Writing

Purpose, Identifying Relevant Competencies, Understanding Applicant Tracking Systems, Lists of Competencies, Writing Accomplishment/ Objective Statements, Finding the Right Words- Action verbs, The Most Popular Resume Format, Other Popular Resume Formats, Do's and Don'ts. Activity: Students have to submit a copy of their resume. **4 Hours**

Module-3

Group Discussion

Types, process, Evaluation criteria, Do's and Don'ts Activity: Group discussions have to be held during the training sessions. **4 Hours**

Module-4

Communicate effectively

Build a Story, Just a Minute, Group Activities, Team building activities, Role Play, Presentation Skills. **4 Hours**

Module-5

Digital right and wrong

Virtual Communication: Agenda, being prepared, Dressing appropriately, background, Use Microphone and camera the right way, restraining from off tasks during virtual meetings, protecting confidential data during online presentations, time management. **4 Hours**

Course Outcomes: At the end of the course the student will be able to:	
22ITB39A.1	Articulate the essential components required for self-introduction in any business or a networking event and also recognize the need to dress appropriately for a successful career in the corporate
22ITB39A.2	Develop a resume inclusive of core competencies, and action verbs which are compatible with Applicant Tracking Systems
22ITB39A.3	Demonstrate the types, process and evaluation process of Group Discussion and carry out effective group discussions
22ITB39A.4	Develop skills required for effective communication
22ITB39A.5	Associate and be accustomed to the etiquette to be followed during online meetings

Sources

1. English for Common Interactions in the Workplace: Basic Level: Coursera: https://www.coursera.org/learn/english-common-interactions-workplace-basic-level
2. Personal Communication-Introduce Yourself With Confidence: https://www.udemy.com/course/how-to-introduce-yourself/
3. Professionalism, Grooming and Etiquette: https://www.edx.org/course/professionalism-grooming-and-etiquette
4. How to Write a Resume: https://www.coursera.org/learn/how-to-write-a-resume#syllabus
5. Group Discussion Strategies: https://www.udemy.com/course/group-discussion-strategies/
6. Communication Strategies for a Virtual Age: https://www.coursera.org/learn/communication-strategies-virtual-age#syllabus

References

1. https://simplifytraining.com/course/personal-hygiene-and-good-grooming/
2. https://www.udemy.com/course/group-discussion-strategies/
3. https://www.educba.com/course/group-discussion/
4. https://getrafiki.ai/meetings/rules-of-virtual-meeting-etiquette-every-sales-professional-should-follow/
5. https://thedigitalworkplace.com/articles/online-meeting-etiquette-for-attendees/
6. https://rigorousthemes.com/blog/virtual-meeting-etiquette-guidelines-ground-rules/

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22ITB39A.1									2	3		1		
22ITB39A.2										3		1		
22ITB39A.3									2	3	1	1		
22ITB39A.4									2	3	1	1		
22ITB39A.5									2	3	1	1		

1: Low 2: Medium 3: High

Industry Oriented Training - Computing Skills			
Course Code	**22ITC39B**	CIE Marks	50
Teaching Hours/Week (L:T:P)	(0:0:2)	SEE Marks	-
Credits	-	Exam Hours	02

Course Learning Objectives:

1. Use logical conditions for problem-solving and also introduce the concepts of arrays
2. Know functions, function calls, and parameter passing
3. Introduce algorithms and appreciate their importance in problem-solving
4. Introduce the core concepts of OOP's
5. Differentiate between front-end & back-end development and recognize the use of database management

Module-1

Introduction to computing constructs

Logical conditions: For Loops, Nested For Loops, While Loops, Do-While Loops, Nesting and Boxes, and combine/negate several logical conditions using logic operations AND, OR, and NOT.

Arrays & strings: Create arrays of characters (strings), use the null terminator, and manipulate strings. **4 Hours**

Module-2

Functions & Pointers

Introduction to Functions, Returning Data From a Function, Passing Data Into a Function, Getting Valid User Input, Changing Parameter Values, Pointer Basics, Changing the Pointed to Value, Walking an Array with Pointers, Dynamic Memory Allocation, Getting More Memory, Pointers to Structure. **4 Hours**

Module-3

Algorithm analysis

Introduction to Algorithm Analysis, Big-O, Big-O Examples, Dynamic Array Operations, Bubble Sort, Selection Sort, Insertion Sort, Recursion, Recursive Binary Search, Merge Sort. **4 Hours**

Module-4

Object-oriented programming

Designing for Object-Oriented Programming, Core Concepts of OO Programming: Classes and objects, data abstraction, encapsulation, inheritance, benefits of inheritance, polymorphism, procedural and object-oriented programming paradigm. **4 Hours**

Module-5

Frontend and backend development

UI, Database management: DBMS overview, Relational Data Model and the CREATE TABLE Statement, Basic Query Formulation with SQL. **4 Hours**

Course Outcomes: At the end of the course the student will be able to:	
22ITC39B.1	Illustrate the use of logical conditions, declare and manipulate data into arrays
22ITC39B.2	Implement functions, function calls, and parameter passing
22ITC39B.3	Design, implement, and evaluate an algorithm to meet desired needs
22ITC39B.4	Describe the core concepts of OOP's
22ITC39B.5	Recognize the concepts of front-end development and database management

Sources
1. Computational Thinking with Beginning C Programming Specialization: https://www.coursera.org/learn/simulation-algorithm-analysis-pointers?specialization=computational-thinking-c-programming#syllabus 2. Simulation, Algorithm Analysis, and Pointers: https://www.coursera.org/lecture/simulation-algorithm-analysis-pointers/big-o-examples-pdCan 3. Programming Fundamentals: https://www.coursera.org/learn/programming-fundamentals?specialization=c-programming#syllabus 4. Object-Oriented Programming Concepts: https://www.coursera.org/learn/concepts-of-object-oriented-programming#syllabus 5. Introduction to Back-End Development: https://www.coursera.org/learn/introduction-to-back-end-development

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22ITC39B.1	2	1	1											
22ITC39B.2	2	1	1											
22ITC39B.3	1	1	2											
22ITC39B.4	2		1											
22ITC39B.5	2	1	1											

1: Low 2: Medium 3: High

IV Semester

Applied Thermodynamics			
Course Code:	**22MEC41**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	2:2:0	SEE	3 Hours
Total Hours	40 hours Theory	Credits	03

Course Learning Objectives: The objective of the course is to

- Understand the applications of the first and second laws of Thermodynamics to various gas processes and cycles.
- Understand the fundamentals of I. C. Engines, Construction and working Principle of an Engine and Compare Actual, Fuel-Air and Air standard cycle Performance.
- Study Combustion in SI and CI engines and the concepts of testing of I C. Engines
- Understand the concepts related to Refrigeration and Air conditioning.
- Get conversant with Psychometric Charts, Psychometric processes, human comfort conditions and load calculations.

Module-1 IC Engines (8 Hours)

Performance analysis of IC Engines: Combustion of SI engine and CI engine, Detonation and factors affecting detonation, , Effect of compression ratio, injection pressure and injection timing, Heat balance, Morse test, Simple numerical. IC Engine fuels, Ratings and Alternate Fuels, Air pollution due to vehicles.

EVs and HEVs: Introduction to Electric vehicles and Hybrid vehicles. Working Principle.

Module-2 Power Cycles -I (8 Hours)

Air standard cycles: Carnot, Otto, Diesel, Dual cycles, p-v and T -s diagrams, description, efficiencies and mean effective pressures. Comparison of Otto and Diesel cycles. Numerical problems

Gas power Cycles: Gas turbine (Brayton) cycle; description and analysis. Regenerative gas turbine cycle. Inter-cooling and reheating in gas turbine cycles. Introduction to Jet Propulsion cycles. Numerical.

Module-3 Power Cycles -II (8 Hours)

Vapour Power Cycles: Carnot vapour power cycle, drawbacks as a reference cycle. Simple Rankine cycle; description, analysis for performance. Comparison of Carnot and Rankine cycles. Effects of pressure and temperature on Rankine cycle performance. Actual vapour power cycles. Ideal and practical regenerative Rankine cycles, open and closed feed water heaters. Reheat Rankine cycle. Numerical.

Module-4 Refrigeration Cycles (8 Hours)

Refrigeration Cycles: Air cycle refrigeration; reversed Carnot cycle, reversed Brayton cycle. Vapour compression refrigeration system; description and performance analysis, Numerical.

Refrigerants: Nomenclature, desirable properties, effects of Freon's on environment, alternate Refrigerants.

Module-5 Psychometrics and Air-conditioning Systems (8 Hours)

Psychometrics and Air-conditioning Systems: Psychometric properties of Air, Psychometric Chart, Analyzing Air-conditioning Processes; Heating, Cooling, Dehumidification and Humidification, Evaporative Cooling. Adiabatic mixing of two moist airstreams. Numerical using Psychometric Chart. Load Calculations.

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

22MEC41.1	Apply thermodynamic concepts to analyze the performance of air standard power cycles.
22MEC41.2	Apply thermodynamic concepts to analyze the performance of gas power cycles.

22MEC41.3	Analyze the performance of I C engines.
22MEC41.4	Apply thermodynamic concepts to analyze the performance of vapour power cycles.
22MEC41.5	Apply Thermodynamic concepts to determine performance parameters of refrigeration.
22MEC41.6	Analyse various psychrometric properties of air and calculation of load for various purposes.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Thermodynamics engineering approach	Yunus A. Cenegal and Michael A. Boles	Tata McGraw Hill Publication	6, 2008
2	Basic and Applied Thermodynamics	P.K. Nag	Tata McGraw Hill	2,2009
3	Fundamentals of Thermodynamics	G.J. Van Wylen and R.E. Sonntag	Wiley Eastern	4, 1993
Reference Books				
1	Principles of Engineering Thermodynamics	Michael J,Moran, Howard N. Shapiro, Wiley	Wiley	9, 2018
2	Thermodynamics	Radhakrishnan	Prentice Hall India	2,2018
3	I.C Engines	Ganeshan.V	Tata McGraw Hill	4,2012
Web links/Video Lectures/MOOCs 1. https://nptel.ac.in/courses/112/103/112103275/ -IIT Guwahati. 2. https://legacy.saylor.org/me103/Unit06/ - For Module 1, 2 and 3.				

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22MEC41.1	-	3	-	-	-	-	-	-	-	-	-	-	2	-
22MEC41.2	-	3	-	-	-	-	-	-	-	-	-	-	2	-
22MEC41.3	-	3	-	-	-	-	-	-	-	-	-	3	-	2
22MEC41.4	-	3	-	-	-	-	-	-	-	-	-	-	2	-
22MEC41.5	-	3	-	-	-	-	-	-	-	-	-	2	-	-
22MEC41.6	-	2	-	-	-	-	-	-	-	-	-	3	-	2

1: Low 2: Medium 3: High

Machining Science and Metrology			
Course Code	**22MEC42**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:2	SEE	3 Hours
Total Hours	40 hours Theory + 10 Lab slots	Credits	04

Course Learning Objectives: The objective of the course is to

- Calculate the values of various forces involved in the machining operations and study the factors affecting the surface finish.
- Enumerate various types of lathes, drilling, shaping, milling, grinding and CNC machines along with various operations involved in it.
- Select the appropriate machining process depending on the geometry of the component required.
- Comprehend appropriate jigs and fixtures for various machining processes..

Module-1 Machining Processes and Machine Tools (8 Hours)

Introduction to Machining Processes and Machine Tools: Subtractive manufacturing processes and classifications.

Construction, specification operations of machine tools: Lathe, Shaping, Milling, Drilling, Grinding Machine. Introduction to CNC machines: CNC Lathe, Milling, Drilling, Machining Centre.

Module-2 Mechanics of Metal Cutting (8 hours)

Mechanics of Metal Cutting: Single point turning tool geometry (SPTT) influences the chip formation mechanisms of the Orthogonal and Oblique cutting process.

Cutting Force Analysis (Orthogonal Cutting): Analysis of machining forces and power requirement, 'Merchant's model of Orthogonal Cutting and Theory of Lee & Shaffer' Chip Velocity, Velocity relationships (simple numerical); the influence of cutting temperature on machinability.

Cutting Fluids: Characteristics of Cutting fluids, Selections, and applying methods of cutting fluids.

Module-3 Machinability and Tool Life (8 hours)

Machinability and Tool Life: Process of cutting tool failure wears and time relationship, tool wear index, feed marks, the effect of tool wear on the machined surface, surface finish, machinability, machinability index/rating, tool life & variables affecting tool life, tool materials.

Finishing Process: Importance of surface finishing processes, Grinding, Abrasive Flow Machining, Honing. Sanding, Abrasive blasting, Polishing, Lapping.

Surface Finishing and Protection: Powder Coating, Liquid Coating, Electroplating, Galvanizing, Anodizing

Module-4 Advanced Machining Process (8 hours)

Advanced Machining Process; Importance and classification of advanced machining process; Process principle, process parameters, and application of: - Abrasive Jet Machining (AJW), Water Jet Machining (WJM), Abrasive Water Jet Machining (AWJM); Ultrasonic Machining (USM); Electrical Discharge Machining (EDM); Wire Electrical Discharge Machining (WEDM); Electro Chemical Machining (ECM). Laser Beam Machining (LBM), Electron Beam Machining (EBM), and Plasma Arc Machining (PAM).

Hybrid Machining Process: Importance of hybrid machining process; Process principal, process parameters, and application of: - Electrochemical Discharge Machining (ECDM), Ultrasonic Assisted Electric Discharge Machining (UAEDM), Electrochemical Discharge Grinding (EDG), Powder Assisted Electric Discharge Machining (PAEDM).

Module-5 Jigs and Fixtures(8 hours)

Jigs and Fixtures: Importance of jigs and fixtures; the difference between jigs and fixtures; types of jigs and fixtures; essential features of jigs and fixtures, Materials used. Factors to be

considered for the design of Jigs and Fixtures.
Jigs: Template, Plate, Channel, Diameter, Leaf, Rung, Box.
Fixtures: Turning, Milling, Broaching, Grinding, Boring, Indexing, Tapping, Duplex, Welding, and Assembly fixtures

PRACTICAL MODULE

1. One Job on Lathe machine with simple operations (turning, facing, Thread cutting and tapering) on low carbon steel and/or heat-treated low carbon steel, and Demonstration of tungsten carbide cutting tool inserts.
2.Operations and One Job each on shaping/milling machine
3. Simple operations and One Job on the drilling and grinding machine.
4. Cutting force measurement with dynamometers (Demonstration) for turning, drilling, and grinding operations.

Course Outcomes: At the end of the course the student will be able to:	
22MEC42.1	Discuss the Conventional CNC machines operations.
22MEC42.2	Demonstrate the advanced manufacturing process operations.
22MEC42.3	Determine tool life, cutting force, and economy of the machining process.
22MEC42.4	Analyse the influence of various parameters on machine tools' performance.
22MEC42.5	Select the appropriate machine tools and processes for various applications.
22MEC42.6	Select the appropriate Jigs and fixtures for various applications.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Metal Cutting Principles	Shaw, M C	Oxford University Press	2016
2	Advanced Methods of Machining	McGeough, J A	Springer	2011
3	Fundamentals of Machining and Machine Tools	Boothroyd, G., and Knight, W. A.	Taylor and Francis	2011
4	Machining and Machine Tools	Chattopadhyay, A B	Wiley India	2013
Reference Books				
1	Fundamentals of Modern Manufacturing: Materials, Processes, and Systems	Mikell P. Groover	Wiley Publications	2019
2	Manufacturing Technology II	Rao P. N.	Tata McGraw Hill	2002

Web links and Video Lectures (e-Resources):

- V. K. Jain, Advanced Machining Processes, NPTEL Course Department of Mechanical Engineering, IIT Kanpur, Link: http://nptel.ac.in/courses/112104028/.
- U. S. Dixit, Mechanics of Machining, NPTEL Course Department of Mechanical Engineering Guwahati, Link: http://nptel.ac.in/courses/112103248/.
- A. B. Chattopadhyay, Manufacturing Processes II, NPTEL Course of Department of Mechanical Engineering, IIT Kharagpur, https://nptel.ac.in/courses/112/105/112105126/

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22MEC42.1	3	-	-	-	3	-	-	-	-	-	-	-	2	2
22MEC42.2	3	-	-	-	3	-	-	-	-	-	-	2	2	2
22MEC42.3	-	-	3	-	2	-	-	-	-	-	-	-	-	-
22MEC42.4	-	-	3	-	-	-	-	-	-	-	-	3	-	-
22MEC42.5	-	-	-	-	-	2	-	-	-	-	2	-	2	-
22MEC42.6	-	-	-	-	-	2	-	-	-	-	2	-	2	-

1: Low 2: Medium 3: High

Fluid Mechanics			
Course Code	**22MEC43**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	2:2:2	SEE	3 Hours
Total Hours	40 hours Theory + 10 Lab slots	Credits	04

Course Learning Objectives: The objective of the course is to

- To understand the basic properties of fluids and understand the continuum approximation.
- To calculate the forces exerted by a fluid at rest on submerged surfaces and understand the force of buoyancy.
- To understand the flow characteristic and dynamics of the flow field for various engineering applications.
- To know how velocity changes and energy transfers in fluid flows are related to forces and torques and to understand why designing for minimum loss of energy in fluid flows is so important.
- To discuss laminar and turbulent flow and appreciate their differences and the concept of boundary layer theory.
- To understand the concept of dynamic similarity and how to apply it to experimental modelling.

Module-1 Introduction, Fluid Statics (8 hours)

Introduction: Fluid Properties, Types of fluids, Fluid Pressure, and its Measurements: Concept of continuum, Newton's law of viscosity, Pascal's law, hydrostatic Law, manometer (simple, differential, inverted and inclined manometers), numerical.

Fluid Statics: Hydrostatic Forces on a horizontal plane, vertical plane, and inclined plane submerged in static fluid, Buoyancy, floatation and stability, numerical

Module-2 Fluid Kinematics and Dynamics (8 hours)

Fluid Kinematics and Dynamics: Types of flows, Eulerian representation, Continuity equation in 3D (Cartesian coordinate only), velocity and acceleration fields, streamlines, streak lines, timeline and path lines, material derivative, linear motion and deformation, angular deformation, vorticity, Laplace's equation in velocity potential and Poisson's equation in stream function, flow net, numerical. Newton's second law along a streamline and normal to streamline, Euler equation of motion andreduction to Bernoulli equation, Navier Stokes equation, numerical.

Module-3 Laminar and Turbulent Flow (8 hours)

Flow-through circular pipe, between parallel plates, Power absorbed in viscous flow in bearings, Poiseuille equation – velocity profile loss of head due to friction in viscous flow. Reynolds's experiment, frictional loss in pipe flow.

Introduction to turbulence, characteristics of turbulent flow, laminar-turbulent transition major and minor losses. Hagen Poiseuille equation, numerical

Module-4 Dimensional Analysis, Flow Over Bodies (8 hours)

Dimensional analysis: Introduction, derived quantities, dimensions of physical quantities, dimensional homogeneity, Rayleigh's method, Buckingham Pi-theorem, dimensionless numbers and their significance, similitude, types of similitude, Unit and specific quantities, model studies and its numerical.

Flow over bodies: Development of boundary layer, Lift and Drag, Flow around circular cylinders, spheres, aerofoils and flat plates, Streamlined and bluff bodies, boundary layer separation and its control

Module-5 Compressible Flows, CFD (8 hours)

Compressible Flows: Introduction, thermodynamic relations of perfect gases, internal energy and enthalpy, speed of sound, pressure field due to a moving source, basic Equations for one-dimensional flow, stagnation and sonic properties, normal and oblique shocks.

CFD: Introduction, necessity, limitations, the philosophy behind CFD, applications. .

PRACTICALMODULE

1. Determine the viscosity of oil using Red wood viscometer and Say-bolt viscometer.
2. Measurement of pressure using different Manometers for high and low pressure measurements (manometers using different monomeric fluids).
3.Working principle of different flow meters and their calibration (orifice plate, venture meter, Rota meter)
4.Working principle of different flow meters for open channel and their calibration
5.Determination of head loss in pipes and pipe fittings having different diameters, different materials and different roughness
6.Reynolds apparatus to measure critical Reynolds number for pipe flows
7.Effect of change in cross section and application of the Bernoulli equation
8.Impact of jet on flat and curved plates

Course Outcomes: At the end of the course the student will be able to:	
22MEC43.1	Describe the key fluid properties used in the analysis of fluid behaviour.
22MEC43.2	Apply the principles of pressure, buoyancy, and floatation to solve numerical problems.
22MEC43.3	Apply the knowledge of fluid statics, kinematics and dynamics while addressing problems of engineering applications.
22MEC43.4	Examine the principles of dimensional analysis to study fluid flow problems
22MEC43.5	Evaluate the basic concept of compressible flow problems using CFD software.
22MEC43.6	Measure various properties of fluid with the help of experimental investigation in the laboratory.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Fundamentals of Fluid Mechanics	Munson, Young, Okiishi, Huebsch	Wiley publications	7, 2017
2	Fluid Mechanics-Fundamentals & Applications	Yunus A Cengel and John A Cimbala	Tata McGraw Hill.	4, 2019
Reference Books				
1	A textbook of Fluid Mechanics and Hydraulic Machines	Dr. R K Bansal	Laxmi Publications (P) Ltd	10, 2019
2	Fluid Mechanics, Hydraulics and Fluid Machines	S Ramamrutham	Dhanpat Rai Publications.	9,2014
3	Introduction to Fluid Mechanics	Fox and MacDonald	Wiley India.	9, 2015

Web links and Video Lectures (e-Resources):

- https://. http://nptel.ac.in/courses/112104118/
- http://www.mooc-list.com/course/fluid-mechanics-saylororg
- https://legacy.saylor.org/me201/Unit01/

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22MEC43.1	-	3	-	-	-	-	-	-	2	2	-	-	2	-
22MEC43.2	-	3	2	-	-	-	-	-	-	-	-	-	-	-
22MEC43.3	-	-	3	-	2	-	-	-	-	-	-	-	3	-
22MEC43.4	-	-	3	-	-	-	-	-	-	-	-	2	-	-
22MEC43.5	-	-	-	1	3	-	-	-	-	-	-	-	-	3
22MEC43.6	-	-	-	3	-	--	-	-	2	2	-	2	-	2

1: Low 2: Medium 3: High

Kinematics of Machines			
Course Code	**22MEC44**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 hours Theory	Credits	03

Course Learning Objectives: The objective of the course is to

- Gain knowledge on the concepts of machines, mechanisms, and related terminologies.
- Comprehend various mechanisms and motion transmission elements used in Mechanical Engineering.
- Analyze mechanisms for displacement, velocity, and acceleration at any point in a moving link.
- Understand the theory of cams, gears, and gear trains.

Module-1 Introduction & Mechanisms (8 hours)

Introduction: Definitions: Link, kinematic pairs, kinematic chain, mechanism, structure, degrees of freedom, Classification links, Classification of pairs based on type of relative motion, Grubler's criterion, mobility of mechanism, Grashoff's criteria, inversions of Grashoff's chain.
Mechanisms: Quick return motion mechanisms-Drag link mechanism, Whitworth mechanism and Crank and slotted lever Mechanism. Straight line motion mechanisms, Peaucellier's mechanism and Robert's mechanism. Intermittent Motion mechanisms: Geneva wheel mechanism, Ratchet and Pawl mechanism, toggle mechanism, pantograph.

Module-2 Velocity and Acceleration Analysis of Mechanisms (8 hours)

Velocity and Acceleration Analysis of Mechanisms (Graphical Method): Velocity and acceleration analysis of four bar mechanism, slider crank mechanism. Mechanism illustrating Coriolis's component of acceleration. Angular velocity and angular acceleration of links. **Velocity Analysis by Instantaneous Center Method**: Definition, Kennedy's theorem, Determination of linear and angular velocity using instantaneous center method.

Module-3 Analytical Method (8 hours)

Velocity and Acceleration Analysis of Mechanisms (Analytical Method): Velocity and acceleration analysis of four bar mechanism, slider crank mechanism using complex algebra method. Freudenstein's equation for four bar mechanism and slider crank mechanism. Function Generation for four bar mechanism.

Module-4 Cams (8 hours)

Cams: Types of cams, types of followers. displacement, velocity and acceleration curves for uniform velocity, Simple Harmonic Motion, Uniform Acceleration, Retardation and Cycloidal motion. Cam profiles: disc cam with reciprocating followers such as knife-edge, roller and flat-face followers, inline and offset.

Module-5 Gears (8 hours)

Spur Gears: Gear terminology, law of gearing, path of contact, arc of contact, contact ratio of spur gear. Interference in involute gears, methods of avoiding interference, condition and expressions for minimum number of teeth to avoid interference.
Gear Trains: Simple gear trains, compound gear trains. Epicyclic gear trains: Tabular methods of finding velocity ratio of epicyclic gear trains, torque calculation in epicyclic gear trains.

Course Outcomes: At the end of the course the student will be able to:	
22MEC44.1	Understand the principles of kinematic pairs, chains, Degree of freedom,, inversions, equivalent chains and planar mechanisms
22MEC44.2	Comprehend various mechanisms and motion transmission elements used in mechanisms of machines.
22MEC44.3	Analyze the velocity, acceleration of links and joints in four bar and slider crank mechanisms.

22MEC44.4	Synthesize and construct cam profile - follower motion for the uniform velocity, Simple Harmonic Motion, Uniform Acceleration, Retardation and Cycloidal motion specifications.
22MEC44.5	Estimate various profile-parameters in gears and demonstrate the working of the spur gears.
22MEC44.6	Identify and analyze the gear trains and calculate power & torque transmission in gear trains.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Theory of Machines Kinematics and Dynamics	Sadhu Singh	Pearson	3, 2019
2	Mechanism and Machine Theory	G. Ambekar	Prentice Hall India	2009
3	Theory of Machines	Rattan S. S	Tata McGraw-Hill	2014
Reference Books				
1	Mechanisms and Machines Kinematics, Dynamics, and Synthesis	Michael M Stanisic	Cengage Learning	2016
2	Theory of Machines	V. P. Singh	Dhanpat Rai	5, 2017
3	Theory of Machines and Mechanisms	P.L.Ballaney	Khanna Publications	2003

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/112105268/
- http://nptel.ac.in/courses/112104121/6
- http://nptel.ac.in/courses/112104121/1

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22MEC44.1	2	-	-	-	-	-	-	-	-	-	-	-	-	-
22MEC44.2	-	2	2	-	1	-	-	-	-	-	-	-	-	-
22MEC44.3	2	-	2	-	1	-	-	-	-	-	-	-	1	-
22MEC44.4	-	-	2	-	1	-	-	-	-	-	-	-	-	-
22MEC44.5	-	2	-	-	-	-	-	-	-	-	-	-	-	
22MEC44.6	1	-	2	-	-	-	-	-	-	-	-	-	-	-

1: Low 2: Medium 3: High

Non-Traditional Machining			
Course Code	**22MEC451**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 hours Theory	Credits	03

Course Learning Objectives: The objective of the course is to

- Learn various concepts related to modern machining processes & their applications.
- Appreciate the differences between conventional and non-conventional machining processes.
- Acquire a functional understanding of non-traditional manufacturing equipment.
- Know about various process parameters and their influence on performance and their applications.
- Impart knowledge on various types of energy involved in non-traditional machining processes.

Module-1 Introduction to Non-traditional Machining (8 hours)

Introduction to Non-traditional machining: Need for Non-traditional machining process, Comparison between traditional and non-traditional machining, general classification Non-traditional machining processes, classification based on nature of energy employed in machining, selection of non-traditional machining processes, Specific advantages, limitations and applications of non-traditional machining processes. Role of NTM processes in Bio-Medical applications, Intelligent methodology for optimal selection of NTM processes.

Module-2 USM & AJM (8 hours)

Ultrasonic Machining (USM): Introduction, Equipment and material process, Effect of process parameters: Effect of amplitude and frequency, Effect of abrasive grain diameter, effect of slurry, tool & work material. Process characteristics: Material removal rate, tool wear, accuracy, surface finish, applications, advantages & limitations of USM.

Abrasive Jet Machining (AJM): Introduction, Equipment and process of material removal, process variables: carrier gas, type of abrasive, work material, stand-off distance (SOD). Process Characteristics-Material removal rate, Nozzle wear, accuracy & surface finish. Applications, advantages & limitations of AJM. Water Jet Machining (WJM), Abrasive Water Jet Machining (AWJM), Sustainable AWJM, Ice Jet Machining (IJM).

Module-3 ECM &CHM (8 hours)

Electrochemical Machining (ECM): Introduction, Principle of electro chemical machining, ECM equipment, elements of ECM operation, Chemistry of ECM. ECM Process characteristics: Material removal rate, accuracy, surface finish. Process parameters: Current density, Tool feed rate, Gap between tool & work piece, velocity of electrolyte flow, type of electrolyte, its concentration, temperature, and choice of electrolytes. ECM Tooling: ECM tooling technique & example, Tool & insulation materials. Applications ECM: Electrochemical grinding and electrochemical honing process. Advantages, disadvantages and application of ECG, ECH. Hybrid ECM process.

Chemical Machining (CHM): Elements of the process, Resists (maskants), Etchants. Types of chemical machining process-chemical blanking process, chemical milling process. Process characteristics of CHM: material removal rate, accuracy, surface finish, advantages, limitations and applications of chemical machining process. Photo Chemical Milling Process.

Module-4 EDM & PAM (8 hours)

Electrical Discharge Machining (EDM): Introduction, mechanism of metal removal, EDM equipment: spark erosion generator (relaxation type), dielectric medium-its functions & desirable properties, electrode feed control system. Flushing types; pressure flushing, suction flushing, side flushing, pulsed flushing. EDM process parameters: Spark frequency, current & spark gap, surface finish, Heat Affected Zone. Advantages, limitations & applications of EDM, Electrical discharge grinding, Traveling wire EDM. Dry & Near Dry EDM, Green EDM, Hybrid EDM.

Plasma Arc Machining (PAM): Introduction, non-thermal generation of plasma, equipment

mechanism of metal removal, Plasma torch, process parameters, process characteristics. Safety precautions. Safety precautions, applications, advantages and limitations.
Module-5 LBM & EBM (8 hours)
LASER BEAM MACHINING (LBM): Introduction, generation of LASER, Equipment and mechanism of metal removal, LBM parameters and characteristics, Applications, Advantages & limitations. Eco LBM, Under water LBM processes. **ELECTRON BEAM MACHINING (EBM):** Introduction, Principle, equipment and mechanism of metal removal, applications, advantages and limitations. **Specific applications of EBM:** Electron Beam Welding, Types of EBW (Thermal EBW, Cold EBW & Resistance EBW).

Course Outcomes: At the end of the course the student will be able to:	
22MEC451.1	Compare various traditional and non-traditional machining processes and recognize the need for Non- traditional machining process.
22MEC451.2	Understand the constructional features, performance parameters, process characteristics, applications, advantages and limitations of USM, AJM and WJM.
22MEC451.3	Identify the need of Chemical and electro-chemical machining process along with the constructional features, process parameters, process characteristics, applications, advantages and limitations
22MEC451.4	Understand the constructional feature of the equipment, process parameters, process characteristics, applications, advantages and limitations EDM & PAM
22MEC451.5	Understand the LBM equipment, LBM parameters, and characteristics. EBM equipment and mechanism of metal removal, applications, advantages and limitations LBM & EBM
22MEC451.6	Assess the role of NTM processes in bio-medical applications and intelligent methodology for optimal selection of NTM processes

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Modern Machining Process	P.C Pandey & H S Shan	McGraw Hill Ed. India Pvt. Ltd.	2000
2	Production technology	HMT	McGraw Hill Ed. India Pvt. Ltd.	2001
Reference Books				
1	New Technology	Dr. A. Bhattacharyya	The IE (India)	2000
2	Modern Machining process	Aditya	-	2002
3	Non-Conventional Machining	P. K. Mishra & IE (I) Test book series	Narosa Publishing House	2005

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/112/105/112105212/
- https://www.classcentral.com/course/swayam-advanced-machining-processes-19791
- https://www.classcentral.com/course/swayam-non-traditional-abrasive-machining-processes-ultrasonic-abrasive-jet-and-abrasive-water-jet-machining-7962
- https://mooc.es/course/mechanics-of-machining/

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22MEC451.1	3	-	-	-	-	-	-	-	-	-	-	-	-	2
22MEC451.2	3	1	-	-	-	-	-	-	-	-	-	-	-	2
22MEC451.3	3	-	2	-	-	2	-	-	-	-	-	-	2	-
22MEC451.4	3	-	-	-	-	2	-	-	-	-	-	-	-	2
22MEC451.5	3	1	2	-	-	-	-	-	-	-	-	-	2	-
22MEC451.6	3	-	-	-	-	2	-	-	-	-	-	-	-	2

1: Low 2: Medium 3: High

Statistical Quality Control			
Course Code	**22MEC452**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 hours Theory	Credits	3

Course Learning Objectives: The objective of the course is to

- To apprehend the purpose and function of statistical quality control and its improvements.
- To acquire the Measures of Dispersion and central tendency.
- To prepare students on identifying and plotting control charts for chance variations.
- Demonstrate an understanding of key concepts of process capability & performance.
- To prepare students on identifying and plotting control charts for assignable variations.
- To acquire knowledge on acceptance sampling methods & its applications.

Module-1 Introduction (8 hours)

The Meaning of Quality and Quality Improvement; Brief History of Quality Methodology; Statistical Methods for Quality Control and Improvement; quality costs, legal aspects of quality implementing, quality improvement. Mean, Median, Mode, Standard deviation, calculating area, Normal distribution tables, Finding the Z score and Central limit theorem

Module-2 Methods and Philosophy of Statistical Process Control (8 hours)

Chance and assignable causes, Statistical Basis of the Control Charts, basic principles, choices of control limits, significance of control limits, sample size and sampling frequency, rational subgroups, analysis of pattern on control charts, warning limits, Average Run Length (ARL)

Module-3 Control Charts for Variables and Process Capability (8 hours)

Control Charts for X-Bar and R- Charts, Type I and Type II errors, the probability of Type II error. Simple Numerical Problems. The foundation of process capability, Natural Tolerance limits, Process capability index, Process performance index, summary of process measures. Numerical problems.

Module-4 Control Charts for Attributes (8 hours)

Binomial distribution, Poisson distribution (from the point of view of Quality control) Control Chart for Fraction Nonconforming, Control Chart for number Nonconforming, Control Charts for Nonconformities or Defects, Control Chart for Number of non- conformities per unit. Numerical problems.

Module-5 Lot-By-Lot Acceptance Sampling for Attributes (8 hours)

The acceptance sampling problem, single sampling plan for attributes, Double, Multiple, and Sequential sampling, AOQL, LTPD, OC curves, the Dodge-Romig sampling plans. Numerical problems.

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

22MEC452.1	Understand the concepts of quality management and apply central limit theorem to estimate population parameters from sample data.
22MEC452.2	Analyze and improve processes using statistical control charts and interpret patterns to identify assignable causes.
22MEC452.3	Use statistical process control and process capability analysis to identify opportunities for process improvement and implement changes to enhance process performance.
22MEC452.4	Understand and implement control charts, monitor and improve product/service quality, and interpret results.
22MEC452.5	Apply binomial and Poisson distributions to quality control, and solve numerical problems related to quality control.

22MEC452.6	Apply sampling plans, evaluate operating characteristics, and solve acceptance sampling problems.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Total Quality Management	Poornima M Charantimath	Pearson	4, 2022
2	Introduction to Statistical Quality Control	Douglas C Montogmery	John Wiley & Sons	8, 2019
Reference Books				
1	Fundamentals of Quality Control and Improvement	Amitava Mitra	John Wiley & Sons	5, 2021
2	Design and Analysis of Experiments	Douglas C Montogmery	John Wiley & Sons	10, 2019

Web links and Video Lectures (e-Resources):

- https://alison.com/course/understanding-cost-of-quality-and-tqm-tools-revised-2018
- https://www.classcentral.com/course/swayam-total-quality-management-i-17825
- https://onlinecourses.nptel.ac.in/noc20_mg34/preview
- https://archive.nptel.ac.in/courses/110/104/110104080/
- https://onlinecourses.nptel.ac.in/noc21_mg24/preview
- https://www.udemy.com/course/statistical-quality-control-sqc/

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22MEC452.1	-	-	-	-	-	2	-	-	-	-	-	-	1	1
22MEC452.2	-	-	-	-	-	1	-	-	-	-	1	-	1	-
22MEC452.3	-	-	-	-	-	2	-	-	-	-	2	-	1	-
22MEC452.4	-	-	-	-	-	2	-	2	-	-	-	-	-	-
22MEC452.5	-	-	-	-	-	1	-	-	-	-	2	-	-	-
22MEC452.6	-	-	-	-	-	2	-	2	-	-	-	-	-	2

1: Low 2: Medium 3: High

MICRO ELECTRO MECHANICAL SYSTEMS			
Course Code	**22MEC453**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 Hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Provide knowledge of semiconductors and solid mechanics to fabricate MEMS devices.
- Educate on the rudiments of Micro fabrication techniques.
- Introduce various sensors and actuators.
- Introduce different materials used for MEMS.
- Educate on the applications of MEMS to disciplines beyond Electrical and mechanical engineering.

Module-1 Introduction (8 Hours)

Intrinsic Characteristics of MEMS, Energy Domains and Transducers, Sensors and Actuators, Introduction to Micro fabrication, Silicon based MEMS processes, New Materials, Review of Electrical and Mechanical concepts in MEMS, Semiconductor devices, Stress and strain analysis, Flexural beam bending, Torsional deflection.

Module-2 Sensors and Actuators-I (8 hours)

Electrostatic sensors, Parallel plate capacitors, Applications , Interdigitated Finger capacitor, Comb drive devices, Micro Grippers , Micro Motors , Thermal Sensing and Actuation, Thermal expansion, Thermal couples, Thermal resistors, Thermal Bimorph, Applications, Magnetic Actuators, Micro magnetic components, Case studies of MEMS in magnetic actuators, Actuation using Shape Memory Alloys.

Module-3 Sensors and Actuators-II (8 hours)

Piezo resistive sensors, Piezo resistive sensor materials, Stress analysis of mechanical elements, Applications to Inertia, Pressure, Tactile and Flow sensors, Piezoelectric sensors and actuators, piezoelectric effects, piezoelectric materials, Applications to Inertia , Acoustic, Tactile and Flow sensors.

Module-4 Micromachining (8 hours)

Silicon Anisotropic Etching, Anisotropic Wet Etching, Dry Etching of Silicon, Plasma Etching, Deep Reactive Ion Etching (DRIE), Isotropic Wet Etching, Gas Phase Etchants, Case studies, Basic surface micromachining processes, Structural and Sacrificial Materials, Acceleration of sacrificial Etch, Striction and Antistriction methods, LIGA Process, Assembly of 3D MEMS, Foundry process.

Module-5 Polymer and Optical Mems (8 hours)

Polymers in MEMS, Polimide, Liquid Crystal Polymer (LCP), PDMS, PMMA, Parylene, Fluorocarbon, Application to Acceleration, Pressure, Flow and Tactile sensors, Optical MEMS – Lenses and Mirrors, Actuators for Active Optical MEMS.

Course Outcomes: At the end of the course the student will be able to:	
22MEC453.1	Select the right sensor for a given application.
22MEC453.2	Design basic circuit building blocks.
22MEC453.3	Analyze the MEMS devices and develop suitable mathematical models.
22MEC453.4	Simulate, synthesize, and layout a complete sensor or sensor system

22MEC453.5	Design MEMS device or microsystem ready for fabrication tools.
22MEC453.6	Analyze the applications and properties of polymers in MEMS

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	MEMS and Micro systems: Design, Manufacture and Nanoscale Engineering	Tai-Ran Hsu	Wiley	2, 2008
2	Microelectromechanical Systems (MEMS)	Dilip Kumar Bhattacharya, Brajesh Kumar Kaushik	Cengage Learning.	1, 2015
Reference Books				
1	Fundamentals of Microfabrication	Marc J Madou	CRC Press	2, 2002
2	Introduction MEMS, Fabrication and Application	Thomas M.Adams and Richard A.Layton,	Springer	2010

Web links and Video Lectures (e-Resources):

- https://www.lboro.ac.uk/microsites/mechman/research/ipm-ktn/pdf/Technology_review/an-introduction-to-mems.pdf
- https://archive.nptel.ac.in/courses/112/104/112104029/
- https://nptel.ac.in/courses/112108092

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22MEC453.1	3	2	-	-	-	-	-	-	-	-	-	-	-	-
22MEC453.2	3	-	3	-	-	-	-	-	-	-	-	-	-	-
22MEC453.3	3	2	-	-	-	-	-	-	-	-	-	-	-	-
22MEC453.4	3	-	2	-	-	-	-	-	-	-	-	-	-	-
22MEC453.5	3	-	2	-	-	-	-	-	-	-	-	-	-	-
22MEC453.6	3	-	2	-	-	-	-	-	-	-	-	-	-	-

1: Low 2: Medium 3: High

Automation and Robotics			
Course Code	**22MEC454**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 hours	Credits	03

Course Learning Objectives: This Course will enable students

- To identify potential areas for automation and justify need for automation.
- To select suitable major control components required to automate a process or an activity.
- To study the various parts of robots and fields of robotics.
- To study the various kinematics and inverse kinematics of robots.
- To study the control of robots for some specific applications.

Module-1 Introduction to Automation (08 hours)

Basic elements of an automated system, advanced automation functions, levels of automation, process industries versus discrete manufacturing industries, continuous versus discrete control, computer process control.

Hardware components for automation and process control, sensors, actuators, analog to digital converters, digital to analog converters, input/output devices for discrete data.

Module-2 Automated Production Lines (08 hours)

Fundamentals of automated production lines, application of automated production lines, analysis of transfer lines, automated assembly systems, fundamentals of automated assembly systems, quantitative analysis of assembly systems.

Automatic identification methods, barcode technology, radio frequency identification, other AIDC technologies.

Module-3 Industrial Robotics (08 hours)

Robotic configuration, robot anatomy and related attributes, robot control systems, sensors in robotics, robot accuracy and repeatability, industrial robot applications.
Robot end effectors: Types of end effectors, Mechanical grippers and their mechanisms, vacuum cups, magnetic grippers, hooks and scoops, tools as end effectors.
Different types of robots, various generations of robots, degrees of freedom – Asimov's laws of robotics.

Module-4 Spatial Descriptions and Transformations (08 hours)

Robot actuators and feedback components: Actuators: pneumatic, hydraulic actuators, electric & stepper motors, comparison. Position sensors –potentiometers, resolvers, encoders –Tactile sensors, Proximity sensors.
Manipulator Kinematics: Homogeneous transformations as applicable to rotation and translation -D-H notation, Forward and inverse kinematics.

Module-5 Robot Programming (08 hours)

Introduction, levels of robot programming, requirements of robot programming language, problems pertaining to robot programming languages, offline programming systems, central issues in OLP systems, automating subtasks in OLP systems, simple programs on robot applications.

Course Outcomes: At the end of the course the student will be able to:	
22MEC454.1	Outline the basics of automated system, its control and hardware components required in case of manufacturing industries.
22MEC454.2	Analyze the given automated production line/assembly system for performance.
22MEC454.3	Identify suitable Automatic Identification and Data Capture (AIDC) technologies.

22MEC454.4	Explain the basics of industrial robotics: configuration, features, applications.
22MEC454.5	Describe the types of robot sensors, actuators and manipulator kinematics.
22MEC454.6	Apply the basic principles of robot programming to simple applications.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Automation Production Systems and Computer Integrated Manufacturing	Mikell P. Groover	Pearson Education Pvt Ltd	4th Edition, 2017
2	Introduction to Robotics Mechanics and Control	John J. Craig	Pearson Education	4th Edition, 2022
Reference Books				
1	Robotics for Engineers	Yoram Koren	McGraw Hill International	1st Edition, 1985
2	Industrial Robotics	Mikell P. Groover	McGraw Hill International	3rd edition, 1986
3	Robotics and Control	Mittal R. K., and Nagrath I. J.	Tata Mc Graw Hill	2003

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/110105155 (Automation in Production Systems and Management)
- https://nptel.ac.in/courses/112103293 (Automation in Manufacturing)
- https://nptel.ac.in/courses/107106090 (Introduction to Robotics)
- https://nptel.ac.in/courses/112105236 (Mechanism and Robot Kinematics)
- https://nptel.ac.in/courses/112105249 (Robotics)

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22MEC454.1	**3**	**-**	**2**	**-**	-	-	-	-	-	2	-	-	-	1
22MEC454.2	**2**	**3**	**-**	**-**	-	-	-	-	-	-	1	-	1	-
22MEC454.3	**3**	**-**	**1**	**-**	-	2	-	-	-	-	-	-	-	1
22MEC454.4	**2**	**-**	**-**	**-**	-	-	1	-	-	-	-	-	-	-
22MEC454.5	**2**	**2**	**-**	**2**	-	-	-	1	-	-	-	-	1	-
22MEC454.6	**2**	**1**	**1**	**-**	-	-	-	-	-	-	-	1	-	1

1: Low 2: Medium 3: High

MECHANICAL MEASUREMENTS AND METROLOGY LAB			
Course Code	**22MEC46L**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Practical	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	0:0:2	SEE	3 Hours
Total Hours	10 Lab slots	Credits	01

Course Learning Objectives: The objective of the course is to

- To illustrate the theoretical concepts through experiments.
- To demonstrate calibration techniques of various measuring devices.
- To illustrate the use of various measuring tools & measuring techniques.

PRACTICAL MODULE

1. Study of instruments for Linear measurement and angular measurements: Slip gauges-Measurement of angle-sine bar, Sine centre, Angle gauges, and Optical instruments for angular measurements.
2.Study of Autocollimator-Applications for measuring straightness
3.Study of different Comparators and calibration of Dial indicator, LVDT,
4.Study of Terminology of screw threads and Measurement of major diameter, Minor diameter, Pitch, Angle and Effective diameter of screw threads by 2- wire and 3-wire methods
5. Gear tooth measurement using Gear tooth Vernier.
6. Various parameter measurements using profile projector.
7. Surface topology measurement using Surface Roughness Tester.
8.Calibration of Pressure gauge, Thermocouple and Load cell
9. Determination of modulus of elasticity of a mild steel specimen using strain gauges.
10. Calibration of Micrometer and Vernier caliper using slip gauges.
11. Surface irregularity measurement using Electronic and Mechanical comparator.
12.Choose any product used in the day-to-day life based on his/her choice, prepare a measurement plan and implement the measurement with existing tools.

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

22MEC46L.1	Demonstrate calibration of pressure gauge, thermocouple, LVDT, load cell, Micrometre and Strain gauge
22MEC46L.2	Apply concepts of angular measurement using Sine bar / Sine centre / Bevel Protractor and alignment using Autocollimator/ Roller set.
22MEC46L.3	Demonstrate linear measurements using Optical Projector/Tool maker microscope, Mechanical comparator/ Tally surf and Optical flats.
22MEC46L.4	Analyse cutting tool forces using Lathe and Drill tool dynamometers
22MEC46L.5	Apply concepts of screw thread measurements using floating carriage micrometre and gear teeth measurements using gear tooth Vernier/Gear tooth micrometre.
22MEC46L.6	Inspections gauges and apply the concepts to inspect the components.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Engineering Metrology	R.K. Jain	Khanna Publishers	2009
2	Engineering Metrology	I.C Gupta	Dhanpat Rai Publications	2002

Reference Books				
1	Mechanical Measurements	Beckwith Marangoni and Lienhard	Pearson Education publisher	6,2006
2	Engineering Metrology and Measurements	N.V.Raghavendra and L. Krishnamurthy	Oxford University Press	2019

Web links and Video Lectures (e-Resources):

- http://www.nitttrc.edu.in/nptel/courses/video/112104250/L52.html (Accessed on 17-10-2022)
- https://nptel.ac.in/courses/112/104/112104250/ (Accessed on 17-10-2022)
- http://bit.ly/MMMsjec(Accessed on 17-10-2022)

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22MEC46L.1	-	-	-	3	-	-	-	2	-	2	-	-	-	-
22MEC46L.2	-	-	-	3	-	-	-	-	-	2	-	-	-	-
22MEC46L.3	-	-	-	3	-	-	-	-	-	2	-	-	-	-
22MEC46L.4	-	-	-	3	-	-	-	-	-	2	-	-	-	-
22MEC46L.5	-	-	-	3	-	-	-	-	-	2	-	-	-	-
22MEC46L.6	-	-	-	3	-	-	-	2	-	3	-	-	-	-

1: Low 2: Medium 3: High

Universal Human Values- II			
Course Code	**22UHV47**	CIE Marks	50
Teaching Hours/Week (L:T:P)	(2:0:0)	SEE Marks	50
Credits	**02**	Exam Hours	02

Course Learning Objectives:

This introductory course input is intended:

1. To help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
2. To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement toward value-based living in a natural way.
3. To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature.

Module-1 Introduction to Value Education

Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education), Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Happiness and Prosperity – Current Scenario, Method to Fulfill the Basic Human Aspirations.

Activities: Sharing about Oneself, Exploring Human Consciousness and Exploring Natural Acceptance. **5 Hours**

Module-2 – Harmony in the Human Being

Understanding Human beings as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health.

Activities: Exploring Sources of Imagination in the Self, Exploring Harmony of Self with the Body and Exploring the difference of Needs of Self and Body. **5 hours**

Module 3 – Harmony in the Family and Society

Harmony in the Family – the Basic Unit of Human Interaction, 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Other Feelings, Justice in Human-to-Human Relationship, Understanding Harmony in the Society, Vision for the Universal Human Order.

Activities: Exploring the Feeling of Trust, Exploring the Feeling of Respect and Exploring the Feeling systems to fulfil Human Goal. **5 hours**

Module-4 – Harmony in the Nature/Existence

Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence.

Activities: Exploring the Four Orders of Nature and Co-existence in Existence. **5 hours**

Module-5 – Implications of the Holistic Understanding – a Look at Professional Ethics

Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics, Holistic Technologies, Production Systems and Management Models-Typical Case Studies, Strategies for Transition towards Value-based Life and Profession

Activities: Exploring Ethical Human Conduct**,** Humanistic Models in Education and steps of Transition towards Universal Human Order. **5 hours**

Course Outcomes: At the end of the course the student will be able to:	
22UHV47.1	Practice the method of self-exploration to understand the basic human aspiration.
22UHV47.2	Distinguish between needs of self and body.
22UHV47.3	Evolve a program for self-regulation and health.
22UHV47.4	Differentiate between the characteristics and activities of different orders and study the mutual fulfillment among them.
22UHV47.5	Realize sustainable solutions to the problems in society and nature.
22UHV47.6	Develop competence in professional ethics and strategies for the transition towards a value-based life/profession.

Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Foundation Course in Human Values and Professional Ethics	R R Gaur, R Asthana, G P Bagaria	Excel Books, New Delhi	2nd Revised Edition, 2019
2	Teachers' Manual for A Foundation Course in Human Values and Professional Ethics	R R Gaur, R Asthana, G P Bagaria	Excel Books New Delhi	2nd Revised Edition, 2019
Reference Books				
1	Jeevan Vidya: Ek Parichaya	A Nagaraj	Jeevan Vidya Prakashan Amarkantak	1999
2	Human Values	A.N. Tripathi	New Age Intl. Publishers, New Delhi	2004

Additional Resources/Web links/Video Lectures

1. The Story of Stuff (Book).
2. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
3. Small is Beautiful - E. F Schumacher.
4. Slow is Beautiful - Cecile Andrews
4. Economy of Permanence - J C Kumarappa
5. Bharat Mein Angreji Raj – Pandit Sunderlal
6. Rediscovering India - by Dharampal
7. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
8. India Wins Freedom - Maulana Abdul Kalam Azad
9. Vivekananda - Romain Rolland (English)
10. Gandhi - Romain Rolland (English)
11. UHV-I Teaching material (Presentations, Pre & Post Surveys etc.)
https://fdp-si.aicte-india.org/AicteSipUHV_download.php
12. Details of UHV-II: Universal Human Values – Understanding Harmony and Ethical Human Conduct
https://drive.google.com/file/d/1cznDaqDwKy__EKWmqJLWF94MeY4AXcsU/view?usp=sharing

13. Recorded FDP (Refresher 1 Part 1: Preparing to teach UHV-I in SIP)
https://www.youtube.com/watch?v=kejuD4faDDE&list=PLWDeKF97v9SOjS4RanhaYj4YLiImqm5pj&index=1

14. Resources, including the class notes and presentations
https://drive.google.com/drive/folders/1nh9m5ibEtvMyqekeiexAJtfbdNtmtt6-?usp=sharing

15. Hindi Recording of 5-day UHV FDP
https://www.youtube.com/playlist?list=PLWDeKF97v9SMRfe5PK1HPYnEcrrJOL6K7

16. English Recording of 5-day UHV FDP
https://www.youtube.com/playlist?list=PLWDeKF97v9SP7wSlapZcQRrT7OH0ZlGC4

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22UHV47.1						3		2						
22UHV47.2						2			3					
22UHV47.3						2		3						
22UHV47.4							3							
22UHV47.5			3				2							
22UHV47.6								3				2		

1: Low 2: Medium 3: High

Biology for Engineers			
Course Code	**22BFE47**	CIE Marks	50
Teaching Hours/Week (L:T:P)	(2:0:0)	SEE Marks	50
Credits	**02**	Exam Hours	02

Course Learning Objectives:

1. To bring awareness of biological concepts to engineering students
2. To introduce the building blocks of life and their complexity
3. To encourage interdisciplinary studies and projects
4. To appreciate the discoveries that mimic nature and its working
5. To inculcate nature-inspired design and operational principles

Module-1 **5 Hours**

Basic Cell Biology: Introduction to Biology, The cell: the basic unit of life, Expression of genetic information-protein structure and function, Cell metabolism; Cells respond to their external environments, Cells grow and reproduce, Cellular differentiation.

Module-2 **5 Hours**

Biochemistry and Molecular Aspects of Life: Biodiversity-Chemical bonds in Biochemistry; Biochemistry and Human biology, Protein synthesis -DNA; RNA, Transcription and translation factors play key roles in protein synthesis, Differences between eukaryotic and prokaryotic protein synthesis, Stem cells and their applications.

Module-3 **5 Hours**

Bioinspired Engineering based on human physiology: Circulatory system (artificial heart, pacemaker, stents), Nervous system (Artificial neural network), Respiratory system, sensory system (electronic nose, electronic tongue), Visual and auditory prosthesis (Bionic eye and cochlear implant).

Module-4 **5 Hours**

Relevance of Biology as an interdisciplinary approach: Biological observation that led to major discoveries, Echolocation (ultrasonography, sonars), Photosynthesis (photovoltaic cells, bionic leaf), Bird flying (aircraft), Lotus leaf effect (Super hydrophobic and self-cleaning surfaces), Plant burrs (Velcro).

Module-5 **5 Hours**

Bioinspired Algorithms and Applications: Genetic algorithm, Gene expression modelling, Parallel Genetic Programming: Methodology, History, and Application to Real-Life Problems, Dynamic Updating DNA Computing Algorithms, Bee-Hive: New Ideas for Developing Routing Algorithms Inspired by Honey Bee Behaviour.

Course Outcomes: At the end of the course the student will be able to:	
22BFE47.1	Discuss how the cell forms the basic building block of life
22BFE47.2	Distinguish between transcription and translation
22BFE47.3	Describe the role played by proteins within the cell
22BFE47.4	Analyze the role of bioinspired design in novel applications
22BFE47.5	Apply bioinspired design principles to other domains
22BFE47.6	Implement a simple genetic algorithm

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Text Books				
1	Biology for Engineers	Thyagarajan.S., Selvamurugan. N., Rajesh.MP, Nazeer RA, Richard W. Thilagaraj, Barathi.S., and Jaganthan.M.K	Tata McGraw Hill	2012
2	Molecular Biology	Robert Weaver	McGraw-Hill	5th Edition, 2012
Reference books				
1	Lewin's Genes XII	Jocelyn E. Krebs, Elliott S. Goldstein, Stephen T. Kilpatrick	Jones and Bartlett Learning	2017
2	Bioinspired Engineering	Jenkins, C.H.	Momentum Press	2012
3	Bio mimetics: Nature-Based Innovation	Yoseph Bar-Cohen	CRC Press	1st Edition, 2016
4	A Practical Guide to Bio-inspired Design	Hashemi Farzaneh, Helena, Lindemann, Udo	Springer	2019

Web links/Video Lectures/MOOCs

1. https://books.google.co.in/books?id=-2LNBQAAQBAJ&printsec=frontcover#v=onepage&q&f=false
2. https://www.aminotes.com/2017/02/biology-for-engineers-module-1-cocepts.html

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22BFE47.1	2					1								
22BFE47.2		1				1								
22BFE47.3	2					2								
22BFE47.4		2										2		
22BFE47.5	2											2		
22BFE47.6		2										2		

1: Low 2: Medium 3: High

COMPUTATIONAL TOOLS FOR ENGINEERS			
Course Code:	**22CTE48**	CIE Marks	50
Teaching Hours/Week (L:T:P)	(0:0:2)	SEE Marks	50
Credits	**01**	Exam Hours	02

Course Learning Objectives:

1. Apply modeling and simulation tools for a wide range of engineering problems.
2. Understand the analysis of data in Excel with statistics.
3. Use MATLAB and Simulink to perform engineering system analysis.

The engineering design process heavily relies on modeling and simulation. Modern simulation techniques enable the development of multi-physical, holistic system models that account for all system interactions. These digital models speed up the design and testing processes, saving time and money.

Module 1

Engineering Design Analysis

Need for engineering design analysis. Product and system design. Introduction to analysis parameters – stress, deformation, acceleration, internal force and stability. Static structural analysis of engineering design using finite element method (case studies). Heat transfer and fluid dynamics modeling and simulation using CFD software (case studies).

10 Hours

Module 2

Data Analysis with EXCEL

Calculate Mean, Median, Mode, Minimum, Maximum, Quartiles, Variance and Standard Deviation from some numbers. Analyze a population using data samples. Group data, build XY charts, apply Logarithmic Scale and Trend Line on a chart, forecast from some data, and calculate running averages. Normal Distribution, Exponential Distribution, Uniform Probabilities, Binomial Distribution, and Poisson Distribution.

4 Hours

Module 3

MATLAB and Simulink for Engineers

Applications of MATLAB and Simulink in electrical engineering, electrical machines and power system projects, simulation of rectifiers, inverters, choppers, and cycloconverters.

10 Hours

Course Project

Solve complex engineering problems via modeling and simulation. The project work is teamwork of 3-5 students. The goals should be clearly defined, use any software tool, and rigorous validation of the mathematical model should be done (experimental or theoretical).

Course Outcomes: At the end of the course, the student will be able to:	
22CTE48.1	Apply the Finite Element Method to solve engineering problems
22CTE48.2	Solve statistical problems using Excel
22CTE48.3	Perform system-level analysis using MATLAB and Simulink
22CTE48.4	Build mathematical models for any given engineering problem.
22CTE48.5	Demonstrate teamwork and communication skills

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Reference Books				
1	**MATLAB and Simulink for Engineers**	Agam Kumar Tyagi	Oxford University Press	2012
2	**Practical Finite Element Analysis**	Nitin S.Gokhale	Finite to Infinite	2020
3	**Excel Crash Course for Engineers**	Eklas Hossain	Springer	2021

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22CTE48.1	1				1	1								
22CTE48.2		1			2				2					
22CTE48.3		1			2									
22CTE48.4					2	2								
22CTE48.5	1								2					

1: Low 2: Medium 3: High

Industry Oriented Training - Business Etiquettes			
Course Code	**22ITB49A**	CIE Marks	50
Teaching Hours/Week (L:T:P)	(0:0:2)	SEE Marks	-
Credits	-	Exam Hours	02

Course Learning Objectives:

11. Know the components of self-introduction
12. Develop a resume with the inclusion of core competencies
13. Involve and contribute to group discussions
14. Develop effective communication to succeed in the professional career
15. Know the etiquettes of digital communication

Module-1

Self-Introduction &Essentials of grooming

Self-Introduction: Learn the secret to introducing Yourself, Things to avoid when introducing yourself. Activity: Video record the self-introduction. **Essentials of grooming:** Creating the first impression, what does the well-dressed man wear? What does the well-dressed woman wear? Personal hygiene and habits. **4 Hours**

Module-2

Resume Writing

Purpose, Identifying Relevant Competencies, Understanding Applicant Tracking Systems, Lists of Competencies, Writing Accomplishment/ Objective Statements, Finding the Right Words- Action verbs, The Most Popular Resume Format, Other Popular Resume Formats, Do's and Don'ts. Activity: Students have to submit a copy of their resume. **4 Hours**

Module-3

Group Discussion

Types, process, Evaluation criteria, Do's and Don'ts Activity: Group discussions have to be held during the training sessions. **4 Hours**

Module-4

Communicate effectively

Build a Story, Just a Minute, Group Activities, Team building activities, Role Play, Presentation Skills. **4 Hours**

Module-5

Digital right and wrong

Virtual Communication: Agenda, being prepared, Dressing appropriately, background, Use Microphone and camera the right way, restraining from off tasks during virtual meetings, protecting confidential data during online presentations, time management. **4 Hours**

Course Outcomes: At the end of the course the student will be able to:	
22ITB49A.1	Articulate the essential components required for self-introduction in any business or a networking event and also recognize the need to dress appropriately for a successful career in the corporate
22ITB49A.2	Develop a resume inclusive of core competencies, and action verbs which are compatible with Applicant Tracking Systems
22ITB49A.3	Demonstrate the types, process and evaluation process of Group Discussion and carry out effective group discussions
22ITB49A.4	Develop skills required for effective communication
22ITB49A.5	Associate and be accustomed to the etiquette to be followed during online meetings

Sources

1. English for Common Interactions in the Workplace: Basic Level: Coursera: https://www.coursera.org/learn/english-common-interactions-workplace-basic-level
2. Personal Communication-Introduce Yourself With Confidence: https://www.udemy.com/course/how-to-introduce-yourself/
3. Professionalism, Grooming and Etiquette: https://www.edx.org/course/professionalism-grooming-and-etiquette
4. How to Write a Resume: https://www.coursera.org/learn/how-to-write-a-resume#syllabus
5. Group Discussion Strategies: https://www.udemy.com/course/group-discussion-strategies/
6. Communication Strategies for a Virtual Age: https://www.coursera.org/learn/communication-strategies-virtual-age#syllabus

References

1. https://simplifytraining.com/course/personal-hygiene-and-good-grooming/
2. https://www.udemy.com/course/group-discussion-strategies/
3. https://www.educba.com/course/group-discussion/
4. https://getrafiki.ai/meetings/rules-of-virtual-meeting-etiquette-every-sales-professional-should-follow/
5. https://thedigitalworkplace.com/articles/online-meeting-etiquette-for-attendees/
6. https://rigorousthemes.com/blog/virtual-meeting-etiquette-guidelines-ground-rules/

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22ITB49A.1									2	3		1		
22ITB49A.2										3		1		
22ITB49A.3									2	3	1	1		
22ITB49A.4									2	3	1	1		
22ITB49A.5									2	3	1	1		

1: Low 2: Medium 3: High

Industry Oriented Training - Computing Skills			
Course Code	**22ITC49B**	CIE Marks	50
Teaching Hours/Week (L:T:P)	(0:0:2)	SEE Marks	-
Credits	-	Exam Hours	02

Course Learning Objectives:

6. Use logical conditions for problem-solving and also introduce the concepts of arrays
7. Know functions, function calls, and parameter passing
8. Introduce algorithms and appreciate their importance in problem-solving
9. Introduce the core concepts of OOP's
10. Differentiate between front-end & back-end development and recognize the use of database management

Module-1

Introduction to computing constructs

Logical conditions: For Loops, Nested For Loops, While Loops, Do-While Loops, Nesting and Boxes, and combine/negate several logical conditions using logic operations AND, OR, and NOT.

Arrays & strings: Create arrays of characters (strings), use the null terminator, and manipulate strings. **4 Hours**

Module-2

Functions & Pointers

Introduction to Functions, Returning Data From a Function, Passing Data Into a Function, Getting Valid User Input, Changing Parameter Values, Pointer Basics, Changing the Pointed to Value, Walking an Array with Pointers, Dynamic Memory Allocation, Getting More Memory, Pointers to Structure. **4 Hours**

Module-3

Algorithm analysis

Introduction to Algorithm Analysis, Big-O, Big-O Examples, Dynamic Array Operations, Bubble Sort, Selection Sort, Insertion Sort, Recursion, Recursive Binary Search, Merge Sort. **4 Hours**

Module-4

Object-oriented programming

Designing for Object-Oriented Programming, Core Concepts of OO Programming: Classes and objects, data abstraction, encapsulation, inheritance, benefits of inheritance, polymorphism, procedural and object-oriented programming paradigm. **4 Hours**

Module-5

Frontend and backend development

UI, Database management: DBMS overview, Relational Data Model and the CREATE TABLE Statement, Basic Query Formulation with SQL. **4 Hours**

Course Outcomes: At the end of the course the student will be able to:	
22ITC49B.1	Illustrate the use of logical conditions, declare and manipulate data into arrays
22ITC49B.2	Implement functions, function calls, and parameter passing
22ITC49B.3	Design, implement, and evaluate an algorithm to meet desired needs
22ITC49B.4	Describe the core concepts of OOP's
22ITC49B.5	Recognize the concepts of front-end development and database management

Sources
1. Computational Thinking with Beginning C Programming Specialization: https://www.coursera.org/learn/simulation-algorithm-analysis-pointers?specialization=computational-thinking-c-programming#syllabus 2. Simulation, Algorithm Analysis, and Pointers: https://www.coursera.org/lecture/simulation-algorithm-analysis-pointers/big-o-examples-pdCan 3. Programming Fundamentals: https://www.coursera.org/learn/programming-fundamentals?specialization=c-programming#syllabus 4. Object-Oriented Programming Concepts: https://www.coursera.org/learn/concepts-of-object-oriented-programming#syllabus 5. Introduction to Back-End Development: https://www.coursera.org/learn/introduction-to-back-end-development

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22ITC49B.1	2	1	1											
22ITC49B.2	2	1	1											
22ITC49B.3	1	1	2											
22ITC49B.4	2		1											
22ITC49B.5	2	1	1											

1: Low 2: Medium 3: High

***

Core Values of the Institution

SERVICE

A Josephite will keep service as the prime goal in everything that is undertaken. Meeting the needs of the stakeholders will be the prime focus of all our endeavors.

EXCELLENCE

A Josephite will not only endeavor to serve, but serve with excellence. Preparing rigorously to excel in whatever we do will be our hallmark.

ACCOUNTABILITY

Every member of the SJEC Family will be guided to deliver on assurances given within the constraints set. A Josephite will always keep budgets and deadlines in mind when delivering a service.

CONTINUOUS ADAPTATION

Every member of the SJEC Family will strive to provide reliable and continuous service by adapting to the changing environment.

COLLABORATION

A Josephite will always seek to collaborate with others and be a team-player in the service of the stakeholders.

Objectives

- Provide Quality Technical Education facilities to every student admitted to the College and facilitate the development of all round personality of the students.
- Provide most competent staff and excellent support facilities like laboratory, library and internet required for good education on a continuous basis.
- Encourage organizing and participation of staff and students in in-house and outside Training programmes, seminars, conferences and workshops on continuous basis.
- Provide incentives and encouragement to motivate staff and students to actively involve in research-innovative projects in collaboration with industry and R &D centres on continuous basis
- Invite more and more number of persons from industry from India and abroad for collaboration and promote Industry-Institute Partnership.
- Encourage consultancy and testing and respond to the needs of the immediate neighbourhood.

St Joseph Engineering College

AN AUTONOMOUS INSTITUTION

Affiliated to VTU, Belagavi | Recognised by AICTE, New Delhi
Accredited by NAAC with A+ Grade
B.E. (CSE, ECE, EEE, ME, CIV), MBA & MCA Accredited by NBA, New Delhi

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