



Scheme – 2023

Department of Mechanical Engineering

**G. Pulla Reddy Engineering College (Autonomous):
Kurnool**

Accredited by NBA of AICTE and NAAC of UGC

Affiliated to JNTUA, Anantapuramu

Scheme and Syllabus for
B.Tech in Mechanical Engineering

(With Effect from the Batch Admitted in 2023-24)

MECHANICAL ENGINEERING
FOUR YEAR B.TECH. DEGREE COURSE
SCHEME OF INSTRUCTION AND EXAMINATION

V Semester

Scheme 2023

S. No.	Category	Title	L/D	T	P	Credits	CIA	End Exam Marks	Total Marks
1	PC	Machining Processes	3	0	0	3	30	70	100
2	PC	Design of Machine Elements	3	0	0	3	30	70	100
3	PC	Metrology and Measurements	3	0	0	3	30	70	100
4	ES	Introduction to Quantum Technologies and Applications	3	0	0	3	30	70	100
5	PE	Professional Elective - I	3	0	0	3	30	70	100
6	OE	Open Elective -I	3	0	0	3	30	70	100
7	PC	Thermal Engineering Lab	0	0	3	1.5	30	70	100
8	PC	Theory of Machines Lab	0	0	3	1.5	30	70	100
9	SEC	Machine Tools & Metrology Lab	0	1	2	2	30	70	100
10	ES	Tinkering Lab	0	0	2	1	30	70	100
11		Evaluation of Community Service Internship	-	-	-	2			100
		Total	18	1	10	26			

VI Semester

Scheme 2023

S. No.	Category	Title	L/D	T	P	Credits	CIA	End Exam Marks	Total Marks
1	PC	Heat Transfer	3	0	0	3	30	70	100
2	PC	CAD/CAM	3	0	0	3	30	70	100
3	PC	Operations Research	3	0	0	3	30	70	100
4	PE	Professional Elective-II	3	0	0	3	30	70	100
5	PE	Professional Elective-III	3	0	0	3	30	70	100
6	OE	Open Elective -II	3	0	0	3	30	70	100
7	PC	Heat Transfer Lab	0	0	3	1.5	30	70	100
8	PC	Computer Aided Manufacturing Lab	0	0	3	1.5	30	70	100
9	SEC	Computer Aided Engineering Lab	0	1	2	2	30	70	100
10.	AC	Technical Paper Writing and IPR	2	0	0	0	-	-	-
		Total	20	1	8	23			
Mandatory Industry Internship of 08 weeks duration during summer vacation									

L/D : Lecture/Design/Drawing

T/P : Tutorial / Practical

PC : Professional Core

CIA : Continuous Internal Assessment

PE : Professional Elective

OE : Open Elective

SEC : Skill Enhancement Course

ES : Engineering Sciences

AC : Audit Course

MACHINING PROCESSES (MP)								
V Semester: Mechanical Engineering						Scheme: 2023		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
ME301	PC	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
		3	0	0	3	30	70	100
Sessional Exam Duration: 2 Hrs					End Exam Duration: 3 Hrs			
Course Outcomes: At the end of the course, students will be able to								
CO1:	Explain cutting tool geometry and solve simple problems on cutting forces and tool life using Merchant's theory and Taylor's equation.							
CO2:	Describe the construction and working of lathe, drilling, and boring machines.							
CO3:	Demonstrate the working mechanisms of shaper, slotter, planer and milling machine and apply indexing methods to perform milling operations like gear cutting.							
CO4:	Explain grinding and finishing operations, including wheel specifications and maintenance.							
CO5:	Explain the principles of jigs and fixtures design and select suitable non-traditional machining processes.							
UNIT – I								
Introduction to Metal Cutting: Classification of metal cutting operations, Nomenclature of Single point cutting tool, mechanics of metal cutting, mechanism of chip formation, types of chips, oblique and orthogonal cutting - Merchant's Theory of metal cutting, Merchant's circle diagram for forces. Simple problems on Force calculations. Tool wear, Tool life Taylor's Tool life equation. Simple problems on tool life. Cutting tool materials.								
UNIT – II								
Lathe: Introduction, types of lathes, Lathe specifications, Parts of a lathe, Lathe accessories and Attachments, Lathe operations.								
Drilling: Introduction, Types of Drilling machines, Upright drilling machine, Radial drilling machine, Drilling machine operations.								
Boring: Introduction, Types of Boring machines, Principal parts of Horizontal boring machine, Vertical boring machine and Jig boring machine.								
UNIT – III								
Shaper: Introduction, Principal parts of a shaper, Shaper size, Shaper mechanisms, Crank and slotted link mechanism, Whitworth quick return mechanism, Hydraulic shaper mechanism, Shaper Operations.								
Planner: Planning machine parts, Open and cross belt drive mechanism, Planner operations								
Slotter: Slotting Machine Parts, Slotter size, Slotter operations								
Milling Machines : Introduction, Types of Milling machines, Principal parts of Column and knee type milling machine, Milling machine operations Dividing heads – Plain or Simple dividing head, Universal dividing head. Indexing methods, Direct or Rapid indexing, Plain or simple indexing, Compound indexing and Differential indexing. Simple problems on Indexing.								
UNIT – IV								
Grinding and Surface Finishing Machines: Introduction, Kinds of Grinding, Classification of Grinding machines, Grinding wheel specification, Glazing and loading in wheels, Dressing and trueing of grinding wheels. Honing, Honing machines, Lapping, Lapping machines and super finishing, Buffing.								
UNIT – V								
Jigs and Fixtures: Introduction, Classification of jigs and fixtures, design principles, location and clamping, types of clamping, 3-2-1 principle, applications of jigs and fixtures.								

Modern Machining processes: Electrical Discharge Machining (EDM), Wire cut Electrical Discharge Machining (WEDM), Electro Chemical Machining (ECM), Laser Beam Machining (LBM), Electron Beam Machining (EBM), Plasma Arc Machining (PAM), Ultrasonic Machining (USM), and Abrasive Jet Machining (AJM)
Text Books:
1. S K Hajra Choudhury and Nirjhar Roy, Elements of Work shop technology Volume II, (Machine Tools) Media Promoters & Publishers, New Delhi
2. P N Rao, Manufacturing Technology, Metal cutting and Machine tools, TMH Publishers, New Delhi
3. P C Sharma, A text book of Production Technology (Manufacturing Processes), S.Chand Publishers, New Delhi.
Reference Books:
1. Amitabha Ghose and Asok Kumar Malik, Manufacturing Science, EWP Publishers, New Delhi.
2. R K Jain, Production Technology, Khanna Publishers, New Delhi.
3. S Kalpakjian and Steven R Schmid, Manufacturing Engineering and Technology, Pearson Publishers, New Delhi.
4. V K Jain, Advanced Machining Processes, Allied Publishers, New Delhi.
Question Paper Pattern:
Sessional Exam: The question paper for Sessional Examination shall be for 40 marks. The question paper shall consist of Four questions and all questions are compulsory. Question No.1 shall contain Five compulsory short answer questions for a total of Ten marks. Question No.2 to 4 shall be EITHER/OR Type for Ten marks each. Student shall Answer any one of them. Each of these questions may contain sub-questions.
End Examination: The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions and all questions are compulsory. Question No.1 shall contain Ten compulsory short answer questions for a total of Twenty marks (with Two short answer questions from each unit). Question No.2 to 6 shall be EITHER/OR Type for Ten marks each and shall cover one Unit of the Syllabus for each question. Student shall Answer any one of them. Each of these questions may contain sub-questions.

DESIGN OF MACHINE ELEMENTS (DME)								
V Semester: Mechanical Engineering					Scheme: 2023			
Course Code	Category	Hours/Week			Credits	Maximum Marks		
ME302	PC	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
		3	0	0	3	30	70	100
Sessional Exam Duration: 2 Hrs					End Exam Duration: 3 Hrs			
Course Outcomes: At the end of the course, students will be able to								
CO1:	Apply design principles for components subjected to static and dynamic loads, analyze and design for fatigue failure using relevant criteria.							
CO2:	Design of bolted and welded joints, considering factors such as different types of loads, including eccentric loading scenarios.							
CO3:	Design of power transmission shafts and couplings for fluctuating loads, and selecting appropriate couplings such as flange, bushed pin, and universal couplings.							
CO4:	Design of sliding and rolling contact bearings.							
CO5:	Design of springs and spur gears.							
UNIT – I								
Introduction, Design for Static and Dynamic Loads Mechanical Engineering Design: Design process, design considerations, Codes and standards of designation of materials, Selection of materials. Design for Static Loads: Modes of failure, Design of components subjected to axial, Bending, Torsional and impact loads. Theories of failure for static loads. Design for Dynamic Loads: Endurance limit, Fatigue strength under axial, Bending and torsion, Stress concentration, Notch sensitivity. Types of fluctuating loads, Fatigue design for infinite life. Soderberg, Goodman and modified Goodman criterion for fatigue failure. Fatigue design under combined stresses.								
UNIT – II								
Design of Bolted and Welded Joints Design of Bolted Joints: Threaded fasteners, Preload of bolts, Various stresses induced in the bolts. Torque requirement for bolt tightening, Gasketed joints and Eccentrically loaded bolted joints. Welded Joints: Strength of lap and butt welds, Joints subjected to bending and torsion. Eccentrically loaded welded joints.								
UNIT – III								
Power Transmission Shafts and Couplings Power Transmission Shafts: Design of shafts subjected to bending, Torsion and axial loading. Shafts subjected to fluctuating loads using shock factors. Couplings: Design of flange and bushed pin couplings, Universal coupling.								
UNIT – IV								
Design of Bearings Design of Sliding Contact Bearings: Lubrication modes, Bearing modulus, McKee's equations, Design of journal bearing. Bearing Failures. Design of Rolling Contact Bearings: Static and dynamic load capacity, Stribeck's Equation, Equivalent bearing load, Load-life relationships, Load factor, Selection of bearings from manufacturer's catalogue.								

UNIT – V

Design of Springs and Gears

Springs: Design of helical compression, Tension, Torsion and Leaf springs.

Design of Gears: Spur gears, Beam strength, Lewis equation, Design for dynamic and Wear loads.

Text Books:

1. R L Norton, Machine Design an Integrated approach, Pearson Education, New Delhi.
2. V B Bhandari, Design of Machine Elements, Tata McGraw Hill, New Delhi.
3. R K Jain, Machine Design, Khanna Publications, New Delhi.

Reference Books:

1. J E Shigley, Mechanical Engineering Design, Tata McGraw Hill, New Delhi
2. M F Spotts and T E Shoup, Design of Machine Elements, Prentice Hall (Pearson Education), London.
3. K Mahadevan and K Balaveera Reddy, Design data handbook, CBS Publications, New Delhi.
4. N C Pandya and C S Shah, Machine design, Charotar Publishing House Pvt. Ltd, Gujarat.

Online Learning Resources:

1. <https://www.yumpu.com/en/document/view/18818306/lesson-3-course-name-design-of-machine-elements-1-nptel>
2. <https://www.digimat.in/nptel/courses/video/112105124/L01.html>
3. <https://dokumen.tips/documents/nptel-design-of-machine-elements-1.html>
4. <http://www.nitttrc.edu.in/nptel/courses/video/112105124/L25.html>

Question Paper Pattern:

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End Examination: The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions and all questions are compulsory. Question No.1 shall contain Ten compulsory short answer questions for a total of Twenty marks (with Two short answer questions from each unit). Question No.2 to 6 shall be EITHER/OR Type for Ten marks each and shall cover one Unit of the Syllabus for each question. Student shall Answer any one of them. Each of these questions may contain sub-questions.

METROLOGY AND MEASUREMENTS (MMT)								
V Semester: Mechanical Engineering					Scheme: 2023			
Course Code	Category	Hours/Week			Credits	Maximum Marks		
ME303	PC	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
		3	0	0	3	30	70	100
Sessional Exam Duration: 2 Hrs					End Exam Duration: 3 Hrs			
Course Outcomes: At the end of the course the student will be able to								
CO1:	Apply measurement standards, limits, fits, and gauge design using Taylor's principle and standard systems.							
CO2:	Measure angles and screw thread parameters using precision instruments and evaluate errors in thread profiles.							
CO3:	Perform gear and surface finish measurements, and evaluate components using CMM with understanding of error sources.							
CO4:	Understand and apply various transducers for measurement of physical quantities, including LVDT, piezoelectric, and photoelectric types.							
CO5:	Apply strain gauge techniques and transducers to measure force, torque, and acceleration accurately.							
UNIT – I								
Standards of Measurements: Line standards, End standards and Wavelength standards. Limits, Fits and Gauges: Tolerances, limits and Fits, Basic types fits, Interchangeable and Selective assemblies, Systems of limits and fits as exemplified in British, International and Indian standards for Plain work, Limit gauging –Plug, Ring and Snap gauges, Taylor's principle of limit gauges. Problems on limits, fits and design of GO and NOGO gauges.								
UNIT – II								
Angular Measurement: Bevel protractor, Clinometer, Angle dekkor, Sine bar, Spirit level, Applications of Slip gauges, Rollers and Balls in testing of tapers. Screw Thread Measurement: Terminology of screw threads, effect of pitch errors and angle errors, concept of virtual effective diameter, Measurement of major, minor and effective diameter.								
UNIT – III								
Measurement of Gears: Terminology of gear tooth, Tooth to tooth pitch measurement, Profile checking, Tooth thickness measurement and Parkinson gear tester. Measurement of Surface Finish: Significance of surface finish, Order of geometrical errors occurring during machining, Magnitude, Sampling length, Methods of measuring surface finish- Stylus probe instruments, Tomlinson surface meter and Taylor – Hobson Talysurf surface meter. Coordinate Measuring Machines: CMM construction, Possible sources of error in CMM, Specifications of coordinate measuring machines, Advantages of CMM.								
UNIT – IV								
Transducers: Introduction, Classification and description, Sensitivity, Mechanical transducers, Electrical transducers, Variable resistance transducers, Variable inductance transducers, Capacitive transducers, LVDT, Piezoelectric and photo electric transducers.								
UNIT – V								
Measurement of Force, Torque, Acceleration: Basic force measurement methods - Elastic load cells, Elastic strain gauge load cells, Hydraulic and Pneumatic load cells, Torque measurement, Types of torsion meters, Piezo-electric accelerometer, Seismic accelerometer, Strain gauge accelerometer. Strain Gauges and Measurement: Strain measuring techniques, Requirement of strain								

gauges, Resistance strain gauges, Strain gauges alloys and materials, Bonded and Unbonded strain gauges, Bonding techniques, Temperature compensation in strain gauges.
Text Books:
1. R K Jain, Engineering Metrology, Khanna Publishers, New Delhi.
2. N V Raghavendra, L Krishnamurthy, Engineering Metrology and Measurements, Oxford University Press, New Delhi.
3. I C Guptha, A text book of Engineering Metrology, Dhanpat rai Publications.
4. M Mahajan, A text book of Metrology, Dhanpat rai and Co.
Reference Books:
1. K L Narayana, Engineering Metrology, Scitech Publications.
2. P C Sharma, A textbook of Production Engineering, S. Chand Publishers, New Delhi.
3. ASME, Hand Book of Industrial Metrology, PHI Publication, New Delhi.
4. D S Kumar, Mechanical Measurements and Control, Metropolitan Books, New Delhi.
Question Paper Pattern:
Sessional Exam: The question paper for Sessional Examination shall be for 40 marks. The question paper shall consist of Four questions and all questions are compulsory. Question No.1 shall contain Five compulsory short answer questions for a total of Ten marks. Question No.2 to 4 shall be EITHER/OR Type for Ten marks each. Student shall Answer any one of them. Each of these questions may contain sub-questions. End Examination: The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions and all questions are compulsory. Question No.1 shall contain Ten compulsory short answer questions for a total of Twenty marks (with Two short answer questions from each unit). Question No.2 to 6 shall be EITHER/OR Type for Ten marks each and shall cover one Unit of the Syllabus for each question. Student shall Answer any one of them. Each of these questions may contain sub-questions.

INTRODUCTION TO QUANTUM TECHNOLOGIES AND APPLICATIONS (IQTA) (Qualitative Treatment)								
V Semester: Common for all Branches					Scheme: 2023			
Course Code	Category	Hours/Week			Credits	Maximum Marks		
ESCM03	ES	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
		3	0	0	3	30	70	100
Sessional Exam Duration: 2 Hrs					End Exam Duration: 3 Hrs			

Course Outcomes : At the end of the course the student will be able to	
CO1:	Explain core quantum principles in a non-mathematical manner
CO2:	Compare classical and quantum information systems.
CO3:	Identify theoretical issues in building quantum computers.
CO4:	Discuss quantum communication and computing concepts.
CO5:	Recognize applications, industry trends, and career paths in quantum technology
UNIT – I	
Introduction to Quantum Theory and Technologies: The transition from classical to quantum physics, Fundamental principles explained conceptually: Superposition, Entanglement, Uncertainty Principle, Wave-particle duality, Classical vs Quantum mechanics – theoretical comparison, Quantum states and measurement: nature of observation, Overview of quantum systems: electrons, photons, atoms, The concept of quantization: discrete energy levels, Why quantum? Strategic, scientific, and technological significance, A snapshot of quantum technologies: Computing, Communication, and Sensing, National and global quantum missions: India's Quantum Mission, EU, USA, China	
UNIT – II	
Theoretical Structure of Quantum Information Systems: What is a qubit? Conceptual understanding using spin and polarization, Comparison: classical bits vs quantum bits, Quantum systems: trapped ions, superconducting circuits, photons (non-engineering view), Quantum coherence and decoherence – intuitive explanation, Theoretical concepts: Hilbert spaces, quantum states, operators – only interpreted in abstract, The role of entanglement and non-locality in systems, Quantum information vs classical information: principles and differences, Philosophical implications: randomness, determinism, and observer role	
UNIT – III	
Building a Quantum Computer – Theoretical Challenges and Requirements: What is required to build a quantum computer (conceptual overview)?, Fragility of quantum systems: decoherence, noise, and control, Conditions for a functional quantum system: Isolation, Error management, Scalability, Stability, Theoretical barriers: Why maintaining entanglement is difficult, Error correction as a theoretical necessity, Quantum hardware platforms (brief conceptual comparison), Superconducting circuits, Trapped ions, Photonics, Vision vs reality: what's working and what remains elusive, The role of quantum software in managing theoretical complexities	
UNIT – IV	
Quantum Communication and Computing – Theoretical Perspective: Quantum vs Classical Information, Basics of Quantum Communication, Quantum Key Distribution (QKD), Role of Entanglement in Communication, The Idea of the Quantum Internet – Secure Global Networking, Introduction to Quantum Computing, Quantum Parallelism (Many States at Once), Classical vs Quantum Gates, Challenges: Decoherence and Error Correction, Real-World Importance and Future Potential	

UNIT – V

Applications, Use Cases, and the Quantum Future: Real-world application domains: Healthcare (drug discovery), Material science, Logistics and optimization, Quantum sensing and precision timing, Industrial case studies: IBM, Google, Microsoft, PsiQuantum, Ethical, societal, and policy considerations, Challenges to adoption: cost, skills, standardization, Emerging careers in quantum: roles, skillsets, and preparation pathways, Educational and research landscape – India's opportunity in the global quantum race

Text Books:

1. Michael A Nielsen and Isaac L Chuang, Quantum Computation and Quantum Information, Cambridge University Press, Cambridge.
2. Eleanor Rieffel and Wolfgang Polak, Quantum Computing: A Gentle Introduction, MIT Press, Cambridge.
3. Chris Bernhardt, Quantum Computing for Everyone, MIT Press, Cambridge.

Reference Books:

1. David McMahon, Quantum Computing Explained, Wiley.
2. Phillip Kaye, Raymond Laflamme and Michele Mosca, An Introduction to Quantum Computing, Oxford University Press.
3. Scott Aaronson, Quantum Computing Since Democritus, Cambridge University Press.
4. Alastair I M Rae, Quantum Physics: A Beginner's Guide, Oneworld Publications.
5. Eleanor G Rieffel and Wolfgang H Polak, Quantum Computing: A Gentle Introduction, MIT Press.
6. Leonard Susskind, Art Friedman, Quantum Mechanics: The Theoretical Minimum, Basic Books.
7. Bruce Rosenblum and Fred Kuttner, Quantum Enigma: Physics Encounters Consciousness, Oxford University Press.
8. Giuliano Benenti, Giulio Casati and Giuliano Strini, Principles of Quantum Computation and Information, Volume I: Basic Concepts, World Scientific Publishing
9. K.B. Whaley et al., Quantum Technologies and Industrial Applications: European Roadmap and Strategy Document, Quantum Flagship, European Commission.
10. Department of Science & Technology (DST), Government of India, National Mission on Quantum Technologies & Applications – Official Reports and Whitepapers, MeitY/DST Publications.

Online Learning Resources:

1. <https://www.coursera.org/learn/quantum-mechanics>
2. <https://nptel.ac.in/courses/106106232>

Question Paper Pattern:

Qualitative Treatment

Sessional Exam: The question paper for Sessional Examination shall be for 40 marks. The question paper shall consist of Four questions and all questions are compulsory. Question No.1 shall contain Five compulsory short answer questions for a total of Ten marks. Question No.2 to 4 shall be EITHER/OR Type for Ten marks each. Student shall Answer any one of them. Each of these questions may contain sub-questions.

End Examination: The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions and all questions are compulsory. Question No.1 shall contain Ten compulsory short answer questions for a total of Twenty marks (with Two short answer questions from each unit). Question No.2 to 6 shall be EITHER/OR Type for Ten marks each and shall cover one Unit of the Syllabus for each question. Student shall Answer any one of them. Each of these questions may contain sub-questions.

THERMAL ENGINEERING LAB (THE (P))								
V Semester: Mechanical Engineering					Scheme: 2023			
Course Code	Category	Hours/Week			Credits	Maximum Marks		
ME304	PC	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
		0	0	3	1.5	30	70	100
End Exam Duration: 3 Hrs								
Course Outcomes : On successful completion of the course, the students will be able to								
CO1:	Analyze IC engine operations through valve timing diagram and determine fuel properties like flash and fire points.							
CO2:	Evaluate the performance characteristics of four-stroke diesel engines using hydraulic, mechanical, and electrical loading, and determine the friction power of an MPFI engine.							
CO3:	Perform retardation and heat balance tests to analyze engine efficiency and losses.							
CO4:	Analyze the performance characteristics of compressor, blower and wind turbine.							
CO5:	Understand the working of boiler operation and identify engine components, and exhaust emissions in IC engine.							
LIST OF EXPERIMENTS								
1.	a) Draw the Valve Timing Diagrams of four stroke Engine b) Determining the Flash and Fire Point of a given oil using Pensky apparatus							
2.	Performance test on 10 H.P, two-cylinder diesel engine using Hydraulic loading							
3.	Performance test on 5 H.P, single cylinder diesel engine with D.C. generator loading							
4.	Evaluation of Engine friction by conducting Morse test on MPFI Engine							
5.	Retardation test on 5 H.P, single cylinder diesel engine using mechanical loading							
6.	Heat Balance test on 5 H.P., single cylinder diesel engine with electrical loading							
7.	Performance test on Two stage reciprocating air compressor							
8.	Performance test on Blower rig							
9.	Determine the theoretical power coefficient of a laboratory model wind turbine using wind tunnel							
10.	Study of Boilers							
11.	Dismantling/Assembly of Engines to identify the parts and their positions in an engine.							
12.	Conduct exhaust gas Emission Test for measuring CO, CO ₂ , HC and NO _x of an IC Engine.							
Experiments beyond the curriculum:								
1.	Load test on 5 H.P diesel engine fuelled with blend of Biodiesel subjected to D.C. generator loading							
2.	Test on Vortex tube							
Note: Student has to perform at least 10 experiments from the above lists.								

THEORY OF MACHINES LAB (TOM(P))								
V Semester: Mechanical Engineering						Scheme: 2023		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
ME305	PC	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
		0	0	3	1.5	30	70	100
End Exam Duration: 3 Hrs								
Course Outcomes: At the end of the course students will be able to								
CO1:	Balance rotating masses in different planes and draw the characteristic curves of governors.							
CO2:	Measure the critical speed of the shaft with fixed end conditions.							
CO3:	Measure vibration characteristics of spring mass system, rotor system and damped system.							
LIST OF EXPERIMENTS								
1.	a) Determination of Radius of Gyration of Connecting Rod b) Displacement, Velocity & Acceleration analysis of Cam & Follower							
2.	Longitudinal Vibrations of Spring-Mass System							
3.	Performance characteristic curves of Watt and Porter Governors using Universal Governor apparatus							
4.	Performance characteristic curves of Proell and Hartnell Governors using Universal Governor apparatus							
5.	Static and Dynamic balancing of rotating masses							
6.	Verification of magnitude of gyroscopic couple & applied couple on motorized gyroscope							
7.	Study of Damped and Un-damped Torsional Vibrations							
8.	Torsional Vibrations of Single and Two Rotor System							
9.	Verification of Dunkerley's Rule							
10.	Determination of Critical speed or Whirling speed of shaft							
Experiments beyond the curriculum:								
1.	Determine the natural frequencies of a rectangular plate with free-free boundary conditions							
2.	Draw the mode shapes of a rectangular plate with free-free boundary conditions							
Note: Student has to perform at least 10 experiments from the above lists								
Virtual labs:								
1.	https://dom-nitk.vlabs.ac.in/							
2.	https://va-coep.vlabs.ac.in/							
3.	https://mdmv-nitk.vlabs.ac.in/							

MACHINE TOOLS & METROLOGY LAB (MTM(P))								
V Semester: Mechanical Engineering						Scheme: 2023		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
SCME01	SEC	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
		0	1	2	2	30	70	100
End Exam Duration: 3 Hrs								
Course Outcomes: At the end of the course students will be able to								
CO1:	Perform step turning, taper turning, eccentric turning and thread cutting on cylindrical work piece using lathe machine.							
CO2:	Perform drilling, shaping and slotting operations on work piece using relevant machine tools.							
CO3:	Prepare single point cutting tools using Tool and cutter grinder.							
CO4:	Measure the taper angle of external and internal taper.							
CO5:	Determine the elements of screw threads and gear elements using metrology equipment.							
LIST OF EXPERIMENTS								
1.	To perform Step turning and Taper turning by compound swivel method on Lathe							
2.	To perform Eccentric turning on Lathe.							
3.	Right hand thread cutting and Left hand thread cutting on Lathe.							
4.	To perform Drilling, reaming, tapping and counter sinking on Drilling machine.							
5.	Making Square rod from round rod using shaper.							
6.	a) Making of a Single point cutting tool by cup grinding wheel on tool cutter grinder. b) Key way cutting on slotting machine.							
7.	Measurement of angle of Taper plug gauge and Ring gauge.							
8.	Measurement of taper angle of an object using Sine bar.							
9.	Measurement of parameters of Screw Threads.							
10.	Measurement of Gear parameters.							
11.	Measurement of co-ordinates of Jig plate							
12.	a) To find small angles and length measurement on objects using Tool Makers micro Scope. b) To find small angles and length measurement on objects using Profile Projector							
13.	Measurement of surface roughness using surface roughness tester							
Note: Student has to perform at least 10 experiments from the above lists								
Online Learning resources:								
1.	https://www.youtube.com/watch?v=sG6GCfX7L3c&pp=ygUeTWFjaGluZSBUb29scyAgbGFiIGV4cGVyaW1lbnRz							
2.	https://www.youtube.com/watch?v=mafthRhZ1iM&pp=ygUeTWFjaGluZSBUb29scyAgbGFiIGV4cGVyaW1lbnRz							
3.	https://www.youtube.com/watch?v=5—saqoYBE&list=PLrcSDk_gQ7jiQCfWEzw93ZMaxHkg2v-CC							
4.	https://www.youtube.com/watch?v=m60m2TcbTgc&pp=ygUZbWV0cm9sb2d5IGxhYiBleHBlcmltZW50cw							

TINKERING LAB (TL(P))								
V Semester: Common for all branches						Scheme: 2023		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
ESCM02	ES	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
		0	0	2	1	30	70	100
End Exam Duration: 3 Hrs								
Course Outcomes: At the end of the course students will be able to								
CO1:	The students will be able to experiment, innovate, and solve real-world challenges.							
LIST OF EXPERIMENTS								
1.	Make your own parallel and series circuits using breadboard for any application of your choice.							
2.	Demonstrate a traffic light circuit-using breadboard.							
3.	Build and demonstrate automatic Street Light using LDR.							
4.	Simulate the Arduino LED blinking activity in Tinkercad.							
5.	Build and demonstrate an Arduino LED blinking activity using Arduino IDE.							
6.	Interfacing IR Sensor and Servo Motor with Arduino.							
7.	Blink LED using ESP32.							
8.	LDR Interfacing with ESP32.							
9.	Control an LED using Mobile App.							
10.	Design and 3D print a Walking Robot							
11.	Design and 3D Print a Rocket.							
12.	Build a live soil moisture-monitoring project, and monitor soil moisture levels of a remote plan in your computer dashboard.							
13.	Demonstrate all the steps in design thinking to redesign a motor bike.							
References:								
1.	https://aim.gov.in/pdf/equipment-manual-pdf.pdf							
2.	https://atl.aim.gov.in/ATL-Equipment-Manual/							
3.	https://aim.gov.in/pdf/Level-1.pdf							
4.	https://aim.gov.in/pdf/Level-2.pdf							
5.	https://aim.gov.in/pdf/Level-3.pdf							

HEAT TRANSFER (HT)								
VI Semester: Mechanical Engineering						Scheme: 2023		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
ME306	PC	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
		3	0	0	3	30	70	100
Sessional Exam Duration: 2 Hrs					End Exam Duration: 3 Hrs			
Course Outcomes: At the end of the course, students will be able to								
CO1:	Understand and apply analytical methods to solve steady and unsteady heat conduction problems.							
CO2:	Evaluate convective heat transfer related to plates and cylinders.							
CO3:	Analyze and distinguish between different boiling regimes and condensation modes, and solve related heat transfer problems in engineering applications.							
CO4:	Design and analyze the heat exchanger configurations.							
CO5:	Apply radiation laws and mass transfer principles to analyze and solve problems involving radiative heat exchange and diffusive transport in engineering systems.							
UNIT – I								
Introduction: Basic modes of heat transfer- Heat Transfer rate equations- Generalized heat conduction equation- Cartesian and cylindrical forms. – Steady state heat conduction solution for plain and composite slabs – cylinders – Critical thickness of insulation- Heat conduction through Fins of uniform cross section- Fin effectiveness and efficiency.								
Unsteady State Heat Transfer Conduction: Transient heat conduction- Lumped system analysis and use of Heisler charts.								
UNIT – II								
Convection: Basic concepts of convection–heat transfer coefficients – types of convection - forced convection and free convection.								
Free Convection: Development of hydrodynamic and thermal boundary layer along a vertical plate – use of empirical relations for convective heat transfer on plates and cylinders in horizontal and vertical orientation								
Forced convection: In external flow–concepts of Hydrodynamic and Thermal boundary layer- use of empirical correlations for flow over plates and cylinders. Fluid friction-heat transfer analogy, approximate solution to laminar boundary layer equation for external flow. Internal flow – Use of empirical relations for convective heat transfer in horizontal pipe flow- problems.								
UNIT – III								
Boiling and Condensation: Different regimes of boiling- nucleate, transition and film boiling –condensation – Film wise and Drop wise condensation- Problems.								
UNIT – IV								
Heat Exchangers: Types of heat exchangers- parallel flow- counter flow- cross flow heat exchangers, overall heat transfer coefficient, LMTD and NTU methods- problems.								
UNIT – V								
Radiation: Radiation heat transfer, thermal radiation, laws of radiation, Black and Gray bodies, shape factor, radiation exchange between surfaces, Radiation Shields.								
Mass Transfer: Conservation laws and constitutive equations- Fick’s law of diffusion.								
Text Books:								
1. P K Nag, Heat and Mass Transfer, Tata McGraw-Hill, New Delhi.								

2. J P Holman, Heat Transfer, Tata McGraw Hill, Singapore.
3. R C Sachdeva, Fundamentals of Engineering Heat and Mass transfer, New Age International Publishers, New Delhi.
Reference Books:
1. F P Incropera and D P Dewitt, Fundamentals of Heat and Mass Transfer, John Wiley.
2. Cengel A Yunus, Heat Transfer- A Practical Approach, Tata McGraw-Hill, New Jersey.
3. S P Sukhatme, A Text book of Heat Transfer, Universities Press, Hyderabad.
4. S C Arora and S Domkundwar, A Course in Heat and Mass Transfer, Dhan pat Rai & CO.(P) LTD-Delhi.
Data Hand Book:
1. B Sreenivasa Reddy and K Hemachandra Reddy, Thermal Data Handbook, IK International Publishers, Bangalore.
Online Resources:
1. https://ocw.mit.edu/courses/mechanical-engineering/2-051-introduction-to-heat-transfer-fall-2015/
2. https://www.udemy.com/topic/heat-transfer/
3. https://www.youtube.com/watch?v=TWtQx3W-2k8
4. https://onlinecourses.nptel.ac.in/noc20_ch21/preview
5. https://ekeeda.com/degree-courses/mechanical-engineering/heat-transfer
6. https://www.coursera.org/lecture/thermodynamics-intro/02-04-heat-transfer-gyDfJ
7. https://www.youtube.com/watch?v=cjJ2LV5lkB8
Question Paper Pattern:
Sessional Exam: The question paper for Sessional Examination shall be for 40 marks. The question paper shall consist of Four questions and all questions are compulsory. Question No.1 shall contain Five compulsory short answer questions for a total of Ten marks. Question No.2 to 4 shall be EITHER/OR Type for Ten marks each. Student shall Answer any one of them. Each of these questions may contain sub-questions. End Examination: The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions and all questions are compulsory. Question No.1 shall contain Ten compulsory short answer questions for a total of Twenty marks (with Two short answer questions from each unit). Question No.2 to 6 shall be EITHER/OR Type for Ten marks each and shall cover one Unit of the Syllabus for each question. Student shall Answer any one of them. Each of these questions may contain sub-questions.

CAD/CAM (CADM)								
VI Semester: Mechanical Engineering						Scheme: 2023		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
ME307	PC	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
		3	0	0	3	30	70	100
Sessional Exam Duration: 2 Hrs					End Exam Duration: 3 Hrs			
Course Outcomes: At the end of the course the student will be able to								
CO1:	Understand the need for CAD/CAM, 3D modelling, Geometric modelling and Computer Graphics							
CO2:	Describe the construction and features of wireframe, solid, and surface models using Bezier, B-spline, and other parametric representations.							
CO3:	Apply the concepts of NC and CNC to write the part programs for various machining operations.							
CO4:	Describe the part classification using group technology and flexible manufacturing systems for layout optimization.							
CO5:	Explain the concepts of material handling systems and computer-integrated manufacturing for effective production planning.							
UNIT – I								
Fundamentals of CAD: The design process, applications of computers for design, benefits of CAD, Computer configuration for CAD application, Computer peripherals for CAD, Design of work station and Graphic terminal. CAD software: Definition of system software and application software. CAD database and structure Geometric Modelling: 3-D wire frame modelling, wire frame entities and their definitions, Interpolation and approximation of curves, concept of parametric and non-parametric representation of curves								
UNIT – II								
Curve and Surface Modelling: Generation of plane and space curves. Wire frame models and curve representation - parametric representation of curved shapes - cubic spline, Bezier, B-spline curves. Curve manipulations, Introduction to surface modelling. Solid Modelling: Solid models and entities, solid representation, fundamentals of solid modelling, Boundary representation (B-rep), Constructive Solid Geometry (CSG) and sweep representation, Solid manipulations								
UNIT – III								
Numerical Control of Manufacturing: Numerical control (NC) definition, Classification of NC machines, Open loop, Closed loop, Absolute, Incremental system, Advantages of NC machines, Machining Centre, Method of NC part programming, computer assisted programming, APT language, APT statements, geometric statement, Motion statement, Post processing statement, Auxiliary statements, Structure of APT programming, simple problems using APT language. CNC, DNC, Adaptive control.								
UNIT – IV								
Group Technology (GT): Group technology fundamentals, Part classification methods, coding systems, advantages of GT, applications of GT Flexible Manufacturing Systems (FMS): Introduction to FMS, components of FMS, computer system configuration, FMS layouts, FMS compared to other types of manufacturing systems, Types of FMS, benefits of FMS, applications of FMS								
UNIT – V								
Material Handling: Types of material handling equipment, Automated guided vehicles (AGVs), Vehicle guidance and routing; Traffic control, Benefits of AGVs								

Computer Integrated manufacturing (CIM): Computerized elements of CIM, Computer integrated production planning systems, Computer aided process planning (CAPP), Retrieval type CAPP system, Generative type CAPP system

Text Books:

1. Ibrahim Zeid, CAD/CAM Theory and Practice, TMH Publishers, New Delhi.
2. M P Groover and E W Zimmers, CAD/CAM, PHI Publishers, New Delhi.
3. Mikell P Groover, Automation of Production Systems and Computer Integrated Manufacturing, PHI Publishers, New Delhi.

Reference Books:

1. P N Rao, CAD/CAM principles and operations, Tata McGraw Hill.
2. Joe Rooney and Philip, Principles of CAD, EWP Publishers, New Delhi.
3. K Lalith Narayan, K Mallikarjuna Rao and M M M Sarcar, Computer Aided Design and Manufacturing, PHI Private Limited, New Delhi.

Question Paper Pattern:

Sessional Exam: The question paper for Sessional Examination shall be for 40 marks. The question paper shall consist of Four questions and all questions are compulsory. Question No.1 shall contain Five compulsory short answer questions for a total of Ten marks. Question No.2 to 4 shall be EITHER/OR Type for Ten marks each. Student shall Answer any one of them. Each of these questions may contain sub-questions.

End Examination: The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions and all questions are compulsory. Question No.1 shall contain Ten compulsory short answer questions for a total of Twenty marks (with Two short answer questions from each unit). Question No.2 to 6 shall be EITHER/OR Type for Ten marks each and shall cover one Unit of the Syllabus for each question. Student shall Answer any one of them. Each of these questions may contain sub-questions.

OPERATIONS RESEARCH (OR)								
VI Semester: Mechanical Engineering					Scheme: 2023			
Course Code	Category	Hours/Week			Credits	Maximum Marks		
ME308	PC	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
		3	0	0	3	30	70	100
Sessional Exam Duration: 2 Hrs					End Exam Duration: 3 Hrs			
Course Outcomes: At the end of the course the student will be able to								
CO1:	Understand Basics of operations research and solve linear programming problems.							
CO2:	Solve Transportation and assignment problems.							
CO3:	Solve game and inventory related problems.							
CO4:	Solve the sequencing related problems.							
CO5:	Solve queuing and replacement problems.							
UNIT – I								
Introduction: Definition, Basic OR models & Applications of OR. Linear Programming : Introduction, Formulation of Linear Programming Problems (LPP), Graphical method of solving LPP, simplex method, Artificial variable Technique, Special cases in LP - Degeneracy in LPP's, unbounded, infeasible and multiple optimum solution, Duality in LP.								
UNIT – II								
Transportation Models: Finding an initial basic feasible solution – North West Corner method, Least cost method, Vogel's Approximation Method; Finding the optimal solution using MODI method, Special cases in Transportation problems – Unbalanced Transportation problem, Degeneracy in transportation problem, multiple optimal solutions, prohibited routes. Assignment Problems: Hungarian Assignment method, maximization in Assignment problem, unbalanced Assignment problem, prohibited Assignments, multiple optimum solutions.								
UNIT – III								
Game Theory : Introduction, Two-person zero sum games, Maxi-min and Mini-max principles, Principle of dominance, solution of mixed strategy problems, Graphical method for $2 \times n$ and $m \times 2$ games. Inventory Management: Introduction, inventory - types, costs; Fixed order quantity vs Periodic review system, Deterministic models – basic EOQ model, Production run model, Selective inventory control – ABC analysis, Simple problems.								
UNIT – IV								
Sequencing Models: Introduction, General Assumptions, Priority rules for job sequencing (Single machine Scheduling), Measures of Performance - Average Completion Time, Average Lateness; Processing n jobs thorough 2 machines (Johnson's Algorithm), Processing n jobs through 3 machines, Processing n jobs thorough m machines, Processing 2 jobs through m machines (Graphical Method).								
UNIT – V								
Queuing Theory: Introduction, Terminology, Elements of Queuing system, Characteristics of Queuing system, Single Channel – Poisson arrivals – Exponential service times with infinite population & finite population; Multi-channel – Poisson arrivals – Exponential service times with infinite population. Replacement Theory: Introduction, replacement of items that deteriorate gradually ignoring change in money value, replacement of items that deteriorate considering								

change in money value with time, replacement of items that fail suddenly – Individual replacement policy, Group replacement policy.
Text Books:
1. S D Sarma, Operations Research, Kedarnath, Ramnath & Co., Meerut.
2. N D Vohra, Quantitative Techniques in Management, TMH Publishers, New Delhi.
Reference Books:
1. V K Kapoor, Operations Research, S Chand Publishers, New Delhi.
2. Prem Kumar Gupta and Hira, Operations Research, S Chand Publishers, New Delhi.
3. Hamdy, A Taha, Operations Research-An Introduction, Prentice Hall of India Pvt. Ltd.
4. S Kalavathi, Operations Research, Vikas Publishers.
Online Resources:
1. https://nptel.ac.in/courses/103/105/103105140/
2. https://nptel.ac.in/courses/112/101/112101097/
3. https://nptel.ac.in/courses/103/101/103101137/
Question Paper Pattern:
Sessional Exam: The question paper for Sessional Examination shall be for 40 marks. The question paper shall consist of Four questions and all questions are compulsory. Question No.1 shall contain Five compulsory short answer questions for a total of Ten marks. Question No.2 to 4 shall be EITHER/OR Type for Ten marks each. Student shall Answer any one of them. Each of these questions may contain sub-questions. End Examination: The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions and all questions are compulsory. Question No.1 shall contain Ten compulsory short answer questions for a total of Twenty marks (with Two short answer questions from each unit). Question No.2 to 6 shall be EITHER/OR Type for Ten marks each and shall cover one Unit of the Syllabus for each question. Student shall Answer any one of them. Each of these questions may contain sub-questions.

HEAT TRANSFER LAB (HT(P))								
VI Semester: Mechanical Engineering					Scheme: 2023			
Course Code	Category	Hours/Week			Credits	Maximum Marks		
ME309	PC	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
		0	0	3	1.5	30	70	100
End Exam Duration: 3 Hrs								
Course Outcomes: At the end of the course, students will be able to								
CO1:	Determine the thermal conductivity of composite wall, metal rod, insulating powder and insulating material.							
CO2:	Measure the emissivity of the test plate surface and determine stefan Boltzman constant of radiation heat transfer.							
CO3:	Determine the surface heat transfer coefficient for heated vertical cylinder in natural convection, and drop and film wise condensation.							
CO4:	Compare LMTD and effectiveness in parallel and counter flow heat exchanger and determine critical heat flux.							
CO5:	Analyze pin fin efficiency, unsteady state heat transfer, and refrigeration system performance experimentally.							
LIST OF EXPERIMENTS								
1.	Determine the overall conductance for a composite wall							
2.	Determine the thermal conductivity of a metal rod							
3.	Determine the thermal conductivity of insulating powder material through concentric sphere apparatus							
4.	Determine the thermal conductivity of insulating material through lagged pipe apparatus							
5.	Determine the efficiency of a pin fin in natural and forced convection.							
6.	Determine the heat transfer coefficient for a vertical cylinder in natural convection							
7.	Test on critical heat flux apparatus							
8.	Determine the heat transfer coefficients on film and drop wise condensation apparatus.							
9.	Determine the LMTD and effectiveness of a parallel and counter flow heat exchanger.							
10.	Study of Unsteady state heat Transfer							
11.	Determine the emissivity of the test plate surface.							
12.	Experiment on Stefan-Boltzmann apparatus							
13.	Performance test on refrigeration tutor							
Note: Student has to perform at least 10 experiments from the above list								
Virtual labs:								
1.	https://ht-amrt.vlabs.ac.in/							
2.	https://ht-nitk.vlabs.ac.in/							

COMPUTER AIDED MANUFACTURING LAB (CAM (P))								
VI Semester: Mechanical Engineering					Scheme: 2023			
Course Code	Category	Hours / Week			Credits	Maximum Marks		
ME310	PC	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
		0	0	3	1.5	30	70	100
End Exam Duration : 3 Hrs								
Course Outcomes: At the end of the course students will be able to								
CO1:	Simulate the components in ESPIRIT CAM, MASTER CAM and EDGE CAM.							
CO2:	Write and execute CNC part programs on turning using G and M codes and manufacture components on CNC machines.							
CO3:	Write and execute CNC part programs on milling using G and M codes and manufacture components on CNC machines.							
LIST OF EXPERIMENTS								
1. Turning Simulation on ESPIRIT CAM								
2. Milling Simulation on ESPIRIT CAM.								
3. Turning Simulation on MASTER CAM LATHE								
4. Milling Simulation on MASTER CAM MILLING								
5. Turning Simulation on EDGE CAM								
6. Milling Simulation on EDGE CAM								
7. Producing Work piece on HITECH CNC LATHE(Step Turning)								
8. Producing Work piece on HITECH CNC LATHE (Taper Turning)								
9. Producing Work piece on HITECH CNC LATHE (Radius turning)								
10. Producing Work piece on HITECH CNC MILLING (Model-1)								
11. Producing Work piece on HITECH CNC MILLING (Model-2)								
12. Producing Work piece on HITECH CNC MILLING (Model-3)								
Note: Student has to perform at least 10 experiments from the above lists								

COMPUTER AIDED ENGINEERING LAB (CAE (P))								
VI Semester: Mechanical Engineering					Scheme: 2023			
Course Code	Category	Hours / Week			Credits	Maximum Marks		
SCME02	SEC	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
		0	1	2	2	30	70	100
End Exam Duration : 3 Hrs								
Course Outcomes: At the end of the course, students will be able to								
CO1:	Understand basic features of ANSYS.							
CO2:	Analyze the deformation and stresses in beams, trusses and plate using ANSYS.							
CO3:	Analyze heat transfer on plates using ANSYS.							
LIST OF EXPERIMENTS								
1.	Introduction to ANSYS software							
2.	Analysis of 2D Truss							
3.	Analysis of plate with a hole subjected to tensile loading							
4.	Analysis of flat rectangular plate with a hole under Plane Stress conditions							
5.	Analysis of a bracket							
6.	Exercise on simple conduction							
7.	Analysis of square plate considering conduction and convection							
8.	Stress and deflection analysis of cantilever beams							
9.	Stress analysis of simply supported beams							
10.	Analysis of bars with different materials							
11.	Analysis of taper bar							
12.	Coupled analysis (structural and thermal)							
Experiments beyond the curriculum:								
1.	Modal analysis of beams							
2.	Fracture Toughness and Fatigue problems							
Note: Student has to perform at least 10 experiments from the above list								

TECHNICAL REPORT WRITING & IPR (TPW & IPR)								
VI Semester: Common for all Branches						Scheme: 2023		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
AC301	AC	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
		2	0	0	0			
Course Outcomes: At the end of the course, students will be able to								
CO1:	Develop precise and ethical technical writing with logical structure and critical analysis.							
CO2:	Formulate and present structured research content and synopsis.							
CO3:	Understand and apply the principles of publishing, journal types, indexing with proper citation and plagiarism standards.							
CO4:	Understand fundamental knowledge of intellectual property rights, international frameworks and registration of trademarks.							
CO5:	Understand the fundamentals of laws of copyrights and patents, intellectual property audits.							
UNIT – I								
Principles of Technical Writing: Styles in technical writing; clarity, precision, coherence and logical sequence in writing, avoiding ambiguity, repetition, and vague language, highlighting your findings, discussing your limitations, hedging and criticizing, plagiarism and paraphrasing.								
UNIT – II								
Technical Research Paper Writing: Abstract, Objectives, Limitations, Review of Literature, Problems and Framing Research Questions, Synopsis.								
UNIT – III								
Process of research: publication mechanism: Types of journals, indexing, seminars, conferences, proof reading, plagiarism style; seminar & conference paper writing; Methodology, discussion, results and citation rules.								
UNIT – IV								
Introduction to Intellectual property: Introduction, types of intellectual property, International organizations, agencies and treaties, importance of intellectual property rights Trade Marks: Purpose and function of trademarks, acquisition of trade mark rights, protectable matter, selecting and evaluating trade mark, trade mark registration processes.								
UNIT – V								
Law of copy rights: Fundamentals of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law Law of patents: Foundation of patent law, patent searching process, ownership rights and transfer. Patent law, intellectual property audits.								
Text Books:								
1. Deborah. E Bouchoux, Intellectual Property Rights, Cengage Learning India								
2. Meenakshi Raman and Sangeeta Sharma. Technical Communication: Principles and practices. Oxford.								
Reference Books:								
1. R Myneni, Law of Intellectual Property, Asia law House.								
2. Prabuddha Ganguli, Intellectual Property Rights Tata Mcgraw Hill, New Delhi								
3. Adrian Wallwork. English for Writing Research Papers, Second Edition. Springer Cham								

Heidelberg New York.
Online Resources:
1. https://theconceptwriters.com.pk/principles-of-technical-writing/ 2. https://lawbhoomi.com/intellectual-property-rights-notes/ 3. https://www.extension.purdue.edu/extmedia/ec/ec-723.pdf

List of Professional Elective Courses

Professional Elective - I

1. Tool Design
2. Nano Technology
3. Mechanical Behavior of Materials
4. Work Study and Ergonomics
5. Internal Combustion Engines & Gas Turbine

Professional Elective - II

1. Engineering Fracture Mechanics
2. Automobile Engineering
3. Control systems
4. Finite Element Methods
5. Smart Materials

Professional Elective - III

1. Computational Fluid Dynamics
2. Fluid Power Systems
3. Refrigeration & Air Conditioning
4. Mechanics & Manufacturing of Composite Materials
5. Introduction to Hybrid and Electric vehicles

TOOL DESIGN (TD)								
V Semester: Mechanical Engineering						Scheme: 2023		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
ME311	PE-I	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
		3	0	0	3	30	70	100
Sessional Exam Duration: 2 Hrs					End Exam Duration: 3 Hrs			
Course Outcomes: At the end of the course the student will be able to								
CO1:	Apply Merchant's theory and cutting mechanics to analyze forces, tool wear, and tool life in metal cutting.							
CO2:	Explain tool materials, cutting fluids, and evaluate machining parameters for economic production.							
CO3:	Demonstrate the design principles of single-point cutting tools, twist drills, and milling cutters based on functional requirements.							
CO4:	Describe press working operations and identify key design factors for dies and press tools.							
CO5:	Demonstrate the principles and design considerations of jigs and fixtures.							
UNIT – I								
Metal Cutting: Classification of metal cutting operations, Mechanics of metal cutting, Tool signature, Oblique and orthogonal cutting, Review of Merchant's theory of metal cutting, Two component tool dynamometer.								
Tool Wear and Tool Life: Sources of heat in metal cutting, Heat dissipation and distribution to chip, Tool and work piece, Methods of evaluating temperature at tool-chip interface. Machinability, Factors affecting machinability, Mechanism of tool wear and various types of tool wear-crater wear and flank wear. Introduction to tool life, Taylor's tool life equation, Effects of tool geometry, Feed, Depth of cut, Cutting speed on tool life.								
UNIT – II								
Cutting Tool Materials: Essential requirements of a tool material, tool materials - HCS, HSS, Cast alloys, Carbides, Ceramic tools, Diamond tool bits.								
Cutting Fluids: Essential requirements of a good cutting fluid, types of cutting fluids and their relative applications.								
Economics of Machining: Introduction, economic tool life, derivations on optimal cutting speed to – maximum production, maximum profit and minimum cost criteria.								
UNIT – III								
Design of Cutting Tools: Design of single point cutting tool, elements of twist drill and its design considerations, Design of milling cutters.								
UNIT – IV								
Press Working: Press working terminology, press operations - punching, blanking and other types of press working operations, drawing and deep drawing, bending and forging, Design considerations for forging and bending dies.								
Press Tools: types of cutting dies and their working, design considerations for press tools- centre of pressure, scrap strip layout, press tonnage capacity, etc.								
UNIT – V								
Jigs & fixtures: Fundamental ideas and principles of Jigs and Fixtures. Design of drill jigs and fixtures for turning, drilling, milling, broaching and grinding operations. Locating and clamping devices of jigs and fixtures. Indexing devices and types. Different types of jigs & fixtures. Design of a jig and fixtures for the given component by using Computer Aided Design								
Text Books:								
1. Ranganath B J, Tool Engineering Design, Vikas publishing house pvt.ltd, New Delhi.								
2. Cyril Donaldson, H Le Cain George, V C Goold and Joyjeet Ghose, Tool Design, McGraw								

Hill Education, New Delhi.
3. Ashok Kumar Singh, Metal Cutting and Tool Design, Vayu Education of India, New Delhi.
4. P H Joshi, Jigs and Fixtures, McGraw Hill Education, New Delhi.
Reference Books
1. Amerego E J and Brown R H , The Machining of Metals, Prentice Hall, New Jersey.
2. N K Mehta, Metal Cutting and Design of Cutting Tools - Jigs and Fixture, McGraw Hill Education, New Delhi.
Question Paper Pattern:
Sessional Exam: The question paper for Sessional Examination shall be for 40 marks. The question paper shall consist of Four questions and all questions are compulsory. Question No.1 shall contain Five compulsory short answer questions for a total of Ten marks. Question No.2 to 4 shall be EITHER/OR Type for Ten marks each. Student shall Answer any one of them. Each of these questions may contain sub-questions. End Examination: The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions and all questions are compulsory. Question No.1 shall contain Ten compulsory short answer questions for a total of Twenty marks (with Two short answer questions from each unit). Question No.2 to 6 shall be EITHER/OR Type for Ten marks each and shall cover one Unit of the Syllabus for each question. Student shall Answer any one of them. Each of these questions may contain sub-questions.

NANO TECHNOLOGY (NT)								
V Semester: Mechanical Engineering						Scheme: 2023		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
ME312	PE-I	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
		3	0	0	3	30	70	100
Sessional Exam Duration: 2 Hrs					End Exam Duration: 3 Hrs			
Course Outcomes: At the end of the course, students will be able to								
CO1:	Understand the fundamentals of nano science and nanotechnology, including the history, classification and analyze the structural aspects of nanomaterials.							
CO2:	Knowledge of the synthesis and fabrication techniques used in nano science, and methods for realizing semiconductor nanostructures.							
CO3:	Advanced characterization techniques used for analysing the structural, morphological, and electronic properties of nanomaterials.							
CO4:	Explore carbon nanomaterials properties and wide-ranging applications.							
CO5:	Familiarize with the diverse applications of nanotechnology, with emphasis on nanostructured thin films and quantum dots.							
UNIT – I								
Introduction: History of nano science, Definition of nano meter, Nano materials, Nano technology. Classification of nano materials. Crystal symmetries, Crystal directions, Crystal planes. Band structure.								
Properties Of Materials: Mechanical properties, Electrical properties, Dielectric properties, Thermal properties, Magnetic properties, Opto electronic properties. Effect of size reduction on properties, Electronic structure of nano materials.								
UNIT – II								
Synthesis and Fabrication: Synthesis of bulk polycrystalline samples, Growth of single crystals. Synthesis techniques for preparation of nano particle – Bottom Up Approach – sol gel synthesis, Hydro thermal growth, Thin film growth, PVD and CVD; Top Down Approach – Ball milling, Micro fabrication, Lithography.								
UNIT – III								
Characterization Techniques: X-Ray diffraction and Scherrer method, Scanning electron microscopy, Transmission electron microscopy, Scanning probe microscopy, Atomic force microscopy, Piezoresponse microscopy, X-ray photoelectron spectroscopy, XANES and XAFS, angle resolved photoemission spectroscopy, Diffuse reflectance spectra, Photoluminescence spectra, Raman spectroscopy								
UNIT – IV								
Semiconductor Nanostructures and Manufacturing: Overview of semiconductor nanomaterials, Quantum wells, wires, and dots; Bandgap engineering in nanostructures, Epitaxial growth methods: MBE, MOCVD; Photolithography, Nanoimprint lithography, Etching techniques, Integration of semiconductor nanostructures in devices.								
UNIT – V								
Applications of Nano Technology: Applications in material science, Biology and medicine, surface science, Energy and environment. Applications of nano structured thin fins, Applications of quantum dots.								
Text Books:								
1. M S Ramachandra Rao and Shubra Singh, Nano science and nano technology, Wiley publishers								
2. Risal Singh and Shipra Mital Gupta, Introduction to Nanotechnology, Oxford Higher Education								

Reference Books:

1. Charles P Poole and Frank J Owens, Introduction to Nano Technology, Wiley publishers
2. Jermy J Ramsden, Nanotechnology, Elsevier publishers
3. A K Bandyopadhyay, Nano Materials, New Age
4. M A Shah, K A Shah, Nanotechnology the Science of Small, Wiley Publishers.

Online Learning Resources:

1. https://youtube.com/playlist?list=PLyqSpQzTE6M8682dGkNTN8936vSY4CbqZ&si=8S682KjXK7_xITpT
2. <https://youtu.be/OLa8DQkKlyU?si=I6R1Of59MArQyPUb>
3. <https://youtu.be/u1ojNgPCHGs?si=mlIgQm4OdwZnHUo3>

Question Paper Pattern:

Sessional Exam: The question paper for Sessional Examination shall be for 40 marks. The question paper shall consist of Four questions and all questions are compulsory. Question No.1 shall contain Five compulsory short answer questions for a total of Ten marks. Question No.2 to 4 shall be EITHER/OR Type for Ten marks each. Student shall Answer any one of them. Each of these questions may contain sub-questions.

End Examination: The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions and all questions are compulsory. Question No.1 shall contain Ten compulsory short answer questions for a total of Twenty marks (with Two short answer questions from each unit). Question No.2 to 6 shall be EITHER/OR Type for Ten marks each and shall cover one Unit of the Syllabus for each question. Student shall Answer any one of them. Each of these questions may contain sub-questions.

MECHANICAL BEHAVIOUR OF MATERIALS (MBM)								
V Semester: Mechanical Engineering						Scheme: 2023		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
ME313	PE-I	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
		3	0	0	3	30	70	100
Sessional Exam Duration: 2 Hrs					End Exam Duration: 3 Hrs			
Course Outcomes: At the end of the course the student will be able to								
CO1:	Dictate the elastic behaviour of engineering materials, recall Hooke's law and apply the dislocation theory, forces on and between dislocations.							
CO2:	Distinguish strengthening mechanisms and strain aging mechanisms							
CO3:	List various modes of fracture and the basic mechanism of ductile and brittle fracture, Identify importance of Griffith's theory, and also the factors effecting DBTT.							
CO4:	Explain fatigue behaviour and testing. Differentiate HCF/LCF, thermo mechanical fatigue.							
CO5:	Explain stages in creep curve. Evaluate and predict the metallurgical factors affecting creep and creep different testing.							
UNIT – I								
Elastic and Plastic Behavior: Elastic behavior of materials – Hooke's law, plastic behavior: dislocation theory – Burger's vectors and dislocation loops, dislocations in FCC, HCP and BCC lattice, stress fields and energies of dislocations, forces on and between dislocations, slip and twinning.								
UNIT – II								
Strengthening Mechanisms: Cold Working, Grain Size Strengthening, Solid Solution Strengthening, Martensitic Strengthening, Precipitation Strengthening, Dispersion Strengthening, Fibre Strengthening, Examples. Yield Point Phenomenon, Strain aging and Dynamic strain aging.								
UNIT – III								
Fracture and Fracture Mechanics: Types of Fracture, Basic Mechanism of Ductile and Brittle Fracture, Griffith's Theory of Brittle Fracture, Ductile to Brittle Transition Temperature (DBTT), Factors Affecting DBTT, Determination of DBTT. Fracture Mechanics- Introduction, Modes of Fracture, Stress Intensity Factor, Strain Energy Release Rate, Fracture Toughness and Determination of KIC.								
UNIT – IV								
Fatigue Behaviour and Testing: Stress Cycles, S-N Curves, Effect of Mean Stress, Factors Affecting Fatigue, Structural Changes Accompanying Fatigue, Cumulative Damage, HCF / LCF, Thermo-mechanical Fatigue, Application of Fracture Mechanics to Fatigue Crack Propagation-Paris law- Fatigue Testing Machines.								
UNIT – V								
Creep Behavior and Testing: Creep Curve, Stages in Creep Curve and Explanation, Structural Changes during Creep, Creep Mechanisms, Metallurgical Factors Affecting Creep, High Temperature Alloys, Stress Rupture Testing, Creep Testing Machines.								
Text Books:								
1. G E Dieter, Mechanical Metallurgy, McGraw Hill, New Delhi								
2. H E Davis, G E Troxell and G E W Hauck, The Testing Of Engineering Materials, McGraw Hill.								
Reference Books:								
1. Wulff, The Structure and Properties of Materials, Vol. III— Mechanical Behavior of								

Materials], John Wiley and Sons.
2. R W K, Honey Combe Plastic Deformation of Materials], Edward Arnold Publishers.
3. A V K Suryanarayana, Testing of Metallic Materials], Prentice Hall India, New Delhi.
Question Paper Pattern:
Sessional Exam: The question paper for Sessional Examination shall be for 40 marks. The question paper shall consist of Four questions and all questions are compulsory. Question No.1 shall contain Five compulsory short answer questions for a total of Ten marks. Question No.2 to 4 shall be EITHER/OR Type for Ten marks each. Student shall Answer any one of them. Each of these questions may contain sub-questions. End Examination: The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions and all questions are compulsory. Question No.1 shall contain Ten compulsory short answer questions for a total of Twenty marks (with Two short answer questions from each unit). Question No.2 to 6 shall be EITHER/OR Type for Ten marks each and shall cover one Unit of the Syllabus for each question. Student shall Answer any one of them. Each of these questions may contain sub-questions.

WORK STUDY AND ERGONOMICS (WSE)								
V Semester: Mechanical Engineering						Scheme: 2023		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
ME314	PE-I	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
		3	0	0	3	30	70	100
Sessional Exam Duration: 2 Hrs					End Exam Duration: 3 Hrs			
Course Outcomes: At the end of the course, students will be able to								
CO1:	Remember the basic concepts of productivity, work content and work study.							
CO2:	Understand the concept of method study, principles of motion economy and work sampling.							
CO3:	Understand the basic work measurement techniques and to gain knowledge of measurement of work and rating							
CO4:	Analyse the basic concepts of Ergonomics and demonstrate a sound knowledge of Ergonomics in engineering applications							
CO5:	Apply the knowledge of Man-Machine Interfaces and design of displays and controls in engineering systems							
UNIT – I								
Productivity and Work Study: Definition of productivity, Task of management, Productivity of materials, land, Building, Machine and power, Factors affecting the productivity, Work content, Basic work content, Excess work content, How manufacturing job is made up, Work content due to excess product and process, Ineffective time due to short comings on part of the management.								
Definition, Objective and scope of Work Study: Work study and management, Work study and work.								
UNIT – II								
Method Study: Definition, Objective and scope of method study, Activity recording and tools, Flow Process Chart, Flow diagram, String Diagram, Travel Chart, Multiple Activity Chart.								
Principles of Motion Economy: Introduction, Classification of movements. Micromotion study, Therbligs								
Work Sampling: Need, Confidence levels, and sample size determination, Conducting study with problems.								
UNIT – III								
Time study: Definition, time study equipment, Selection of job, Steps in time study. Breaking jobs into elements.								
Recording information. Rating: Systems of rating, Standard rating, Standard performance, scales of rating. Allowances: Standard time determination, Predetermined motion time study (PMTS), factors affecting rate of working, Problems on allowances.								
UNIT – IV								
Introduction to Ergonomics: Human factors and ergonomics, Psychology, bio mechanics, Industrial design, graphics design, Anthropometry Morphology of design and its relationship with cognitive abilities of human being.								
Physical Ergonomics: Human anatomy, and some of the anthropometric, Physiological and bio mechanical characteristics as they relate to physical activity.								
Cognitive: Mental processes, such as perception, Memory, Reasoning, and motor response, Mental workload, and Decision-making.								
Organizational Ergonomics: Optimization of socio-technical systems, including their								

organizational structures, policies, processes. Communication, work design, cooperative work.

Environmental Ergonomics: Human interaction with the environment- Characterized by climate, temperature, pressure, vibration, light.

UNIT – V

Man-Machine Interaction; Man-Machine interaction cycle, Man-machine interfaces, Display factors that control choice of display, visual displays- qualitative displays; moving pointer displays, moving scale displays, digital displays Indicators, auditory displays, tactile displays. Factors affecting effectiveness of displays. Quantitative displays, check- reading displays, representational displays. Types of controls and their integration with displays.

Design Guidelines for Displays and Controls: Viewing distance, Illumination, Angle of view, reach etc., General design checklist for displays and controls. Standards for ergonomics in engineering and design, displays and controls.

Text Books:

1. Introduction to Work Study, ILO.
2. Mark S Sanders and Ernest J McCornick, Human Factor in Engineering and Design, McGraw-Hill Book Co., Inc., New York.

Reference Books:

1. S Dalela and Sourabh, Work Study and Ergonomics. Standard publishers.
2. Wesley Woodson, Peggy Tillman and Barry Tillman, Human Factors Design Handbook, McGraw-Hill.
3. Ralph M Barnes, Motion and Time Study, Wiley International.
4. Mark S Sanders and Ernest J McCormick, Human Factors in Engineering Design.

Online Learning Resources:

1. <https://youtu.be/b05FPBjFH6A?si=dWB1YOLOmSMRBSX7>
2. https://youtube.com/playlist?list=PLLy_2iUCG87BbIF6sF5sy_ZZLFoUcnncb&si=n1NAnNAnFTti9vtK
3. https://youtube.com/playlist?list=PLuF8VVHesRxXBZzQpQSzvJI7eM_SduxwR&si=j2vyTNYybgvXrDiy

Question Paper Pattern:

Sessional Exam: The question paper for Sessional Examination shall be for 40 marks. The question paper shall consist of Four questions and all questions are compulsory. Question No.1 shall contain Five compulsory short answer questions for a total of Ten marks. Question No.2 to 4 shall be EITHER/OR Type for Ten marks each. Student shall Answer any one of them. Each of these questions may contain sub-questions.

End Examination: The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions and all questions are compulsory. Question No.1 shall contain Ten compulsory short answer questions for a total of Twenty marks (with Two short answer questions from each unit). Question No.2 to 6 shall be EITHER/OR Type for Ten marks each and shall cover one Unit of the Syllabus for each question. Student shall Answer any one of them. Each of these questions may contain sub-questions.

INTERNAL COMBUSTION ENGINES AND GAS TURBINES (ICGT)								
V Semester: Mechanical Engineering					Scheme: 2023			
Course Code	Category	Hours/Week			Credits	Maximum Marks		
ME315	PE-I	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
		3	0	0	3	30	70	100
Sessional Exam Duration: 2 Hrs					End Exam Duration: 3 Hrs			

Course Outcomes : At the end of the course the student will be able to	
CO1:	Solve problems on engine performance parameters.
CO2:	Understand the combustion process, carburetion, emissions of engines.
CO3:	Understand the working of superchargers, turbo charging and sensors.
CO4:	Analyze the basic operation of a gas turbine and its component.
CO5:	Apply the basic concepts of rocket propulsion to solve related problems.
UNIT – I	
IC Engines: Introduction, Engine performance parameters, Calculation of engine power and efficiencies, Performance characteristics, Heat balance calculation, Measurement of friction power and brake power	
UNIT – II	
Carburetion: Air-fuel mixtures and its requirements, Principle of carburetion, Working of simple carburetor, Basic principle of mechanical and electronic fuel injection	
Combustion: Stages of combustion in SI engines and CI engines	
Emissions: Basic categories of engine emissions, causes of HC, CO, and NOx emissions and control methods	
UNIT – III	
Engine Electronics: Introduction, Engine management system, Position displacement and speed sensing sensors, Temperature and Intake air flow measurement	
Supercharging: Introduction, Advantages and limitations, Types of superchargers, Turbo charging.	
UNIT – IV	
Gas Turbines : Simple Gas Turbine, Ideal cycle, essential components, Open and closed cycle arrangements, Requirements of working medium, Applications of Gas Turbines, Comparison of Gas Turbines with reciprocating engines, Work output and efficiency of a simple Gas Turbine cycle, Optimum pressure ratio for maximum specific output, Gas Turbines with regeneration, Reheating and inter cooling	
UNIT – V	
Jet Propulsion: Introduction to Propeller engines and Gas Turbine engines, Working principle of Ramjet engine, Pulse jet engine, Turboprop engine and Turbojet engine, Thrust and thrust equation, Specific thrust, Parameters affecting flight performance, Introduction to Rocket propulsion, Classification of Rockets and principle of Rocket propulsion	
Text Books:	
1. V Ganesan, Internal Combustion Engines, TMH Publishers, New Delhi.	
2. V Ganesan, Gas Turbines, TMH Publishers, New Delhi.	
Reference Books:	
1. H N Gupta, Fundamentals of internal combustion engines, Prentice hall, New Delhi.	
2. P K Nag, Power Plant Engineering, McGraw hill, New Delhi.	
3. S L Soma Sundaran, Gas dynamics and Jet Propulsion, NAI Publishers, New Delhi.	
4. P L Ballaney, Thermal Engineering, Khanna Publishers, New Delhi.	

5. Sarvanamutto and GFC Rogers, Gas Turbine Theory, Pearson Education, New Delhi.
Online Learning Resources:
1. https://archive.nptel.ac.in/courses/112/103/112103262/
Question Paper Pattern:
Sessional Exam: The question paper for Sessional Examination shall be for 40 marks. The question paper shall consist of Four questions and all questions are compulsory. Question No.1 shall contain Five compulsory short answer questions for a total of Ten marks. Question No.2 to 4 shall be EITHER/OR Type for Ten marks each. Student shall Answer any one of them. Each of these questions may contain sub-questions. End Examination: The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions and all questions are compulsory. Question No.1 shall contain Ten compulsory short answer questions for a total of Twenty marks (with Two short answer questions from each unit). Question No.2 to 6 shall be EITHER/OR Type for Ten marks each and shall cover one Unit of the Syllabus for each question. Student shall Answer any one of them. Each of these questions may contain sub-questions.

ENGINEERING FRACTURE MECHANICS (EFM)								
VI Semester: Mechanical Engineering					Scheme: 2023			
Course Code	Category	Hours/Week			Credits	Maximum Marks		
ME316	PE-II	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
		3	0	0	3	30	70	100
Sessional Exam Duration: 2 Hrs					End Exam Duration: 3 Hrs			
Course Outcomes: At the end of the course the student will be able to								
CO1:	Apply LEFM, EPFM, and fatigue crack growth models to assess and prevent catastrophic structural failures at different loads.							
CO2:	Apply Griffith's theory, calculate energy release rates, and analyze crack propagation mechanisms in materials to predict and prevent fractures in engineering applications.							
CO3:	Analyze and apply the theory of elasticity and displacement in Mode I fracture, and understand the connection between the stress intensity factor (K) and the energy release rate (G).							
CO4:	Analyze and calculate multi-parameter stress fields for different fracture modes and apply Irwin's and Dugdale's models to understand deformation around crack tips.							
CO5:	Perform fracture toughness testing, apply crack growth models, and understand crack closure and failure assessment diagrams.							
UNIT – I								
EFM Course outline and Spectacular Failures, Introduction to LEFM and EPFM, Fatigue Crack Growth Model								
UNIT – II								
Crack Growth and Fracture Mechanisms, Griffith TMs Theory of Fracture, Energy Release Rate								
UNIT – III								
Review of Theory of Elasticity, Westergaard Solution for Stress and Displacements for Mode I, Relationship between K and G								
UNIT – IV								
Introduction to multi parameter stress field for Mode I, Mode II and Mixed Modes, SIF for Various Geometries, Modeling Plastic Deformation, Irwin TMs model, Dugdale Model								
UNIT – V								
Fracture Toughness Testing, Paris Law and Sigmoidal curve, Crack Closure, Crack Growth Models, J-Integral, Failure Assessment Diagram, Mixed Mode Fracture, Crack Arrest and Repair Methodologies								
Text Books:								
1. Prashant Kumar, Elements of Fracture Mechanics, Tata McGraw Hill, New Delhi.								
2. K R Y Simha, Fracture Mechanics for Modern Engineering Design, Universities Press (India) Limited.								
Reference Books:								
1. D Broek, Elementary Engineering Fracture Mechanics, Kluwer Academic Publishers, Dordrecht.								
2. T L Anderson, Fracture Mechanics Fundamentals and Applications, Taylor and Francis Group.								
3. K Ramesh, e-Book on Engineering Fracture Mechanics, IIT Madras.								
Online Resources:								
1. https://nptel.ac.in/courses/112106065								
2. https://youtube.com/playlist?list=PLA218B83235A4AD5C&si=XI175OWGIvdMCQH9								
3. https://youtube.com/playlist?list=PLA218B83235A4AD5C&si=ruHP1MIIsJGNAYMYV								
4. https://youtube.com/playlist?list=PLfIFNJ1DPG4ks5AjeCgpbm8nLGM1Pgxr&si=F-								

Question Paper Pattern:

Sessional Exam: The question paper for Sessional Examination shall be for 40 marks. The question paper shall consist of Four questions and all questions are compulsory. Question No.1 shall contain Five compulsory short answer questions for a total of Ten marks. Question No.2 to 4 shall be EITHER/OR Type for Ten marks each. Student shall Answer any one of them. Each of these questions may contain sub-questions.

End Examination: The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions and all questions are compulsory. Question No.1 shall contain Ten compulsory short answer questions for a total of Twenty marks (with Two short answer questions from each unit). Question No.2 to 6 shall be EITHER/OR Type for Ten marks each and shall cover one Unit of the Syllabus for each question. Student shall Answer any one of them. Each of these questions may contain sub-questions.

AUTOMOBILE ENGINEERING (AE)								
VI Semester: Mechanical Engineering					Scheme: 2023			
Course Code	Category	Hours/Week			Credits	Maximum Marks		
ME317	PE-II	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
		3	0	0	3	30	70	100
Sessional Exam Duration: 2 Hrs					End Exam Duration: 3 Hrs			
Course Outcomes: At the end of the course the student will be able to								
CO1:	Explain the vehicle construction and engines in automobiles.							
CO2:	Understand the fuel injection and ignition system.							
CO3:	Demonstrate how the steering and the suspension systems work.							
CO4:	Illustrate the different types of wheels and breaking systems. Choose the suitable tyres and brakes for different applications.							
CO5:	Demonstrate knowledge of automobile electrical systems and recent advancements in automotives.							
UNIT – I								
Introduction to Vehicle Structure and Engine Components: Vehicle construction-chassis and body- Specifications-Engine- Types-construction-Location of engine-Cylinder arrangement-Construction details- Cylinder block- Cylinder head-Cylinder liners- Piston-piston rings-piston pin- Connecting rods- Crankshaft- Valves- Lubrication System-Types-Oil pumps-Filters. Crankcase ventilation.								
UNIT – II								
Ignition and Fuel Supply Systems: Ignition system-Coil and Magneto-Spark plug-Distributor-Electronic Ignition system-Fuel system-Carburetor-Fuel pumps –Fuel Injection systems-Mono point and Multipoint- Unit Injector-Nozzle types-Electronic Fuel Injection system (EFI) –GDI, MPFI.								
UNIT – III								
Steering and Suspension: Principle of steering – Steering Geometry and wheel alignment-Steering linkages-Steering gearboxes- Power steering- front axle-Suspension system-Independent and Solid axle-coil, leaf spring and air suspensions-torsion bar –shock absorbers.								
UNIT – IV								
Wheels, Tyres and Braking System: Wheels and Tyres-Construction-Tyre and specification – Tyre wear and causes- Brakes- Needs-Classification-Drum and Disc Mechanical- Hydraulic and pneumatic-Vacuum assist-Retarders-Anti lock Braking system (ABS).								
UNIT – V								
Automobile Electrical Systems and Advances in Automobile Engineering: Battery-General electrical circuits –Active suspension Systems (ASS)- Electronic Brake Distribution (EBD)- Electronic Stability Program (ESP), Traction Control System (TCS)- Global Positioning System (GPS), Electric Hybrid vehicle, Fuel Cell, Autonomous Vehicles.								
Text Books:								
1. Kirpal Singh, Automobile Engineering, Vol.1 & 2, Standard Publications, India.								
2. S Srinivasan, Automotive Mechanics, McGraw-Hill, New Delhi.								
3. David A. Corolla, Automotive Engineering: Powertrain, Chassis System and Vehicle Body, Butterworth- Heinemann Publishing Ltd.								
4. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, Florida.								
Reference Books:								
1. Bosch, Automotive Hand Book, SAE Publications.								

2. K Newton and W Steeds, The motor vehicle, Butterworth- Heinemann Publishing Ltd.
3. Joseph Heitner, Automotive Mechanics Principles and Practices, CBS Publishing.
4. Richard Stone, Jeffrey K. Ball, Automotive Engineering Fundamentals, SAE International.
Online Resources:
1. https://nptel.ac.in/courses/107106088
2. https://nptel.ac.in/courses/107106080
3. https://ed.iitm.ac.in/~shankarram/Course_Files/ED5160/ED5160.htm
Question Paper Pattern:
Sessional Exam: The question paper for Sessional Examination shall be for 40 marks. The question paper shall consist of Four questions and all questions are compulsory. Question No.1 shall contain Five compulsory short answer questions for a total of Ten marks. Question No.2 to 4 shall be EITHER/OR Type for Ten marks each. Student shall Answer any one of them. Each of these questions may contain sub-questions. End Examination: The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions and all questions are compulsory. Question No.1 shall contain Ten compulsory short answer questions for a total of Twenty marks (with Two short answer questions from each unit). Question No.2 to 6 shall be EITHER/OR Type for Ten marks each and shall cover one Unit of the Syllabus for each question. Student shall Answer any one of them. Each of these questions may contain sub-questions.

CONTROL SYSTEMS (CS)								
VI Semester: Mechanical Engineering						Scheme: 2023		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
ME318	PE-II	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
		3	0	0	3	30	70	100
Sessional Exam Duration: 2 Hrs					End Exam Duration : 3 Hrs			
Course Outcomes : At the end of the course, students will be able to								
CO1:	Understand the basic concepts of control systems and their representation using transfer function.							
CO2:	Apply signal flow graphs and manon's gain formula to represent systems using transfer function.							
CO3:	Analyze the performance of control systems and signal response.							
CO4:	Analyze the frequency response of control systems using bode and polar plots.							
CO5:	Analyze state-space models from block diagrams, system controllability and observability, and solve time-invariant state equations using the state transition matrix.							
UNIT – I								
Basics in Control System and Transfer Function: Introduction of Control Systems, Various types of systems (Open Loop and closed loop) and their differences- Classification and Feed-Back Characteristics of control system- Effects of feedback. Mathematical models – Differential equations, Translational and Rotational mechanical systems.								
UNIT – II								
Representation of Transfer Function: Block diagram representation of systems considering electrical systems as examples. Block diagram algebra – Representation by Signal flow graph - Reduction using Mason’s gain formula.								
UNIT – III								
Time Response Analysis: Standard test signals - Time response of first order systems – Characteristic Equation of Feedback control systems – Steady state response - Steady state errors and error constants Stability Analysis: The concept of stability – Routh’s stability criterion – qualitative stability and conditional stability – limitations of Routh’s stability.								
UNIT – IV								
Frequency Response Analysis: Introduction, Frequency domain Specifications-Bode diagrams Determination of Frequency domain specifications and transfer function from the Bode Diagram-Phase margin and Gain margin Stability Analysis from Bode Plots.								
Stability Analysis in Frequency Domain: Polar Plots, Stability Analysis.								
UNIT – V								
State Space Analysis: Concepts of state, state variables and state model, derivation of state models from block diagrams, Diagonalization- Solving the Time invariant state Equations- State Transition Matrix and it’s Properties – Concepts of Controllability and Observability.								
Text Books:								
1. I J Nagrath and M Gopal, Control Systems Engineering, New Age International (P) Limited, New Delhi.								
2. Benjamin C Kuo, Automatic Control Systems, John Wiley and Son’s, USA.								
Reference Books:								
1. K Ogata, Modern Control Engineering, Prentice Hall of India Pvt. Ltd, New Delhi.								
2. V K Barbudhe, Control system Engineering National Press, Chennai.								
3. Richard Dorf and Robert Bishop, Modern Control Systems, Pearson, New Jersey.								

Online Resources:

1. <https://nptel.ac.in/courses/112106318>
2. <https://youtube.com/playlist?list=PLyqSpQzTE6M-ZgdjYukayF6QevPv7WE-r&si=-mwIa2X-SuSiNy13>
3. https://youtube.com/playlist?list=PLyqSpQzTE6M-ZgdjYukayF6QevPv7WE-r&si=Apfjx6oDfz1Rb_N3
4. https://youtu.be/zx04Kl8y4dE?si=VmOvp_OgqisILTAF

Question Paper Pattern:

Sessional Exam: The question paper for Sessional Examination shall be for 40 marks. The question paper shall consist of Four questions and all questions are compulsory. Question No.1 shall contain Five compulsory short answer questions for a total of Ten marks. Question No.2 to 4 shall be EITHER/OR Type for Ten marks each. Student shall Answer any one of them. Each of these questions may contain sub-questions.

End Examination: The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions and all questions are compulsory. Question No.1 shall contain Ten compulsory short answer questions for a total of Twenty marks (with Two short answer questions from each unit). Question No.2 to 6 shall be EITHER/OR Type for Ten marks each and shall cover one Unit of the Syllabus for each question. Student shall Answer any one of them. Each of these questions may contain sub-questions.

FINITE ELEMENT METHODS (FEM)								
VI Semester: Mechanical Engineering						Scheme: 2023		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
ME319	PE-II	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
		3	0	0	3	30	70	100
Sessional Exam Duration: 2 Hrs					End Exam Duration: 3 Hrs			
Course Outcomes: At the end of the course, students will be able to								
CO1:	Understand step by step procedure of FEM, shape functions, selection of elements and treatment of boundary conditions.							
CO2:	Solve problems on bar and truss elements.							
CO3:	Determine slope and deflection of beam structures using beam element.							
CO4:	Apply finite element method for solving the two dimensional stress analysis using CST.							
CO5:	Solve One dimensional heat transfer and Dynamic problems using FEM.							
UNIT – I								
Finite Element Technique: Fundamental concepts of the Finite Element Methods, advantages and applications of FEM, steps followed in FEM, Discretization of the domain, types of elements.								
Shape Functions and Boundary Conditions: Shape functions, element stiffness matrix, applying of boundary conditions: Penalty and Elimination approach, natural coordinate systems and global coordinate systems. Formulation of finite element model and solution.								
UNIT – II								
Analysis of Bar Structures: Axial or Bar element, stiffness matrix for bar element, problems on bar element.								
Analysis of Truss Structures: Two-dimensional truss element, stiffness matrix for two-dimensional truss, simple problems on two-dimensional truss structures.								
UNIT – III								
Analysis of Beam Structures: Beam elements, stiffness matrix for beam element, transformation matrix, simple problems on beam structures – slope and deflection of beams – cantilever and simply supported beams.								
UNIT – IV								
Two Dimensional Stress Analyses: Finite element modeling for two-dimensional stress analysis, element stiffness matrix for constant strain triangle (CST) and treatment of boundary conditions, Simple problems on CST element.								
UNIT – V								
Dynamic Analysis: Mass matrix of bar element. Simple problems on dynamic analysis of bar element.								
Steady State Heat Transfer Analysis: One-dimensional heat transfer analysis of a fin and wall.								
Text Books:								
1. T Chandraputla and Ashok Belegundu, Introduction to Finite Element in Engineering, Pearson Publications, London.								
2. S S Rao, The Finite Element Methods in Engineering, Elsevier Butterworth -Heinemann, Oxford.								
3. J N Reddy, An introduction to the Finite Element Method, McGraw Hill, New York.								
Reference Books:								
1. R D Cook, D S Malkus and M E Plesha, Concepts and Applications of Finite Element								

Analysis, John Wiley, New York.
2. K J Bathe, Finite Element Procedures in Engineering Analysis, Prentice-Hall, Englewood Cliffs.
3. G Lakshmi Narasaiah, Finite Element Analysis, B.S. Publications, Hyderabad.
4. O C Zienkiewicz and R L Taylor, the Finite Element Method, McGraw-Hill, Oxford.
Online Learning Resources:
1. https://nptel.ac.in/courses/112/104/112104193/ 2. https://nptel.ac.in/courses/112/104/112104205/ 3. https://nptel.ac.in/courses/105/105/105105041/ 4. https://nptel.ac.in/courses/112/106/112106130/ 5. https://nptel.ac.in/courses/112/103/112103295/
Question Paper Pattern:
Sessional Exam: The question paper for Sessional Examination shall be for 40 marks. The question paper shall consist of Four questions and all questions are compulsory. Question No.1 shall contain Five compulsory short answer questions for a total of Ten marks. Question No.2 to 4 shall be EITHER/OR Type for Ten marks each. Student shall Answer any one of them. Each of these questions may contain sub-questions. End Examination: The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions and all questions are compulsory. Question No.1 shall contain Ten compulsory short answer questions for a total of Twenty marks (with Two short answer questions from each unit). Question No.2 to 6 shall be EITHER/OR Type for Ten marks each and shall cover one Unit of the Syllabus for each question. Student shall Answer any one of them. Each of these questions may contain sub-questions.

SMART MATERIALS (SM)								
VI Semester: Mechanical Engineering					Scheme: 2023			
Course Code	Category	Hours/Week			Credits	Maximum Marks		
ME320	PE-II	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
		3	0	0	3	30	70	100
Sessional Exam Duration: 2 Hrs					End Exam Duration: 3 Hrs			
Course Outcomes : At the end of the course the student will be able to								
CO1:	Understand and distinguish between traditional engineering materials and smart materials, and identify appropriate smart materials for various engineering applications.							
CO2:	Explain the working principles, properties, and applications of different smart materials and evaluate their suitability for specific engineering and technological applications.							
CO3:	Understand and apply suitable processing and fabrication techniques for different smart materials in engineering applications.							
CO4:	Identify, describe, and equate different sensor technologies and select appropriate sensors for engineering applications.							
CO5:	Demonstrate the working mechanisms of various actuators compare and select suitable actuation methods for different smart materials for create system applications.							
UNIT – I								
Introduction: Characteristics of metals, polymers and ceramics. Introduction to smart materials. Classification of smart materials, Components of a smart System, Applications of smart material.								
UNIT – II								
Smart Materials: Piezoelectric materials, Electro strictive Materials, Magnetostrictive materials, Magnetoelectric materials, Magnetorheological Electrorheological fluids, Shape Memory materials.								
UNIT – III								
Processing of Smart Materials Semiconductors and their processing, Metals and metallization techniques, Ceramics and their processing, Polymers and their synthesis, UV radiation curing of polymers, fluids.								
UNIT – IV								
Introduction to Sensors, Conductometric sensors, Capacitive sensors, Piezoelectric sensors, Magnetostrictive sensors, Piezoresistive sensors, Optical sensors, Resonant sensors, semiconductor-based sensors, Acoustic sensors, polymerize sensors, Carbon nanotube sensors.								
UNIT – V								
Introduction to Actuators, Electrostatic transducers, Electromagnetic transducers, Electrodynamic transducers, Piezoelectric transducers, Electro-strictive transducers, Magneto-strictive transducers, Electro thermal actuators, Comparison of actuation, Applications								
Text Books:								
1. V K Varadan, K J Vinoy and S Gopalakrishnan, Smart Material Systems and MEMS: Design and Development Methodologies, John Wiley and Sons, England.								
2. Brain Culshaw, Smart Structures and Materials, Artech House, London,								
3. Mukesh V Gandhi and Brian S Thompson, Smart Materials and Structures, Springer.								
Reference Books:								

1.	A V Srinivasan, Smart Structures: Analysis and Design, Cambridge University Press, Cambridge, New York.
2.	P Gauenzi, Smart Structures, Wiley.
3.	G Gautschi, Piezoelectric Sensorics: Force, Strain, Pressure, Acceleration and Acoustic Emission Sensors, Materials and Amplifiers, Springer, Berlin, New York.
4.	T W Duerig, K N Melton, D Stockel and C M. Wayman Engineering aspects of Shape memory Alloys Butterworth Heinemann Publishing, London.
Question Paper Pattern:	
Sessional Exam: The question paper for Sessional Examination shall be for 40 marks. The question paper shall consist of Four questions and all questions are compulsory. Question No.1 shall contain Five compulsory short answer questions for a total of Ten marks. Question No.2 to 4 shall be EITHER/OR Type for Ten marks each. Student shall Answer any one of them. Each of these questions may contain sub-questions. End Examination: The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions and all questions are compulsory. Question No.1 shall contain Ten compulsory short answer questions for a total of Twenty marks (with Two short answer questions from each unit). Question No.2 to 6 shall be EITHER/OR Type for Ten marks each and shall cover one Unit of the Syllabus for each question. Student shall Answer any one of them. Each of these questions may contain sub-questions.	

COMPUTATIONAL FLUID DYNAMICS (CFD)								
VI Semester: Mechanical Engineering						Scheme: 2023		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
ME321	PE-III	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
		3	0	0	3	30	70	100
Sessional Exam Duration: 2 Hrs					End Exam Duration: 3 Hrs			
Course Outcomes: At the end of the course, students will be able to								
CO1:	Understand and analyze partial differential equations using finite element methods.							
CO2:	Apply and analyze explicit and implicit numerical schemes, solve second-order PDEs.							
CO3:	Create and solve incompressible and compressible viscous flow problems.							
CO4:	Develop and implement finite volume formulations based on finite difference methods, ensuring accurate and conservative solutions in CFD applications.							
CO5:	Analyze and solve linear fluid flow problems, using appropriate numerical methods and interpret the physical significance of the computed results.							
UNIT – I								
Introduction: Finite difference method, finite volume method, finite element method, governing equations and boundary conditions. Solution Methods: Solution methods of elliptical equations — finite difference formulations, interactive solution methods, direct method with Gaussian elimination.								
UNIT – II								
Hyperbolic Equations: Explicit and implicit schemes, Multi step methods, Second order one-dimensional wave equations.								
UNIT – III								
Formulations of Incompressible Viscous Flows: Formulations of incompressible viscous flows by finite difference methods								
UNIT – IV								
Finite Volume Method Finite volume method via finite difference method, formulations for two and three-dimensional problems.								
UNIT – V								
Standard Variational Methods Linear fluid flow problems, steady state problems, Transient problems.								
Text Books:								
1. Sreenivas Jayanti, CFD for Engineers and Scientists, Springer, Switzerland.								
2. John D Anderson, Computational Fluid Dynamics: Basics with applications, Mc Graw Hill.								
3. Joel H Ferziger, Milovan Peric and Robert L Street, Computational Methods for Fluid Dynamics, Springer, Switzerland.								
Reference Books:								
1. Frank Choriton, Text book of fluid dynamics, CBS Publishers & distributors,								
2. Suhas V Patankar, Numerical heat transfer and fluid flow, Hema shava Publishers corporation & Mc Graw Hill,								
3. Muralidaran, Computational Fluid Flow and Heat Transfer, Narosa Publications,								
4. Tapan K Sengupta, Fundamentals of Computational Fluid Dynamics, Universities Press								
5. C Pozrikidis, Introduction to Theoretical and Computational Fluid Dynamics, Oxford University press,								

Online Resources:

1. <https://nptel.ac.in/courses/112107079>
2. <https://www.youtube.com/watch?v=3QFT7pGx03I>
3. https://www.youtube.com/watch?v=t7jS7V_6TGQ
4. <https://nptel.ac.in/courses/112107080>

Question Paper Pattern:

Sessional Exam: The question paper for Sessional Examination shall be for 40 marks. The question paper shall consist of Four questions and all questions are compulsory. Question No.1 shall contain Five compulsory short answer questions for a total of Ten marks. Question No.2 to 4 shall be EITHER/OR Type for Ten marks each. Student shall Answer any one of them. Each of these questions may contain sub-questions.

End Examination: The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions and all questions are compulsory. Question No.1 shall contain Ten compulsory short answer questions for a total of Twenty marks (with Two short answer questions from each unit). Question No.2 to 6 shall be EITHER/OR Type for Ten marks each and shall cover one Unit of the Syllabus for each question. Student shall Answer any one of them. Each of these questions may contain sub-questions.

FLUID POWER SYSTEMS (FPS)								
VI Semester: Mechanical Engineering					Scheme: 2023			
Course Code	Category	Hours/Week			Credits	Maximum Marks		
ME322	PE-III	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
		3	0	0	3	30	70	100
Sessional Exam Duration: 2 Hrs					End Exam Duration: 3 Hrs			
Course Outcomes : At the end of the course the student will be able to								
CO1:	Identify hydraulic and pneumatic components and its symbol and usage.							
CO2:	Ability to design hydraulic and pneumatic circuits.							
CO3:	Identify and analyse the functional requirements of a power transmission system for a given application.							
CO4:	Ability to visualize how the hydraulic/pneumatic circuit will work to accomplish the function.							
CO5:	Ability to Design and understand the electro-hydraulic and electro-pneumatic circuits.							
UNIT – I								
Fluid Power Principles and Hydraulic Pumps: Introduction to Fluid power – Advantages and Applications – Fluid power systems – Types of fluids - Properties of fluids and selection – Basics of Hydraulics – Pascal’s Law, Sources of Hydraulic power, Pump Classification – Construction, Working, Design, Advantages, and Disadvantages								
UNIT – II								
Hydraulic Actuators and Control Components: Hydraulic Actuators: Cylinders – Types and construction, Application, Hydraulic cushioning – Hydraulic motors - Control Components: Direction Control, Flow control and pressure control valves – Types, Construction and Operation – Servo and Proportional valves.								
UNIT – III								
Hydraulic Circuits and Systems: Accumulators, Intensifiers, Industrial hydraulic circuits – Regenerative, Pump Unloading, Double-Pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-Safe, Speed Control, Hydrostatic transmission, Mechanical hydraulic servo systems.								
UNIT – IV								
Pneumatic and Electro Pneumatic Systems: Properties of air – Perfect Gas Laws – Compressor – Filters, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust Valves, Pneumatic actuators, Design of Pneumatic circuit – Cascade method – Electro Pneumatic System.								
UNIT – V								
Trouble Shooting and Applications: Installation, Selection, Maintenance, Trouble Shooting and Remedies in Hydraulic and Pneumatic systems, Design of hydraulic circuits for Drilling, Surface grinding, Press and Forklift applications. Design of Pneumatic circuits for Pick and Place applications and tool handling in CNC Machine tools.								
Text Books:								
1. T Jagadeesha and Thammaiah Gowda, Fluid Power: Generation, Transmission and Control, Wiley Publications.								
2. Sundaram K Shanmuga, Hydraulics & Pneumatics Controls, S Chand& company.								
3. Andrew Parr, Hydraulics And Pneumatics, Jaico Publishing House.								
Reference Books:								
1. S Majumdar, Oil hydraulic systems: principles and maintenance, McGraw Hill								

Education.
2. R Srinivasan, Hydraulics and Pneumatic Controls, McGraw Hill Education.
3. M. Galal Rabie, Fluid Power Engineering, McGraw Hill.
Question Paper Pattern:
Sessional Exam: The question paper for Sessional Examination shall be for 40 marks. The question paper shall consist of Four questions and all questions are compulsory. Question No.1 shall contain Five compulsory short answer questions for a total of Ten marks. Question No.2 to 4 shall be EITHER/OR Type for Ten marks each. Student shall Answer any one of them. Each of these questions may contain sub-questions. End Examination: The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions and all questions are compulsory. Question No.1 shall contain Ten compulsory short answer questions for a total of Twenty marks (with Two short answer questions from each unit). Question No.2 to 6 shall be EITHER/OR Type for Ten marks each and shall cover one Unit of the Syllabus for each question. Student shall Answer any one of them. Each of these questions may contain sub-questions.

REFRIGERATION & AIR CONDITIONING (RAC)								
VI Semester: Mechanical Engineering					Scheme: 2023			
Course Code	Category	Hours/Week			Credits	Maximum Marks		
ME323	PE-III	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
		3	0	0	3	30	70	100
Sessional Exam Duration: 2 Hrs					End Exam Duration : 3 Hrs			
Course Outcomes : At the end of the course, students will be able to								
CO1:	Understand the necessity of refrigeration and working of refrigerating systems including air refrigeration.							
CO2:	Describe the working of VCR system, classification of refrigerants and their impact on the environment.							
CO3:	Understand the vapour absorption, stem jet, thermo electric, vortex tube and pulse tube refrigeration system.							
CO4:	Solve load calculation for air conditioning systems.							
CO5:	Describe the concept of human comfort and low temperature refrigeration.							
UNIT – I								
Introduction to Refrigeration: Necessity and Applications, Carnot Refrigerator, First and Second Law Applied to Refrigerating Machines, Unit of Refrigeration, COP, Different Refrigeration Methods.								
Air Refrigeration: Bell-Coleman Cycle, Ideal and Actual Cycles, Air craft refrigeration and simple problems.								
UNIT – II								
Vapour Compression Refrigeration (VCR) System: Working Principle - COP - Representation of Cycle On T-S and P-h Charts - Effect of Sub Cooling and Super Heating , Ideal and actual cycle, Numerical problems								
Refrigerants: Desirable Properties - Classification of Refrigerants Used - Nomenclature-Secondary Refrigerants, Environmental effects of CFC refrigerants, substitutes for CFC refrigerants.								
UNIT – III								
Vapor Absorption Refrigeration (VAR) System: Description and Working of NH ₃ - Water System, Li Br -Water absorption, three fluid absorption refrigeration system.								
Other refrigeration Systems: Working principles of steam jet refrigeration system, Thermo electric, Vortex and Pulse tube refrigerators.								
UNIT – IV								
Introduction to Air Conditioning: Psychrometric properties chart and processes - Characterization of Sensible and Latent Heat Loads, Load concepts of RSHF, GSHF problems, concept of ESHF and ADP temperature, Summer, Winter and Year round air conditioning								
UNIT – V								
Human Comfort: Requirements of Temperature, Humidity and Concept of Effective Temperature, Comfort chart, Heat pump circuits – Air to air and water to air.								
Introduction to Low Temperature Refrigeration: Liquefaction of air – Linda and Claude system, Liquefaction of hydrogen and helium, Low temperature insulation, Applications of low temperature refrigeration.								
Text Books:								
1. C P Arora , Refrigeration and Air Conditioning, TMH,								
2. S. C Arora & Domkundwar, A Course in Refrigeration and Air conditioning, Dhanpat rai								

& Co
3. R C Aora , Refrigeration and Air-Conditioning, PHI,
Reference Books:
1. Manohar Prasad , Refrigeration and Air Conditioning , New Age
2. Dossat, Principles of Refrigeration, Pearson Education,
3. P L Ballaney , Refrigeration and Air Conditioning,
4. P N Ananthanarayanan , Basic Refrigeration and Air-Conditioning , TMH
Data Hand Book:
1. Sreenivasa Reddy, B. and Hemachandra Reddy, K, Thermal Data Handbook, IK International Publishers, Bangalore
Online Resources:
1. https://www.iare.ac.in/sites/default/files/lecture_notes/IARE_RAC_Lecture_Notes.pdf
2. https://nptel.ac.in/courses/112105129
3. http://dte.karnataka.gov.in/Institutes/gptkampli/GenericDocHandler/68-fc177b7d-f5d1-4580-b577-b1118df994f4.pdf
Question Paper Pattern:
Sessional Exam: The question paper for Sessional Examination shall be for 40 marks. The question paper shall consist of Four questions and all questions are compulsory. Question No.1 shall contain Five compulsory short answer questions for a total of Ten marks. Question No.2 to 4 shall be EITHER/OR Type for Ten marks each. Student shall Answer any one of them. Each of these questions may contain sub-questions. End Examination: The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions and all questions are compulsory. Question No.1 shall contain Ten compulsory short answer questions for a total of Twenty marks (with Two short answer questions from each unit). Question No.2 to 6 shall be EITHER/OR Type for Ten marks each and shall cover one Unit of the Syllabus for each question. Student shall Answer any one of them. Each of these questions may contain sub-questions.

MECHANICS & MANUFACTURING OF COMPOSITE MATERIALS (MMC)								
VI Semester: Mechanical Engineering						Scheme: 2023		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
ME324	PE-III	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
		3	0	0	3	30	70	100
Sessional Exam Duration: 2 Hrs					End Exam Duration: 3 Hrs			
Course Outcomes: At the end of the course, students will be able to								
CO1:	Classify and describe the characteristics of different types of composite materials, and explain and apply various fiber-reinforced plastic processing methods.							
CO2:	Evaluate the elastic moduli of composite laminas, apply Hooke's law to different material types and solve numerical problems.							
CO3:	Analyze the failure of composite laminates, and perform macro-mechanical analysis using Classical Laminate Theory (CLT), for various laminate configurations through numerical problem-solving.							
CO4:	Identify and select appropriate reinforcements and base metals for MMCs, understand and apply various fabrication processes.							
CO5:	Analyze and evaluate the failure mechanisms of unidirectional lamina using micromechanical models and apply suitable failure theories through practical examples							
UNIT – I								
Introduction to Composite Materials: Introduction to Composite Materials: Definition, classification and characteristics of composite Materials – fibrous composites, laminated composites, particulate composites.								
Applications: Automobile, Aircrafts. missiles. Space hardware, Electrical and electronics, Marine, recreational and sports equipment, future potential of composites.								
Fiber Reinforced Plastic Processing: Lay-up and curing, fabricating process, open and closed mould process, hand lay-up techniques; structural laminate bag molding, production procedures for bag molding; filament winding, pultrusion, pulforming, thermo-forming, injection molding, blow molding.								
UNIT – II								
Micro Mechanical Analysis of a Lamina: Micro Mechanical Analysis of a Lamina: Introduction, Evaluation of the four elastic moduli by Rule of mixture, Numerical problems.								
Macro Mechanics of a Lamina: Hooke's law for different types of materials, Number of elastic constants, Two - dimensional relationship of compliance and stiffness matrix. Hooke's law for two-dimensional angle lamina, engineering constants - Numerical problems. Stress-Strain relations for lamina of arbitrary orientation, Numerical problems.								
UNIT – III								
Biaxial Strength Theories: Maximum stress theory, Maximum strain theory, Tsai-Hill theory, Tsai, Wu tensor theory, Numerical problems.								
Macro Mechanical Analysis of Laminate: Introduction, code, Kirchoff hypothesis, CL T, A, B, and D matrices (Detailed derivation) , Special cases of laminates, Numerical problems.								
UNIT – IV								
Metal Matrix Composites: Metal Matrix Composites: Reinforcement materials, types, characteristics and selection base metals selection. Need for production MMC's and its application.								
Fabrication Process For MMC's: Powder metallurgy technique, liquid metallurgy technique and secondary processing, special fabrication techniques.								
Study Properties Of MMC's: Physical Mechanical, Wear, machinability and Other								

Properties. Effect of size, shape and distribution of particulate on properties.
UNIT – V
Failure Theories Micromechanics of Failure of Unidirectional Lamina, Anisotropic Strength and Failure Theories, Importance of Shear Strength, Choice of Failure Criteria, Examples.
Text Books:
1. K.K. Chawla, Composite Materials, Springer-Verlag, New York.
2. B.T. Astrom, Manufacturing of Polymer Composites, Chapman & Hall, Sweden
3. Stuart M Lee, J. Ian Gray, Miltz, Reference Book for Composites Technology, CRC press, USA.
Reference Books:
1. Frank L Matthews and R D Rawlings, Composite Materials: Engineering and Science, Taylor and Francis, New York.
2. D. Hull and T.W. Clyne, Introduction to Composite Materials, Cambridge University Press, New York.
3. M.R. Piggott, Load Bearing Fibre Composites, Pergamon press, Oxford.
4. F. Ashby and D.R.H. Jones, Engineering Materials, Pergamon press, Oxford.
Online Resources:
1. https://nptel.ac.in/courses/112104221
2. https://nptel.ac.in/courses/112104229
3. https://nptel.ac.in/courses/112104161
4. https://onlinecourses.nptel.ac.in/noc22_me40/preview
Question Paper Pattern:
Sessional Exam: The question paper for Sessional Examination shall be for 40 marks. The question paper shall consist of Four questions and all questions are compulsory. Question No.1 shall contain Five compulsory short answer questions for a total of Ten marks. Question No.2 to 4 shall be EITHER/OR Type for Ten marks each. Student shall Answer any one of them. Each of these questions may contain sub-questions. End Examination: The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions and all questions are compulsory. Question No.1 shall contain Ten compulsory short answer questions for a total of Twenty marks (with Two short answer questions from each unit). Question No.2 to 6 shall be EITHER/OR Type for Ten marks each and shall cover one Unit of the Syllabus for each question. Student shall Answer any one of them. Each of these questions may contain sub-questions.

INTRODUCTION TO HYBRID AND ELECTRIC VEHICLES (HEV)								
VI Semester: Mechanical Engineering						Scheme: 2023		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
ME325	PE-III	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
		3	0	0	3	30	70	100
Sessional Exam Duration: 2 Hrs					End Exam Duration: 3 Hrs			
Course Outcomes: At the end of the course, students will be able to								
CO1:	Explain the basics of EV propulsion, energy requirements and battery technologies with their management systems.							
CO2:	Describe electric vehicle power plants, motor types and basic power electronic converters and control methods used in EV drives.							
CO3:	Describe hybrid and electric drive train configurations, control strategies, and their impact on energy efficiency.							
CO4:	Interpret electric and hybrid vehicle architectures and technologies through real-world case studies.							
CO5:	Explain the principles of electric and hybrid vehicle design including component sizing, energy storage selection and energy management strategies.							
UNIT – I								
Electric Vehicle Propulsion and Energy Sources: Introduction to electric vehicles, vehicle mechanics - kinetics and dynamics, roadway fundamentals propulsion system design - force velocity characteristics, calculation of tractive power and energy required, electric vehicle power source - battery capacity, state of charge and discharge, specific energy, specific power, Ragone plot. battery modeling - run time battery model, first principle model, battery management system- soc measurement, battery cell balancing. Traction batteries - nickel metal hydride battery, Li-Ion, Li-polymer battery.								
UNIT – II								
Electric Vehicle Power Plant And Drives: Introduction electric vehicle power plants. Induction machines, permanent magnet machines, switch reluctance machines. Power electronic converters-DC/DC converters - buck boost converter, isolated DC/DC converter. Two quadrant chopper and switching modes. AC drives- PWM, current control method. Switch reluctance machine drives - voltage control, current control.								
UNIT – III								
Hybrid And Electric Drive Trains: Introduction hybrid electric vehicles, history and social importance, impact of modern drive trains in energy supplies. Hybrid traction and electric traction. Hybrid and electric drive train topologies. Power flow control and energy efficiency analysis, configuration and control of DC motor drives and induction motor drives, permanent magnet motor drives, switch reluctance motor drives, drive system efficiency.								
UNIT – IV								
Electric and Hybrid Vehicles - Case Studies: Parallel hybrid, series hybrid -charge sustaining, charge depleting. Hybrid vehicle case study – Toyota Prius, Honda Insight, Chevrolet Volt. 42 V system for traction applications. Lightly hybridized vehicles and low voltage systems. Electric vehicle case study - GM EV1, Nissan Leaf, Mitsubishi Miev. Hybrid electric heavy duty vehicles, fuel cell heavy duty vehicles.								
UNIT – V								
Electric And Hybrid Vehicle Design: Introduction to hybrid vehicle design. Matching the electric machine and the internal combustion engine. Sizing of propulsion motor, power electronics, drive system. Selection of energy storage technology, communications, supporting subsystem. Energy management strategies in hybrid and electric vehicles - energy management strategies- classification, comparison, implementation.								

Text Books:
1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press.
2. Amir Khajepour, M. Saber Fallah and Avesta Goodarzi, Electric and Hybrid Vehicles: Technologies, Modeling and Control - A Mechatronic Approach, John Wiley & Sons.
Reference Books:
1. James Larminie and John Lowry, Electric Vehicle Technology, Explained, Wiley.
2. John G Hayes and G Abas Goodarzi, Electric Powertrain: Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles, Wiley- Blackwell.
3. Mehrdad Ehsani, YimiGao, Sebastian E. Gay and Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press.
Online Resources:
1. https://youtube.com/playlist?list=PL9f9hWLZS62VF18qPQ1gC7NqIAjaCIsI&si=JKUPBH9r1LPqsm9-
2. https://youtu.be/h5ysddrlXLw?si=UzfPunK1x-MQOAz1
3. https://youtu.be/i7Rq0bN8eig?si=iHGLGNTGOzSTaGpW
Question Paper Pattern:
Sessional Exam: The question paper for Sessional Examination shall be for 40 marks. The question paper shall consist of Four questions and all questions are compulsory. Question No.1 shall contain Five compulsory short answer questions for a total of Ten marks. Question No.2 to 4 shall be EITHER/OR Type for Ten marks each. Student shall Answer any one of them. Each of these questions may contain sub-questions. End Examination: The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions and all questions are compulsory. Question No.1 shall contain Ten compulsory short answer questions for a total of Twenty marks (with Two short answer questions from each unit). Question No.2 to 6 shall be EITHER/OR Type for Ten marks each and shall cover one Unit of the Syllabus for each question. Student shall Answer any one of them. Each of these questions may contain sub-questions.

List of Open Elective Courses

Open Elective – I

1. Green Buildings
2. Construction Technology and Management
3. Electrical Safety Practices and Standards
4. Sustainable Energy Technologies
5. Electronic Circuits
6. Java Programming
7. Foundations of Artificial Intelligence
8. Ethical Hacking
9. Mathematics for Machine Learning and AI
10. Materials Characterization Techniques
11. Chemistry of Energy Systems
12. English for Competitive Examinations
13. Entrepreneurship and New Venture Creation

Open Elective – II

1. Disaster Management
2. Sustainability in Engineering Practices
3. Renewable Energy Sources
4. Automation and Robotics
5. Product Lifecycle Management
6. Digital Electronics
7. Foundations of Operating Systems
8. Foundations of Machine Learning
9. Web Technologies
10. Introduction to Information Systems
11. Optimization Techniques
12. Physics of Electronic Materials and Devices
13. Chemistry of Polymers and Applications
14. Academic Writing and Public Speaking
15. Mathematical Foundation of Quantum Technologies

GREEN BUILDINGS (GB)								
V Semester: All Branches					Scheme: 2023			
Course Code	Category	Hours/Week			Credits	Maximum Marks		
OE501	OE-I	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
		3	0	0	3	30	70	100
Sessional Exam Duration: 2 Hrs					End Exam Duration: 3 Hrs			
Course Outcomes : At the end of the course, students will be able to								
CO1:	Understand the importance of green buildings, their necessity, and sustainable features							
CO2:	Analyze various green building practices, rating systems, and their impact on environmental sustainability.							
CO3:	Apply principles of green building design to enhance energy efficiency and incorporate renewable energy sources.							
CO4:	Evaluate HVAC systems, energy-efficient air conditioning techniques, and their role in sustainable building design.							
CO5:	Assess material conservation techniques, waste reduction strategies, and indoor air quality management in green buildings.							
UNIT – I								
Introduction to Green Building: Necessity of Green Buildings, Benefits of Green Buildings, Green Building Materials and Equipment in India, Key Requisites for Constructing a Green Building, Important Sustainable Features for Green Buildings.								
UNIT – II								
Green Building Concepts and Practices: Indian Green Building Council, Green Building Movement in India, Benefits Experienced in Green Buildings, Green Building Rating Systems, Residential Sector, Market Transformation								
Green Building Opportunities and Benefits: Opportunities of Green Buildings, Green Building Features, Material and Resources, Water Efficiency, Optimum Energy Efficiency, Typical Energy-Saving Approaches in Buildings, LEED India Rating System, and Energy Efficiency.								
UNIT – III								
Green Building Design: Introduction, Reduction in Energy Demand, Onsite Sources and Sinks, Maximizing System Efficiency, Steps to Reduce Energy Demand and Use Onsite Sources and Sinks, Use of Renewable Energy Sources, Eco-Friendly Captive Power Generation for Factories, Building Requirements.								
UNIT – IV								
Air Conditioning: Introduction, CII Godrej Green Business Centre, Design Philosophy, Design Interventions, Energy Modeling, HVAC System Design, Chiller Selection, Pump Selection, Selection of Cooling towers, Selection of Air Handling Units, Pre-Cooling of Fresh Air, Interior Lighting Systems, Key Features of The Building, Eco-Friendly Captive Power Generation for Factories, Building Requirements.								
UNIT – V								
Material Conservation: Handling of Non-Process Waste, Waste Reduction During Construction, Materials With Recycled Content, Local Materials, Material Reuse, Certified Wood, Rapidly Renewable Building Materials and Furniture.								
Indoor Environment Quality and Occupational Health: Air Conditioning, Indoor Air Quality, Sick Building Syndrome, tobacco Smoke.								
Text Books:								
1. Handbook on Green Practices published by Indian Society of Heating Refrigerating and								

Air conditioning Engineers, 2009.
2. Green Building Hand Book by Tomwoolley and Samkimings, 2009.
Reference Books:
1. Complete Guide to Green Buildings by Trish riley
2. Standard for the design for High Performance Green Buildings by Kent Peterson, 2009
3. Energy Conservation Building Code-ECBC-2020, published by BEE
4. Alternative Building Materials and Technologies – By K S Jagadeesh, B V Venkata Rama Reddy & K S NanjundaRao – New Age International Publishers
5. Non-conventional Energy Resources – By D S Chauhan and S K Sreevasthava – New Age International Publishers
Online Learning Resources:
1. https://archive.nptel.ac.in/courses/105/102/105102195/
2. https://igbc.in/resources
3. https://www.grihaindia.org/
Question Paper Pattern:
Sessional Exam: The question paper for Sessional Examination shall be for 40 marks. The question paper shall consist of Four questions and all questions are compulsory. Question No.1 shall contain Five compulsory short answer questions for a total of Ten marks. Question No.2 to 4 shall be EITHER/OR Type for Ten marks each. Student shall Answer any one of them. Each of these questions may contain sub-questions. End Examination: The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions and all questions are compulsory. Question No.1 shall contain Ten compulsory short answer questions for a total of Twenty marks (with Two short answer questions from each unit). Question No.2 to 6 shall be EITHER/OR Type for Ten marks each and shall cover one Unit of the Syllabus for each question. Student shall Answer any one of them. Each of these questions may contain sub-questions.

CONSTRUCTION TECHNOLOGY AND MANAGEMENT (CTM)								
V Semester: All Branches Except CE						Scheme: 2023		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
OE502	OE-I	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
		3	0	0	3	30	70	100
Sessional Exam Duration: 2 Hrs					End Exam Duration: 3 Hrs			
Course Outcomes : At the end of the course, students will be able to								
CO1:	Understand project management fundamentals, organizational structures, and leadership principles in construction.							
CO2:	Solve and formulate network analysis in CPM and PERT networks.							
CO3:	Understand the structure of organization and resource allocation							
CO4:	Evaluate various contract types, contract formation, and legal aspects in construction management							
CO5:	Assess safety management practices, accident prevention strategies, and quality management systems in construction							
UNIT – I								
Introduction: Management Objectives and Functions; Stages of Project Management - Types of Organization, Organizational Chart of a Construction Company – Team of Construction Unit - Manager's Duties and Responsibilities.								
Construction Planning and Scheduling: Objectives and importance of planning and scheduling – Methods of Planning and Scheduling.								
UNIT – II								
Network Techniques in Construction management: Elements of network – Network techniques – Breakdown structures – Representation and specifying of activities and events – Rules for Network.								
Critical Path Method (CPM): Introduction – Difference between CPM and PERT – Time estimates – Float – Critical path – Network analysis and computation problems.								
UNIT – III								
Program Evaluation and Review Technique (PERT): Introduction, time estimates, slack, critical path – Network analysis and computation problems.								
Cost-Time Analysis in Net Work Planning: Importance of time – Project cost analysis in network planning – Updating – Resources allocation.								
UNIT – IV								
Tenders and Contracts: Type of tenders – Principles of tendering – Notice inviting tender – Contracts definition – Essentials – Types – Documents – Conditions of contracts.								
Arbitration: Definition – Arbitrator – Arbitration agreement – Qualification of arbitrator – Advantages of arbitration.								
UNIT – V								
Safety Management: Implementation and Application of QMS, ISO 9000 Series, Accident Theories, Cost of Accidents, Problem Areas in Construction Safety, Fall Protection, Incentives, Zero Accident Concepts, Planning for Safety.								
Text Books:								
1. Construction Project Management, SK. Sears, GA. Sears, RH. Clough, John Wiley and Sons, 6th Edition, 2016.								
2. Construction Project Scheduling and Control by Saleh Mubarak, 4th Edition, 2019								
3. Pandey, I.M (2021) Financial Management 12th edition. Pearson India Education Services Pvt. Ltd.								
Reference Books:								

1. Brien, J.O. and Plotnick, F.L., CPM in Construction Management, McGraw Hill, 2010.
2. Punmia, B.C., and Khandelwal, K.K., Project Planning and control with PERT and CPM, Laxmi Publications, 2002.
3. Construction Methods and Management: Pearson New International Edition 8 th Edition Stephens Nunnally.
4. Rhoden, M and Cato B, Construction Management and Organisational Behaviour, Wiley-Blackwell, 2016.
Online Learning Resources:
1. https://archive.nptel.ac.in/courses/105/104/105104161/
2. https://archive.nptel.ac.in/courses/105/103/105103093/
Question Paper Pattern:
Sessional Exam: The question paper for Sessional Examination shall be for 40 marks. The question paper shall consist of Four questions and all questions are compulsory. Question No.1 shall contain Five compulsory short answer questions for a total of Ten marks. Question No.2 to 4 shall be EITHER/OR Type for Ten marks each. Student shall Answer any one of them. Each of these questions may contain sub-questions. End Examination: The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions and all questions are compulsory. Question No.1 shall contain Ten compulsory short answer questions for a total of Twenty marks (with Two short answer questions from each unit). Question No.2 to 6 shall be EITHER/OR Type for Ten marks each and shall cover one Unit of the Syllabus for each question. Student shall Answer any one of them. Each of these questions may contain sub-questions.

ELECTRICAL SAFETY PRACTICES AND STANDARDS (ESPS)								
V Semester: All Branches Except EEE					Scheme: 2023			
Course Code	Category	Hours/Week			Credits	Maximum Marks		
OE503	OE-I	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
		3	0	0	3	30	70	100
Sessional Exam Duration: 2 Hrs					End Exam Duration: 3 Hrs			
Course Outcomes : At the end of the course, students will be able to								
CO1:	Understanding the Fundamentals of Electrical Safety							
CO2:	Identifying and Applying Safety Components							
CO3:	Analyzing Grounding Practices and Electrical Bonding							
CO4:	Applying Safety Practices in Electrical Installations and Environments							
CO5:	Evaluating Electrical Safety Standards and Regulatory Compliance							
UNIT – I								
Introduction To Electrical Safety: Fundamentals of Electrical Safety-Electric Shock-physiological effects of electric current - Safety requirements –Hazards of electricity- Arc - Blast- Causes for electrical failure.								
UNIT – II								
Safety Components: Introduction to conductors and insulators- voltage classification - safety against over voltages- safety against static electricity-Electrical safety equipment's - Fire extinguishers for electrical safety.								
UNIT – III								
Grounding: General requirements for grounding and bonding- Definitions- System grounding-Equipment grounding - The Earth - Earthing practices- Determining safe approach distance-Determining arc hazard category.								
UNIT – IV								
Safety Practices: General first aid- Safety in handling hand held electrical appliances tools- Electrical safety in train stations-swimming pools, external lighting installations, medical locations-Case studies.								
UNIT – V								
Standards For Electrical Safety: Electricity Acts- Rules & regulations- Electrical standards-NFPA 70 E-OSHA standards-IEEE standards-National Electrical Code 2005 - National Electric Safety code NESC-Statutory requirements from electrical inspectorate								
Text Books:								
1. Massimo A.G.Mitolo, “Electrical Safety of Low-Voltage Systems”, McGraw Hill, USA, 2009.								
2. Mohamed El-Sharkawi, “Electric Safety - Practice and Standards”, CRC Press, USA, 2014.								
Reference Books:								
1. Kenneth G.Mastrullo, Ray A. Jones, “The Electrical Safety Program Book”, Jones and Bartlett Publishers, London, 2nd Edition, 2011.								
2. Palmer Hickman, “Electrical Safety-Related Work Practices”, Jones & Bartlett Publishers, London, 2009.								
3. Fordham Cooper, W., “Electrical Safety Engineering”, Butterworth and Company, London, 1986.								
4. John Cadick, Mary Capelli-Schellpfeffer, Dennis K. Neitzel, “Electrical Safety Hand book”, McGraw-Hill, New York, USA, 4th edition, 2012.								
Online Learning Resources:								

1. https://onlinecourses.swayam2.ac.in/nou25_ec08/preview

Question Paper Pattern:

Sessional Exam: The question paper for Sessional Examination shall be for 40 marks. The question paper shall consist of Four questions and all questions are compulsory. Question No.1 shall contain Five compulsory short answer questions for a total of Ten marks. Question No.2 to 4 shall be EITHER/OR Type for Ten marks each. Student shall Answer any one of them. Each of these questions may contain sub-questions.

End Examination: The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions and all questions are compulsory. Question No.1 shall contain Ten compulsory short answer questions for a total of Twenty marks (with Two short answer questions from each unit). Question No.2 to 6 shall be EITHER/OR Type for Ten marks each and shall cover one Unit of the Syllabus for each question. Student shall Answer any one of them. Each of these questions may contain sub-questions.

SUSTAINABLE ENERGY TECHNOLOGIES (SET)								
V Semester: All Branches Except ME						Scheme: 2023		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
OE504	OE-I	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
		3	0	0	3	30	70	100
Sessional Exam Duration: 2 Hrs					End Exam Duration: 3 Hrs			
Course Outcomes : At the end of the course, students will be able to								
CO1:	Understand the importance of solar radiation and solar PV modules.							
CO2:	Describe the storage methods in PV systems							
CO3:	Explain the solar energy storage for different applications							
CO4:	Illustrate the principles of wind energy, and bio-mass energy.							
CO5:	Attain knowledge in geothermal energy, ocean energy and fuel cells.							
UNIT – I								
Solar Radiation: Role and potential of new and renewable sources, the solar energy option, Environmental impact of solar power, structure of the sun, the solar constant, sun-earth relationships, coordinate systems and coordinates of the sun, extraterrestrial and terrestrial solar radiation, solar radiation on tilted surface, instruments for measuring solar radiation and sun shine, solar radiation data, numerical problems.								
Solar PV Modules and PV Systems: PV Module Circuit Design, Module Structure, Packing Density, Interconnections, Mismatch and Temperature Effects, Electrical and Mechanical Insulation, Lifetime of PV Modules, Degradation and Failure, PV Module Parameters, Efficiency of PV Module, Solar PV Systems-Design of Off Grid Solar Power Plant. Installation and Maintenance.								
UNIT – II								
Storage in PV Systems: Battery Operation, Types of Batteries, Battery Parameters, Application and Selection of Batteries for Solar PV System, Battery Maintenance and Measurements, Battery Installation for PV System.								
UNIT – III								
Solar Energy Collection: Flat plate and concentrating collectors, classification of concentrating collectors, orientation.								
Solar Energy Storage and Applications: Different methods, sensible, latent heat and stratified storage, solar ponds, solar applications- solar heating/cooling technique, solar distillation and drying, solar cookers, central power tower concept and solar chimney.								
UNIT – IV								
Wind Energy: Sources and potentials, horizontal and vertical axis windmills, performance characteristics, betz criteria, types of winds, wind data measurement.								
Bio-Mass: Principles of bio-conversion, anaerobic/aerobic digestion, types of bio-gas digesters, gas yield, utilization for cooking, bio fuels, I.C. engine operation and economic aspects.								
UNIT – V								
Geothermal Energy: Origin, Applications, Types of Geothermal Resources, Relative Merits.								
Ocean Energy: Ocean Thermal Energy; Open Cycle & Closed Cycle OTEC Plants, Environmental Impacts, Challenges.								
Fuel Cells: Introduction, Applications, Classification, Different Types of Fuel Cells Such as Phosphoric Acid Fuel Cell, Alkaline Fuel Cell, PEM Fuel Cell, MC Fuel Cell.								
Text Books:								
1. Sukhatme S.P. and J.K.Nayak , Solar Energy – Principles of Thermal Collection and								

Storage, TMH, 2009
2. Khan B.H , Non-Conventional Energy Resources, Tata McGraw Hill, New Delhi,2006
3. Twidell & Weir, Renewable Energy Sources , Taylor and Francis / 2nd Special Indian Edition,2006
4. G.N Tiwari and M.K.Ghosal , Fundamentals of Renewable Energy Sources, Alpha Science International Limited, 2007
Reference Books:
1. D.Yogi Goswami, Frank Krieth& John F Kreider , Principles of Solar Engineering , Taylor & Francis,2015
2. Ashok V Desai ,Non-Conventional Energy , New Age International (P) Ltd,1990
3. R. Ramesh & K. Uday Kumar, Renewable Energy Technologies, Narosa Publishing,1997
4. G.D Roy , Non-conventional Energy Source, Standard Publishers,2004
5. Anjaneyulu & Francis , Energy Resources Utilization and Technologies , BS Publications/2012.
6. Frank Krieth & John F Kreider, Principles of Solar Energy, Hemisphere Publications.2000
Online Learning Resources:
1. https://nptel.ac.in/courses/112106318
Question Paper Pattern:
Sessional Exam: The question paper for Sessional Examination shall be for 40 marks. The question paper shall consist of Four questions and all questions are compulsory. Question No.1 shall contain Five compulsory short answer questions for a total of Ten marks. Question No.2 to 4 shall be EITHER/OR Type for Ten marks each. Student shall Answer any one of them. Each of these questions may contain sub-questions. End Examination: The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions and all questions are compulsory. Question No.1 shall contain Ten compulsory short answer questions for a total of Twenty marks (with Two short answer questions from each unit). Question No.2 to 6 shall be EITHER/OR Type for Ten marks each and shall cover one Unit of the Syllabus for each question. Student shall Answer any one of them. Each of these questions may contain sub-questions.

ELECTRONIC CIRCUITS (EC)								
V Semester: All Branches Except ECE						Scheme: 2023		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
OE505	OE-I	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
		3	0	0	3	30	70	100
Sessional Exam Duration: 2 Hrs					End Exam Duration: 3 Hrs			
Course Outcomes : At the end of the course, students will be able to								
CO1:	Illustrate the VI Characteristics of Diode and special purpose diodes, Design rectifiers, wave shaping circuits and describe the behavior of special purpose diodes.							
CO2:	Explore the operation, configurations, and biasing of BJTs.							
CO3:	Gain knowledge about the operation, analysis, and coupling techniques of BJT amplifiers.							
CO4:	Understand the operation, applications and uses of feedback amplifiers and oscillators							
CO5:	Analyze the characteristics, configurations, and applications of operational amplifiers.							
UNIT – I								
Semiconductor Diode and Applications: Introduction, PN junction diode – structure, operation and VI characteristics, Half-wave, Full-wave and Bridge Rectifiers with and without Filters, Positive and Negative Clipping and Clamping circuits (Qualitative treatment only).								
Special Diodes: Zener and Avalanche Breakdowns, VI Characteristics of Zener diode, Zener diode as voltage regulator, Construction, operation and VI characteristics of Tunnel Diode, LED, Varactor Diode, Photo Diode								
UNIT – II								
Bipolar Junction Transistor (BJT): Principle of Operation, Common Emitter, Common Base and Common Collector Configurations, Transistor as a switch and Amplifier, Transistor Biasing and Stabilization - Operating point, DC & AC load lines, Biasing - Fixed Bias, Self Bias, Bias Stability, Bias Compensation using Diodes.								
UNIT – III								
Single Stage Amplifiers: Classification of Amplifiers - Distortion in amplifiers, Analysis of CE, CC and CB configurations with simplified hybrid model.								
Multistage Amplifiers: Different Coupling Schemes used in Amplifiers - RC coupled amplifiers, Transformer Coupled Amplifier, Direct Coupled Amplifier; Multistage RC coupled BJT amplifier (Qualitative treatment only).								
UNIT – IV								
Feedback Amplifiers: Concepts of feedback, Classification of feedback amplifiers, Effect of feedback on amplifier characteristics, Voltage Series, Voltage Shunt, Current Series and Current Shunt Feedback Configurations (Qualitative treatment only).								
Oscillators: Classification of oscillators, Condition for oscillations, RC Phase shift Oscillators, Generalized analysis of LC Oscillators-Hartley and Colpitts Oscillators, Wien Bridge Oscillator.								
UNIT – V								
Op-amp: Classification of IC'S, basic information of Op-amp, ideal and practical Op-amp, 741 op-amp and its features, modes of operation-inverting, non-inverting, differential.								
Applications of Op-amp: Summing, scaling and averaging amplifiers, Integrator, Differentiator, phase shift oscillator and comparator.								
Text Books:								

1. Electronics Devices and Circuits, J.Millman and Christos. C. Halkias, 3rd edition, Tata McGraw Hill, 2006.
2. Electronics Devices and Circuits Theory, David A. Bell, 5th Edition, Oxford University press. 2008.
Reference Books:
1. Electronics Devices and Circuits Theory, R.L.Boylestad, LouisNashelsky and K.Lal Kishore, 12th edition, 2006, Pearson, 2006.
2. Electronic Devices and Circuits, N.Salivahanan, and N.Suresh Kumar, 3rd Edition, TMH, 2012
3. Microelectronic Circuits, S.Sedra and K.C.Smith, 5th Edition, Oxford University Press.
Question Paper Pattern:
Sessional Exam: The question paper for Sessional Examination shall be for 40 marks. The question paper shall consist of Four questions and all questions are compulsory. Question No.1 shall contain Five compulsory short answer questions for a total of Ten marks. Question No.2 to 4 shall be EITHER/OR Type for Ten marks each. Student shall Answer any one of them. Each of these questions may contain sub-questions. End Examination: The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions and all questions are compulsory. Question No.1 shall contain Ten compulsory short answer questions for a total of Twenty marks (with Two short answer questions from each unit). Question No.2 to 6 shall be EITHER/OR Type for Ten marks each and shall cover one Unit of the Syllabus for each question. Student shall Answer any one of them. Each of these questions may contain sub-questions.

JAVA PROGRAMMING (JP)								
V Semester: CE, EEE, ME and ECE						Scheme: 2023		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
OE506	OE-I	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
		3	0	0	3	30	70	100
Sessional Exam Duration: 2 Hrs					End Exam Duration: 3 Hrs			
Course Outcomes : At the end of the course, students will be able to								
CO1:	Analyze problems, design solutions using OOP principles, and implement them efficiently in Java.							
CO2:	Design and implement classes to model real-world entities, with a focus on attributes, behaviors, and relationships between objects							
CO3:	Demonstrate an understanding of inheritance hierarchies and polymorphic behaviour, including method overriding and dynamic method dispatch.							
CO4:	Apply Competence in handling exceptions and errors to write robust and fault-tolerant code.							
CO5:	Perform file input/output operations, including reading from and writing to files using Java I/O classes, graphical user interface (GUI) programming using JavaFX							
CO6:	Choose appropriate data structure of Java to solve a problem							
UNIT – I								
Object Oriented Programming: Basic concepts, Features of Java , Principles Program Structure in Java: Introduction, Writing Simple Java Programs, Java Statements Data Types, Variables, and Operators: Introduction, Data Types in Java, Declaration of Variables, Type Casting, Scope of Variable Identifier, Variables, Constants, Scope and Lifetime of variables, Operators, Type conversion and casting Introduction to Operators: Precedence and Associativity of Operators, Assignment Operator (=), Basic Arithmetic Operators, Increment (++) and Decrement (--) Operators, Ternary Operator, Relational Operators, Boolean Logical Operators, Bit-wise Logical Operators. Control Statements: Introduction, Control Statements- If Nested loops, Switch Statement, Iteration Statements, while Expression, do-while Loop, for Loop, Nested for Loop								
UNIT – II								
Classes and Objects: Introduction to Classes: Introduction, Class Declaration and Modifiers, Class Members, Declaration of Class Objects, Assigning One Object to Another, Constructor Methods for Class, , Nested Classes, Final Class and Methods, Passing Arguments by Value and by Reference, Keyword this, finalize and Wrapper classes Methods: Introduction, Defining Methods, Overloaded Methods, Overloaded Constructor Methods, Class Objects as Parameters in Methods, Access Control, Recursive Methods, , Attributes Final and Static.								
UNIT – III								
Arrays: Introduction, Declaration and Initialization of Arrays, Memory Storage & Access, Array Operations, Arrays as Vectors. Two dimensional Arrays, Arrays of Varying Lengths, Three dimensional Arrays. Inheritance: Introduction, Access Control and Types of Inheritance, Multilevel and Hierarchical Inheritance, Final and Super keywords, Method Overriding, Dynamic Method Dispatch, Abstract Classes, Interfaces and Inheritance. Interfaces: Introduction, Declaration of Interface, Implementation of Interface, , Default Methods in Interfaces, Static Methods in Interface, Functional Interfaces, Annotations.								
UNIT – IV								

Packages and Java Library :Packages:

Introduction, Defining Package, Importing Packages and Classes into Programs, Access Control, Packages in Java SE, Class Object, Enumeration, class Math, Wrapper Classes, Java util Classes and Interfaces, Formatter Class, Random Class, Formatting for Date/Time in Java

Exception Handling: Introduction, Hierarchy of Standard Exception Classes, Keywords throws and throw, try, catch, and finally Blocks, Multiple Catch Clauses, Class Throwable, Unchecked Exceptions, Checked Exceptions.

Java I/O and File: Java I/O API, standard I/O streams, types, Byte streams.

UNIT – V

String Handling in Java: Introduction, Interface Char Sequence, Class String, Methods for Extracting Characters from Strings, Comparison, Modifying, Searching; Class StringBuffer.

Multithreaded Programming: Introduction, Java thread model, Creating a thread-Extending Thread class and Implementing Runnable interface, Thread life cycle, Thread class methods, Thread priorities, Deadlocks in Threads, Thread Synchronization and Inter Thread Communication

Java Database Connectivity: Introduction, JDBC Architecture, Installing My SQL and My SQL Connector/J, JDBC Environment Setup, Establishing JDBC Database Connections, Result Set Interface

Text Books:

1. JAVA one step ahead, Anitha Seth, B.L.Juneja, Oxford.
2. Joy with JAVA, Fundamentals of Object Oriented Programming, Debasis Samanta, Monalisa Sarma, Cambridge, 2023.
3. JAVA 9 for Programmers, Paul Deitel, Harvey Deitel, 4th Edition, Pearson.

Reference Books:

1. The complete Reference Java, 11th edition, Herbert Schildt, TMH
2. Introduction to Java programming, 7th Edition, Y Daniel Liang, Pearson

Online Learning Resources:

1. <https://nptel.ac.in/courses/106/105/106105191/>
2. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_012880464547618816347_shared/overview

Question Paper Pattern:

Sessional Exam: The question paper for Sessional Examination shall be for 40 marks. The question paper shall consist of Four questions and all questions are compulsory. Question No.1 shall contain Five compulsory short answer questions for a total of Ten marks. Question No.2 to 4 shall be EITHER/OR Type for Ten marks each. Student shall Answer any one of them. Each of these questions may contain sub-questions.

End Examination: The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions and all questions are compulsory. Question No.1 shall contain Ten compulsory short answer questions for a total of Twenty marks (with Two short answer questions from each unit). Question No.2 to 6 shall be EITHER/OR Type for Ten marks each and shall cover one Unit of the Syllabus for each question. Student shall Answer any one of them. Each of these questions may contain sub-questions.

FOUNDATIONS OF ARTIFICIAL INTELLIGENCE (FAI)								
V Semester: CE and ECE					Scheme: 2023			
Course Code	Category	Hours/Week			Credits	Maximum Marks		
OE507	OE-I	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
		3	0	0	3	30	70	100
Sessional Exam Duration: 2 Hrs					End Exam Duration: 3 Hrs			
Course Outcomes : At the end of the course, students will be able to								
CO1:	Learn the distinction between optimal reasoning Vs human like reasoning and formulate an efficient problem space for a problem expressed in natural language. Also select a search algorithm for a problem and estimate its time and space complexities.							
CO2:	Apply AI techniques to solve problems of game playing, theorem proving, and machine learning.							
CO3:	Learn different knowledge representation techniques.							
CO4:	Understand the concepts of state space representation, exhaustive search, heuristic search together with the time and space complexities.							
CO5:	Comprehend the applications of Probabilistic Reasoning and Bayesian Networks.							
CO6:	Analyze Supervised Learning Vs. Learning Decision Trees.							
UNIT – I								
Introduction to AI: Intelligent Agents, Problem-Solving Agents. Searching for Solutions: Breadth-first search, Depth-first search, Hill-climbing search, Simulated annealing search, Local Search in Continuous Spaces.								
UNIT – II								
Games: Optimal Decisions in Games, Alpha-Beta Pruning, Defining Constraint Satisfaction Problems, Constraint Propagation, Backtracking Search for CSPs, Knowledge-Based Agents, Logic- Propositional Logic, Propositional Theorem Proving: Inference and proofs, Proof by resolution, Horn clauses and definite clauses.								
UNIT – III								
First-Order Logic: Syntax and Semantics of First-Order Logic, Using First Order Logic, Knowledge Engineering in First-Order Logic. Inference in First-Order Logic: Propositional vs. First Order Inference, Unification, Forward Chaining, Backward Chaining, Resolution. Knowledge Representation: Ontological Engineering, Categories and Objects, Events.								
UNIT – IV								
Planning: Definition of Classical Planning, Algorithms for Planning with State Space Search, Planning Graphs, other Classical Planning Approaches, Analysis of Planning approaches. Hierarchical Planning.								
UNIT – V								
Probabilistic Reasoning: Acting under Uncertainty, Basic Probability Notation Bayes' Rule and Its Use, Probabilistic Reasoning, Representing Knowledge in an Uncertain Domain, The Semantics of Bayesian Networks, Efficient Representation of Conditional Distributions, Approximate Inference in Bayesian Networks, Relational and First- Order Probability.								
Text Books:								
1. Artificial Intelligence: A Modern Approach, Third Edition, Stuart Russell and Peter Norvig, Pearson Education.								
Reference Books:								
1. Artificial Intelligence, 3rd Edition, E. Rich and K. Knight (TMH).								
2. Artificial Intelligence, 3rd Edition, Patrick Henny Winston, Pearson Education.								
3. Artificial Intelligence, Shivani Goel, Pearson Education.								

4. Artificial Intelligence and Expert systems – Patterson, Pearson Education.

Online Learning Resources:

1. https://swayam.gov.in/nd1_noc19_me71/preview

2. <https://ai.google/>

Question Paper Pattern:

Sessional Exam: The question paper for Sessional Examination shall be for 40 marks. The question paper shall consist of Four questions and all questions are compulsory. Question No.1 shall contain Five compulsory short answer questions for a total of Ten marks. Question No.2 to 4 shall be EITHER/OR Type for Ten marks each. Student shall Answer any one of them. Each of these questions may contain sub-questions.

End Examination: The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions and all questions are compulsory. Question No.1 shall contain Ten compulsory short answer questions for a total of Twenty marks (with Two short answer questions from each unit). Question No.2 to 6 shall be EITHER/OR Type for Ten marks each and shall cover one Unit of the Syllabus for each question. Student shall Answer any one of them. Each of these questions may contain sub-questions.

ETHICAL HACKING (EH)								
V Semester: All Branches					Scheme: 2023			
Course Code	Category	Hours/Week			Credits	Maximum Marks		
OE508	OE-I	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
		3	0	0	3	30	70	100
Sessional Exam Duration: 2 Hrs					End Exam Duration: 3 Hrs			
Course Outcomes : At the end of the course, students will be able to								
CO1:	Understand the basics of security and ethical hacking.							
CO2:	Understand about foot printing and types of attacks in social engineering.							
CO3:	Understand about sniffers, hijacking and DoS attacks.							
CO4:	Understand the importance of web server hacking, database hacking and SQL Injection.							
CO5:	Understand about Wireless technologies, intrusion detection and firewalls.							
UNIT – I								
Introduction to Ethical Hacking: Introduction, Security fundamentals, Security testing, Hackers and crackers description, Ethical Hackers.								
Technical Foundations of Hacking: The Hacking process, Information Security Systems and the Stack.								
UNIT – II								
Foot printing: Information Gathering Methodology , OS Fingerprinting, Fingerprinting Services, Enumeration, System Hacking.								
Social Engineering: Social Engineering, Malware threats, Vulnerability analysis.								
UNIT – III								
Sniffers: Passive sniffing, Active sniffing, ARP,ARP poisoning and MAC flooding, tools for sniffing, wire shark, sniffing and spoofing countermeasures.								
Session Hijacking: Transport layer Hijacking, Application layer Hijacking, Session Hijacking								
Tools. Denial of Service: DoS attack techniques, Distributed DoS, DDoS tools.								
UNIT – IV								
Web Server Hacking: HTTP protocol, scanning web servers, Banner grabbing and Enumeration, Web server, DoS/ DDoS and DNS attacks.								
Database Hacking: Introduction to SQL and SQL injection and categories, Finger printing, UNION Exploitation technique, Boolean in SQL injection attacks, Out-of band exploitation, exploring the time-delay SQL injection technique, Stored procedure SQL injection and mitigations, SQL injection hacking tools.								
UNIT – V								
Wireless Technologies, Mobile Security: Mobile device operation and security, Wireless LAN's- Basics, Wireless LAN frequencies and signalling, Wireless LAN security.								
IDS: Intrusion Detection and Prevention Systems. Firewalls and Honey pots.								
Text Books:								
1. Micheal Gregg, “Certified Ethical Hacker (CEH) Cert Guide”, Pearson education, 2020.								
Reference Books:								
1. EC-Council, “Ethical Hacking and Counter measures (CEH)”,CENGAGE Learning, 2020								
2. Sai Satish, “Hacking Secrets Part-1”, Indian Servers, 2018.								
3. David Litchfield, Chris Anley “The Database Hackers Handbook: Defending Database Servers”, Wiley.								
Online Learning Resources:								

1. <https://www.coursera.org/courses?query=ethical%20hacking>
2. https://onlinecourses.nptel.ac.in/noc22_cs13/preview
3. <https://www.geeksforgeeks.org/ethical-hacking-tutorial/>

Question Paper Pattern:

Sessional Exam: The question paper for Sessional Examination shall be for 40 marks. The question paper shall consist of Four questions and all questions are compulsory. Question No.1 shall contain Five compulsory short answer questions for a total of Ten marks. Question No.2 to 4 shall be EITHER/OR Type for Ten marks each. Student shall Answer any one of them. Each of these questions may contain sub-questions.

End Examination: The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions and all questions are compulsory. Question No.1 shall contain Ten compulsory short answer questions for a total of Twenty marks (with Two short answer questions from each unit). Question No.2 to 6 shall be EITHER/OR Type for Ten marks each and shall cover one Unit of the Syllabus for each question. Student shall Answer any one of them. Each of these questions may contain sub-questions.

MATHEMATICS FOR MACHINE LEARNING AND AI (MMLA)								
V Semester: All Branches					Scheme: 2023			
Course Code	Category	Hours/Week			Credits	Maximum Marks		
OE509	OE-I	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
		3	0	0	3	30	70	100
Sessional Exam Duration: 2 Hrs					End Exam Duration: 3 Hrs			
Course Outcomes : At the end of the course, students will be able to								
CO1:	Apply linear algebra concepts to ML techniques like PCA and regression							
CO2:	Analyze probabilistic models and statistical methods for AI applications.							
CO3:	Implement optimization techniques for machine learning algorithms.							
CO4:	Utilize vector calculus and transformations in AI-based models.							
CO5:	Develop graph-based AI models using mathematical representations.							
UNIT – I								
Linear Algebra for Machine Learning: Review of Vector spaces, basis, linear independence, Vector and matrix norms, Matrix factorization techniques, Eigen values, eigenvectors, diagonalization, Singular Value Decomposition (SVD) and Principal Component Analysis (PCA).								
UNIT – II								
Probability and Statistics for AI: Probability distributions: Gaussian, Binomial, Poisson. Bayes' Theorem, Maximum Likelihood Estimation (MLE), and Maximum a Posteriori (MAP). Entropy and Kullback-Leibler (KL) Divergence in AI, Cross entropy loss, Markov chains.								
UNIT – III								
Optimization Techniques for ML: Multivariable calculus: Gradients, Hessians, Jacobians. Constrained optimization: Lagrange multipliers and KKT conditions. Gradient Descent and its variants (Momentum, Adam) Newton's method, BFGS method.								
UNIT – IV								
Vector Calculus & Transformations: Vector calculus: Gradient, divergence, curl. Fourier Transform & Laplace Transform in ML applications								
UNIT – V								
Graph Theory for AI: Graph representations: Adjacency matrices, Laplacian matrices. Bayesian Networks & Probabilistic Graphical Models. Introduction to Graph Neural Networks (GNNs).								
Text Books:								
1. Mathematics for Machine Learning by Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, Cambridge University Press, 2020.								
2. Pattern Recognition and Machine Learning by Christopher Bishop, Springer.								
Reference Books:								
1. Gilbert Strang, Linear Algebra and Its Applications, Cengage Learning, 2016.								
2. Jonathan Gross, Jay Yellen, Graph Theory and Its Applications, CRC Press, 2018.								
Online Learning Resources:								
1. https://ocw.mit.edu								
2. https://cs229.stanford.edu/								
3. https://deeptai.org								
Question Paper Pattern:								
Sessional Exam: The question paper for Sessional Examination shall be for 40 marks. The question paper shall consist of Four questions and all questions are compulsory. Question								

No.1 shall contain Five compulsory short answer questions for a total of Ten marks. Question No.2 to 4 shall be EITHER/OR Type for Ten marks each. Student shall Answer any one of them. Each of these questions may contain sub-questions.

End Examination: The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions and all questions are compulsory. Question No.1 shall contain Ten compulsory short answer questions for a total of Twenty marks (with Two short answer questions from each unit). Question No.2 to 6 shall be EITHER/OR Type for Ten marks each and shall cover one Unit of the Syllabus for each question. Student shall Answer any one of them. Each of these questions may contain sub-questions.

MATERIALS CHARACTERIZATION TECHNIQUES (MCT)								
V Semester: All Branches					Scheme: 2023			
Course Code	Category	Hours/Week			Credits	Maximum Marks		
OE510	OE-I	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
		3	0	0	3	30	70	100
Sessional Exam Duration: 2 Hrs					End Exam Duration: 3 Hrs			
Course Outcomes : At the end of the course, students will be able to								
CO1:	Analyze the crystal structure and crystallite size by various methods							
CO2:	Analyze the morphology of the sample by using a Scanning Electron Microscope							
CO3:	Analyze the morphology and crystal structure of the sample by using Transmission Electron Microscope							
CO4:	Explain the principle and experimental arrangement of various spectroscopic techniques							
CO5:	Identify the construction and working principle of various Electrical & Magnetic Characterization technique							
UNIT – I								
Structure analysis by Powder X-Ray Diffraction: Introduction, Bragg's law of diffraction, Intensity of Diffracted beams, Factors affecting Diffraction, Intensities, Structure of polycrystalline Aggregates, Determination of crystal structure, Crystallite size by Scherer and Williamson-Hall (W-H) Methods, Small angle X-ray scattering (SAXS) (in brief).								
UNIT – II								
Microscopy technique -1 –Scanning Electron Microscopy (SEM): Introduction, Principle, Construction and working principle of Scanning Electron Microscopy, Specimen preparation, Different types of modes used (Secondary Electron and Backscatter Electron), Advantages, limitations and applications of SEM.								
UNIT – III								
Microscopy Technique -2 - Transmission Electron Microscopy (TEM): Construction and Working principle, Resolving power and Magnification, Bright and dark fields, Diffraction and image formation, Specimen preparation, Selected Area Diffraction, Applications of Transmission Electron Microscopy, Difference between SEM and TEM, Advantage and Limitations of Transmission Electron Microscopy								
UNIT – IV								
Spectroscopy techniques: Principle, Experimental arrangement, Analysis and advantages of the spectroscopic techniques – (i) UV-Visible spectroscopy (ii) Raman Spectroscopy, (iii) Fourier Transform infrared (FTIR) spectroscopy, (iv) X-ray photoelectron spectroscopy (XPS).								
UNIT – V								
Electrical & Magnetic Characterization techniques: Electrical Properties analysis techniques (DC conductivity, AC conductivity) Activation Energy, Effect of Magnetic field on the electrical properties (Hall Effect). Magnetization measurement by induction method, Vibrating sample Magnetometer (VSM) and SQUID.								
Text Books:								
1. Material Characterization: Introduction to Microscopic and Spectroscopic Methods – Yang Leng – John Wiley & Sons (Asia) Pvt. Ltd. 2013.								
2. Microstructural Characterization of Materials - David Brandon, Wayne D Kalpan, John Wiley & Sons Ltd., 2008								
Reference Books:								
1. Fundamentals of Molecular Spectroscopy – IV Ed. – Colin Neville Banwell and Elaine M. McCash, Tata McGraw-Hill, 2008.								
2. Elements of X-ray diffraction – Bernard Dennis Cullity & Stuart R Stocks, Prentice Hall ,								

2001 – Science.
3. Practical Guide to Materials Characterization: Techniques and Applications - Khalid Sultan – Wiley – 2021.
4. Materials Characterization Techniques -Sam Zhang, Lin Li, Ashok Kumar -CRC Press - 2008
Online Learning Resources:
1. https://nptel.ac.in/courses/115/103/115103030/ 2. https://nptel.ac.in/content/syllabus_pdf/113106034.pdf 3. https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-mm08/
Question Paper Pattern:
Sessional Exam: The question paper for Sessional Examination shall be for 40 marks. The question paper shall consist of Four questions and all questions are compulsory. Question No.1 shall contain Five compulsory short answer questions for a total of Ten marks. Question No.2 to 4 shall be EITHER/OR Type for Ten marks each. Student shall Answer any one of them. Each of these questions may contain sub-questions. End Examination: The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions and all questions are compulsory. Question No.1 shall contain Ten compulsory short answer questions for a total of Twenty marks (with Two short answer questions from each unit). Question No.2 to 6 shall be EITHER/OR Type for Ten marks each and shall cover one Unit of the Syllabus for each question. Student shall Answer any one of them. Each of these questions may contain sub-questions.

CHEMISTRY OF ENERGY SYSTEMS (CES)								
V Semester: All Branches					Scheme: 2023			
Course Code	Category	Hours/Week			Credits	Maximum Marks		
OE511	OE-I	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
		3	0	0	3	30	70	100
Sessional Exam Duration: 2 Hrs					End Exam Duration: 3 Hrs			
Course Outcomes : At the end of the course, students will be able to								
CO1:	Solve the problems based on electrode potential, Describe the Galvanic Cell, Differentiate between Lead acid and Lithium ion batteries, Illustrate the electrical double layer							
CO2:	Describe the working Principle of Fuel cell, Explain the efficiency of the fuel cell, Discuss about the Basic design of fuel cells, Classify the fuel cell							
CO3:	Differentiate between Photo and Photo electro chemical Conversions, Illustrate the photochemical cells, Identify the applications of photochemical reactions, Interpret advantages of photo electron catalytic conversion.							
CO4:	Apply the photovoltaic technology, Demonstrate about solar energy and prospects Illustrate the Solar cells, Discuss about concentrated solar power							
CO5:	Differentiate Chemical and Physical methods of hydrogen storage, Discuss the metal organic framework, Illustrate the carbon and metal oxide porous structures, Describe the liquification methods.							
UNIT – I								
Electrochemical Systems: Galvanic cell, Nernst equation, standard electrode potential, application of EMF, electrical double layer, polarization, Batteries- Introduction, Lead-acid, Nickel- cadmium, Lithium ion batteries and their applications.								
UNIT – II								
Fuel Cells: Fuel cell- Introduction, Basic design of fuel cell, working principle, Classification of fuel cells, Polymer electrolyte membrane (PEM) fuel cells, Solid-oxide fuel cells (SOFC), Fuel cell efficiency and applications.								
UNIT – III								
Photo and Photo electrochemical Conversions: Photochemical cells Introduction and applications of photochemical reactions, specificity of photo electrochemical cell, advantage of photoelectron catalytic conversions and their applications.								
UNIT – IV								
Solar Energy: Introduction and prospects, photovoltaic (PV) technology, concentrated solar power (CSP), Solar cells and applications								
UNIT – V								
Hydrogen Storage: Hydrogen storage and delivery: State-of-the art, Established technologies, Chemical and Physical methods of hydrogen storage, Compressed gas storage, Liquid hydrogen storage, Other storage methods, Hydrogen storage in metal hydrides, metal organic frameworks (MOF), Metal oxide porous structures, hydrogel , and Organic hydrogen carriers.								
Text Books:								
1. Physical chemistry by Ira N. Levine								
2. Essentials of Physical Chemistry, Bahl and Bahl and Tuli.								
3. Inorganic Chemistry, Silver and Atkins								
Reference Books:								
1. Fuel Cell Hand Book 7th Edition, by US Department of Energy (EG&G technical services And corporation)								
2. Hand book of solar energy and applications by ArvindTiwari and Shyam.								

3. Solar energy fundamental, technology and systems by Klaus Jagar et.al.

4. Hydrogen storage by Levine Klebonoff

Question Paper Pattern:

Sessional Exam: The question paper for Sessional Examination shall be for 40 marks. The question paper shall consist of Four questions and all questions are compulsory. Question No.1 shall contain Five compulsory short answer questions for a total of Ten marks. Question No.2 to 4 shall be EITHER/OR Type for Ten marks each. Student shall Answer any one of them. Each of these questions may contain sub-questions.

End Examination: The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions and all questions are compulsory. Question No.1 shall contain Ten compulsory short answer questions for a total of Twenty marks (with Two short answer questions from each unit). Question No.2 to 6 shall be EITHER/OR Type for Ten marks each and shall cover one Unit of the Syllabus for each question. Student shall Answer any one of them. Each of these questions may contain sub-questions.

ENGLISH FOR COMPETITIVE EXAMINATIONS (ECE)								
V Semester: All Branches					Scheme: 2023			
Course Code	Category	Hours/Week			Credits	Maximum Marks		
OE512	OE-I	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
		3	0	0	3	30	70	100
Sessional Exam Duration: 2 Hrs					End Exam Duration: 3 Hrs			
Course Outcomes : At the end of the course, students will be able to								
CO1:	Identify the basics of English grammar and its importance							
CO2:	Explain the use of grammatical structures in sentences							
CO3:	Demonstrate the ability to use various concepts in grammar and vocabulary and their applications in everyday use and in competitive exams							
CO4:	Analyze an unknown passage and reach conclusions about it							
CO5:	Choose the appropriate form of verbs in framing sentences							
CO6:	Develop speed reading and comprehending ability thereby perform better in competitive exams							
UNIT – I								
Grammar - I: Nouns-classification-errors, Pronouns-types-errors, Adjectives-types-errors, Articles-definite indefinite, Degrees of Comparison, Adverbs-types- errors, Conjunctions-usage Prepositions-usage, Tag Questions, types-identifying errors- Practice								
UNIT – II								
Grammar - II: Verbs-tenses- structure-usages- negatives- positives- time adverbs, Sequence of tenses--If Clause, Voice-active voice and passive voice, reported Speech, Agreement-subject and verb Modals-Spotting Errors-Practices								
UNIT – III								
Verbal Ability: Sentence completion-Verbal analogies-Word groups-Instructions, Critical reasoning-Verbal deduction-Select appropriate pair, Reading Comprehension-Paragraph-Jumbles-Selecting the proper statement by reading a given paragraph.								
UNIT – IV								
Reading Comprehension and Vocabulary: Competitive Vocabulary :Word Building – Memory techniques, Synonyms, Antonyms, Affixes-Prefix & Suffix, One word substitutes, Compound words, Phrasal Verbs, Idioms and Phrases, Homophones, Linking Words, Modifiers, Intensifiers - Mastering Competitive Vocabulary, Cracking the unknowing passage-speed reading techniques- Skimming & Scanning-types of answering-Elimination methods								
UNIT – V								
Writing for Competitive Examinations: Punctuation- Spelling rules- Word order-Sub Skills of Writing- Paragraph meaning-salient features-types - Note-making, Note-taking, summarizing-precise writing- Paraphrasing Expansion of proverbs- Essay writing-types								
Text Books:								
1. Wren & Martin, English for Competitive Examinations, S.Chand & Co, 2021.								
2. Objective English for Competitive Examination, Tata McGraw Hill, New Delhi, 2014								
Reference Books:								
1. Hari Mohan Prasad, Objective English for Competitive Examination, Tata McGraw Hill, New Delhi, 2014.								
2. Philip Sunil Solomon, English for Success in Competitive Exams, Oxford 2016								
3. Shalini Verma , Word Power Made Handy, S Chand Publications								
4. Neira, Anjana Dev & Co. Creative Writing: A Beginner's Manual. Pearson Education India, 2008.								

5. Abhishek Jain,Vocabulary Learning Techniques Vol.I&II,RR Global Publishers 2013.
6. Michel Swan, Practical English Usage,Oxford,2006.
Online Learning Resources:
1. https://www.grammar.cl/english/parts-of-speech.htm 2. https://academicguides.waldenu.edu/writingcenter/grammar/partsofspeech 3. https://learnenglish.britishcouncil.org/grammar/english-grammar-reference/active-passive-voice 4. https://languagetool.org/insights/post/verb-tenses/ 5. https://www.britishcouncil.in/blog/best-free-english-learning-resources-british-council 6. https://www.careerride.com/post/social-essays-for-competitive-exams-586.aspx
Question Paper Pattern:
Sessional Exam: The question paper for Sessional Examination shall be for 40 marks. The question paper shall consist of Four questions and all questions are compulsory. Question No.1 shall contain Five compulsory short answer questions for a total of Ten marks. Question No.2 to 4 shall be EITHER/OR Type for Ten marks each. Student shall Answer any one of them. Each of these questions may contain sub-questions. End Examination: The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions and all questions are compulsory. Question No.1 shall contain Ten compulsory short answer questions for a total of Twenty marks (with Two short answer questions from each unit). Question No.2 to 6 shall be EITHER/OR Type for Ten marks each and shall cover one Unit of the Syllabus for each question. Student shall Answer any one of them. Each of these questions may contain sub-questions.

ENTREPRENEURSHIP AND NEW VENTURE CREATION (ENVC)								
V Semester: All Branches					Scheme: 2023			
Course Code	Category	Hours/Week			Credits	Maximum Marks		
OE513	OE-I	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
		3	0	0	3	30	70	100
Sessional Exam Duration: 2 Hrs					End Exam Duration: 3 Hrs			
Course Outcomes : At the end of the course, students will be able to								
CO1:	Understand the concept of entrepreneurship, analyze its role in economic development, and develop a creative mindset for starting a business.							
CO2:	Understand customer problems, validate them with potential customers, and evaluate customer segments and personas.							
CO3:	Evaluate customer needs through jobs-to-be-done analysis and develop value propositions using prototypes and MVPs.							
CO4:	Apply lean business models, financial and sales plans to design a venture with suitable funding and marketing channels.							
CO5:	Analyze scaling aspirations and venture components to develop an investor-ready pitch							
UNIT – I								
Entrepreneurship Fundamentals and Context: Meaning and concept, attributes and mindset of entrepreneurial and entrepreneurial leadership, role models in each and their role in economic development. An understanding of how to build entrepreneurial mindset, skill sets, attributes and networks while on campus.								
UNIT – II								
Problem & Customer Identification: Understanding and analyzing the macro-Problem and Industry perspective - technological, socioeconomic and urbanization trends and their implication on new opportunities - Identifying passion –identifying and defining problem using Design thinking principles –Analyzing problem and validating with the potential customer - Understanding customer segmentation, creating and validating customer personas.								
UNIT – III								
Solution Design, Prototyping & Opportunity Assessment and Sizing: Understanding Customer Jobs-to-be-done and crafting innovative solution design to map to customer’s needs and create a strong value proposition - Understanding prototyping and Minimum Viable product (MVP) - Developing a feasibility prototype with differentiating value, features and benefits - Assess relative market position via competition analysis - Sizing the market and assess scope and potential scale of the opportunity.								
UNIT – IV								
Business & Financial Model, Go-To-Market Plan: Introduction to Business model and types, Lean approach,9 block lean canvas model, riskiest assumptions to Business models. Importance of Build - Measure – Lean approach. Business planning: components of Business plan- Sales plan, People plan and financial plan. Financial Planning: Types of costs, preparing a financial plan for profitability using financial template, understanding basics of Unit economics and analyzing financial performance. Introduction to Marketing and Sales, Selecting the Right Channel, creating digital presence, building customer acquisition strategy. Choosing a form of business organization specific to your venture, identifying sources of funds: Debt & Equity Map the Start-up Life-cycle to Funding Options.								
UNIT – V								

Scale Outlook and Venture Pitch Readiness: Understand and identify potential and aspiration for scale vis-a-vis your venture idea. Persuasive Storytelling and its key components. Build an Investor ready pitch deck.
Text Books:
1. Robert D. Hisrich, Michael P. Peters, Dean A. Shepherd, Sabyasachi Sinha. Entrepreneurship, McGrawHill, 11th Edition.(2020)
2. Ries, E.The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses. Crown Business, (2011).
Reference Books:
1. Simon Sinek,Start with Why, Penguin Books limited. (2011)
2. Brown Tim,Change by Design Revised & Updated: How Design Thinking
3. Transforms Organizations and Inspires Innovation, Harper Business.(2019)
4. Namita Thapar(2022) The Dolphin and the Shark: Stories on Entrepreneurship, Penguin Books Limited
Online Learning Resources:
1. https://wadhwanifoundation.org/initiatives/entrepreneurship/
Question Paper Pattern:
Sessional Exam: The question paper for Sessional Examination shall be for 40 marks. The question paper shall consist of Four questions and all questions are compulsory. Question No.1 shall contain Five compulsory short answer questions for a total of Ten marks. Question No.2 to 4 shall be EITHER/OR Type for Ten marks each. Student shall Answer any one of them. Each of these questions may contain sub-questions. End Examination: The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions and all questions are compulsory. Question No.1 shall contain Ten compulsory short answer questions for a total of Twenty marks (with Two short answer questions from each unit). Question No.2 to 6 shall be EITHER/OR Type for Ten marks each and shall cover one Unit of the Syllabus for each question. Student shall Answer any one of them. Each of these questions may contain sub-questions.

DISASTER MANAGEMENT (DM)								
VI Semester: All Branches					Scheme: 2023			
Course Code	Category	Hours/Week			Credits	Maximum Marks		
OE601	OE-II	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
		3	0	0	3	30	70	100
Sessional Exam Duration: 2 Hrs					End Exam Duration: 3 Hrs			
Course Outcomes : At the end of the course, students will be able to								
CO1:	Understand the definitions and terminologies used in disaster management.							
CO2:	Understand the types and categories of disasters.							
CO3:	Understand the impact of disasters on socio-economic and environment.							
CO4:	Plan for disaster risk reduction, mitigation and management strategies.							
CO5:	Understand the relationship between development and disasters.							
UNIT – I								
Introduction: Concepts and definitions: disaster, hazard, vulnerability, risks, severity, frequency and details, capacity, impact, prevention, mitigation.								
UNIT – II								
Disasters: Disasters classification Natural Disasters: Floods, draught, cyclones, volcanoes, earthquakes, tsunami, landslides, coastal erosion, soil erosion, forest fires etc. Manmade Disasters: Industrial pollution – Artificial flooding in urban areas –Nuclear radiation – Chemical spills – Transportation accidents – Terrorist strikes, etc. – Mountain and coastal areas.								
UNIT – III								
Disaster Impacts: Disaster impacts –Environmental, physical, social, ecological, economic, political, etc., Health - psycho-social issues – Demographic aspects – Hazard locations – Global and national disaster trends – Climate change and urban disasters.								
UNIT – IV								
Disaster Risk Reduction: Disaster Management Cycle - its phases: Prevention, mitigation, preparedness, relief and recovery – Risk analysis, vulnerability and capacity assessment – Early warning systems. Post-Disaster Environmental Response (i.e. water, sanitation, food safety, waste management, disease control, security, and communications): Role and responsibilities of government, community, local institutions, NGOs and other stakeholders – Policies and legislation for disaster risk reduction – Activities of National Disaster Management Authority.								
UNIT – V								
Disasters, Environment and Development: Factors affecting vulnerability such as impact of developmental projects and environmental modifications – Sustainable and environmental friendly recovery – Reconstruction and development methods.								
Text Books:								
1. PradeepSahni, Disaster Risk Reduction in South Asia, PHI, New Delhi.								
2. Ghosh G.K., Disaster Management, APH Publishing Corporation.								
3. Singh B.K., Handbook of Disaster Management Techniques &Guidelines, Rajat Publication.								
4. V. K. Sharma, Disaster Management, National Centre for Disaster Management, IIPE, Delhi								
Reference Books:								

1. A Status Report Publication of the Govt. of India, Ministry of Home Affairs, National Disaster Management Division, Disaster Management in India.
2. A. S. Arya, Anup Karanth, and Ankush Agarwal, Hazards, Disasters and Your Community; A Primer for Parliamentarians, GOI-UNDP Disaster Risk Management Programme.
3. Interagency Standing Committee (IASC) (Feb. 2007). IASC Guidelines on Mental Health and Psychosocial Support in Emergency Settings. Geneva: IASC.
Online Learning Resources:
1. http://ndma.gov.in/ (Home page of National Disaster Management Authority)
2. http://www.ndmindia.nic.in/ (National Disaster management in India, Ministry of Home Affairs).
3. www.odihpn.org , Disaster Preparedness Programme in India. A Cost Benefit Analysis, Commissioned and Published by the Humanitarian Practice Network 'at ODI HPN.
4. www.empowerpoor.org , Drought in India: Challenges and Initiatives; Poorest Areas in Civil Society (PACS) Programme. [2001–2008]
Question Paper Pattern:
Sessional Exam: The question paper for Sessional Examination shall be for 40 marks. The question paper shall consist of Four questions and all questions are compulsory. Question No.1 shall contain Five compulsory short answer questions for a total of Ten marks. Question No.2 to 4 shall be EITHER/OR Type for Ten marks each. Student shall Answer any one of them. Each of these questions may contain sub-questions. End Examination: The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions and all questions are compulsory. Question No.1 shall contain Ten compulsory short answer questions for a total of Twenty marks (with Two short answer questions from each unit). Question No.2 to 6 shall be EITHER/OR Type for Ten marks each and shall cover one Unit of the Syllabus for each question. Student shall Answer any one of them. Each of these questions may contain sub-questions.

SUSTAINABILITY IN ENGINEERING PRACTICES (SIE)								
VI Semester: All Branches					Scheme: 2023			
Course Code	Category	Hours/Week			Credits	Maximum Marks		
OE602	OE-II	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
		3	0	0	3	30	70	100
Sessional Exam Duration: 2 Hrs					End Exam Duration: 3 Hrs			
Course Outcomes : At the end of the course, students will be able to								
CO1:	Understand the fundamentals of sustainability, the carbon cycle, and the environmental impact of construction materials.							
CO2:	Analyze sustainable construction materials, their durability, and lifecycle assessment.							
CO3:	Apply Energy Calculations in construction materials and assess the embodied energy.							
CO4:	Evaluate green building standards, energy codes, and performance ratings.							
CO5:	Assess the environmental effects of energy use, climate change, and global warming.							
UNIT – I								
Introduction: Introduction and Definition of Sustainability - Carbon Cycle - Role of Construction Material: Concrete and Steel, Etc. - CO2Contribution From Cement and Other Construction Materials.								
UNIT – II								
Materials Used in Sustainable Construction: Construction Materials and Indoor Air Quality-No/Low Cement Concrete-Recycled and Manufactured Aggregate - Role of QC and Durability - Life Cycle and Sustainability.								
UNIT – III								
Energy Calculations: Components of Embodied Energy-Calculation of Embodied Energy for Construction Materials-Energy Concept and Primary Energy-Embodied Energy Via-A-Vis Operational Energy in Conditioned Building -Lifecycle Energy Use.								
UNIT – IV								
Green Buildings: Control of Energy Use in Building - ECBC Code, Codes in Neighboring Tropical Countries - OTTV Concepts and Calculations – Features of LEED and TERI – GRIHA Ratings - Role of Insulation and Thermal Properties of Construction Materials - Influence of Moisture Content and Modeling - Performance Ratings of Green Buildings - Zero Energy Building.								
UNIT – V								
Environmental Effects: Non-Renewable Sources of Energy and Environmental Impact–Energy Norm, Coal, Oil, Natural Gas - Nuclear Energy - Global Temperature, Green House Effects, Global Warming - Acid Rain: Causes, Effects and Control Methods - Regional Impacts of Temperature Change.								
Text Books:								
1. Charles J kibert Sustainable Construction: Green Building Design & Delivery,4 th Edition, Wiley Publisher 2016.								
2. Steve Goodhew, Sustainable Construction Process, Wiley Blackwell, UK,2016.								
Reference Books:								
1. Carig A.Langston & Grace K.C. Ding, Sustainable Practices in the Built Environment, Butterworth Heinemann Publishers, 2011.								
2. William P Spence, Construction Materials, Methods& Techniques (3e),Yesdee Publication Pvt. Ltd, 2012.								

Online Learning Resources:

1. <https://archive.nptel.ac.in/courses/105/105/105105157/>

Question Paper Pattern:

Sessional Exam: The question paper for Sessional Examination shall be for 40 marks. The question paper shall consist of Four questions and all questions are compulsory. Question No.1 shall contain Five compulsory short answer questions for a total of Ten marks. Question No.2 to 4 shall be EITHER/OR Type for Ten marks each. Student shall Answer any one of them. Each of these questions may contain sub-questions.

End Examination: The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions and all questions are compulsory. Question No.1 shall contain Ten compulsory short answer questions for a total of Twenty marks (with Two short answer questions from each unit). Question No.2 to 6 shall be EITHER/OR Type for Ten marks each and shall cover one Unit of the Syllabus for each question. Student shall Answer any one of them. Each of these questions may contain sub-questions.

RENEWABLE ENERGY SOURCES (RES)								
VI Semester: All Branches Except EEE						Scheme: 2023		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
OE603	OE-II	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
		3	0	0	3	30	70	100
Sessional Exam Duration: 2 Hrs					End Exam Duration: 3 Hrs			
Course Outcomes : At the end of the course, students will be able to								
CO1:	Understand principle operation of various renewable energy sources.							
CO2:	Identify site selection of various renewable energy sources.							
CO3:	Analyze various factors affecting on solar energy measurements, wind energy conversion techniques, Geothermal, Biomass, Tidal Wave and Fuel cell energies.							
CO4:	Design of Solar PV modules and considerations of horizontal and vertical axis Wind energy systems							
CO5:	Apply the concepts of Geo Thermal Energy, Ocean Energy, Bio mass and Fuel Cells for generation of power.							
UNIT – I								
Solar Energy: Solar radiation - beam and diffuse radiation, solar constant, Sun at Zenith, attenuation and measurement of solar radiation, local solar time, derived solar angles, sunrise, sunset and day length. flat plate collectors, concentrating collectors, storage of solar energy-thermal storage.								
UNIT – II								
PV Energy Systems: Introduction, The PV effect in crystalline silicon basic principles, the film PV, Other PV technologies, Solar PV modules from solar cells, mismatch in series and parallel connections design and structure of PV modules, Electrical characteristics of silicon PV cells and modules, Stand-alone PV system configuration, Grid connected PV systems.								
UNIT – III								
Wind Energy: Principle of wind energy conversion; Basic components of wind energy conversion systems; wind mill components, various types and their constructional features; design considerations of horizontal and vertical axis wind machines: analysis of aerodynamic forces acting on wind mill blades; wind data and energy estimation and site selection considerations.								
UNIT – IV								
Geothermal Energy: Estimation and nature of geothermal energy, geothermal sources and resources like hydrothermal, geo-pressured hot dry rock, magma. Advantages, disadvantages and application of geothermal energy, prospects of geothermal energy in India.								
UNIT – V								
Miscellaneous Energy Technologies:								
Ocean Energy: Tidal Energy-Principle of working, Operation methods, advantages and limitations. Wave Energy-Principle of working, energy and power from waves, wave energy conversion devices, advantages and limitations.								
Biomass Energy: Biomass conversion technologies, Biogas generation plants, Classification, advantages and disadvantages, constructional details, site selection, digester design consideration.								
Fuel Cell: Principle of working of various types of fuel cells and their working, performance and limitations.								
Text Books:								
1. G. D. Rai, “Non-Conventional Energy Sources”, 4th Edition, Khanna Publishers, 2000.								

2. Chetan Singh Solanki “Solar Photo voltaics fundamentals, technologies and applications” 2nd Edition PHI Learning Private Limited. 2012.

Reference Books:

1. Stephen Peake, “Renewable Energy Power for a Sustainable Future”, Oxford International Edition, 2018.
2. S. P. Sukhatme, “Solar Energy”, 3rd Edition, Tata Mc Graw Hill Education Pvt. Ltd, 2008.
3. B H Khan, “Non-Conventional Energy Resources”, 2nd Edition, Tata Mc Graw Hill Education Pvt Ltd, 2011.
4. S. Hasan Saeed and D.K.Sharma, “Non-Conventional Energy Resources”, 3rd Edition, S.K.Kataria& Sons, 2012.
5. G. N. Tiwari and M.K.Ghosal, –Renewable Energy Resource: Basic Principles and Applications, Narosa Publishing House, 2004.

Online Learning Resources:

1. <https://nptel.ac.in/courses/103103206>
2. <https://nptel.ac.in/courses/108108078>

Question Paper Pattern:

Sessional Exam: The question paper for Sessional Examination shall be for 40 marks. The question paper shall consist of Four questions and all questions are compulsory. Question No.1 shall contain Five compulsory short answer questions for a total of Ten marks. Question No.2 to 4 shall be EITHER/OR Type for Ten marks each. Student shall Answer any one of them. Each of these questions may contain sub-questions.

End Examination: The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions and all questions are compulsory. Question No.1 shall contain Ten compulsory short answer questions for a total of Twenty marks (with Two short answer questions from each unit). Question No.2 to 6 shall be EITHER/OR Type for Ten marks each and shall cover one Unit of the Syllabus for each question. Student shall Answer any one of them. Each of these questions may contain sub-questions.

AUTOMATION AND ROBOTICS (ART)								
VI Semester: All Branches except ME					Scheme: 2023			
Course Code	Category	Hours/Week			Credits	Maximum Marks		
OE604	OE-II	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
		3	0	0	3	30	70	100
Sessional Exam Duration: 2 Hrs					End Exam Duration: 3 Hrs			
Course Outcomes : At the end of the course the student will be able to								
CO1:	Understand the fundamentals of automation, manufacturing systems and automation hardware.							
CO2:	Analyze automated flow lines and apply assembly line balancing methods.							
CO3:	Classify robots, joints, actuators, and sensors used in robotic systems.							
CO4:	Solve basic manipulator kinematics using transformation matrices.							
CO5:	Explain the robot programming method and its applications.							
UNIT – I								
Introduction to Automation: Notion of Automation, Types, Basic elements of an automated system, Manufacturing Industries, Types of production, Functions in manufacturing, Organization and information processing in manufacturing, Automation strategies and levels of automation, Hardware components for automation and process control, mechanical feeders, hoppers, orienters, high speed automatic insertion devices.								
UNIT – II								
Automated Flow Lines: Automated flow lines, Part transfer methods and mechanisms, types of Flow lines, flow line with/without buffer storage, Quantitative analysis of flow lines. Assembly line balancing: Assembly process and systems assembly line, line balancing methods, ways of improving line balance, flexible assembly lines.								
UNIT – III								
Introduction to Robotics: Definition of Robot, Classification of Robot configurations, Types of Joints, degrees of freedom, End effectors, types of end effectors, Grippers-Mechanical grippers, Vacuum cups, magnetic grippers, Tools.								
Robot Actuators and Feedback Components: Electrical Actuators (Variable Reluctance stepper motor, Permanent magnet stepper motor), Hydraulic and Pneumatic actuators. Position sensors–Potentiometer, Resolvers, Encoders. Velocity sensors, Tactile sensors, Proximity sensors.								
UNIT – IV								
Manipulator Kinematics: Introduction to manipulator kinematics, position representation, forward transformation and reverse transformation of two degree freedom robot arm, three degree of freedom arm in two dimensions, four degree freedom manipulators in three dimension, 3×3 Rotation matrix, Homogeneous transformation matrix and D – H notation matrix.								
UNIT – V								
Robot Programming: Methods of robot programming- Lead through- WAIT, SIGNAL and delay commands; The textual robot programming languages, robot language structures, constants, variables and other data objects, motion commands, end effectors, sensors commands and monitor mode commands.								
Robot Applications in Manufacturing: Material transfer and machine loading and unloading general considerations in material handling.								
Processing Operations: Spot welding, continuous arc welding, spray coating, and other processing operations. Assembly and Inspection.								

Text Books:
1. M P Groover, Automation , Production systems and Computer Integrated Manufacturing, Pearson Education, India
2. Mickel P Groover et. al, Industrial Robotics- Technology, Programming and Applications, McGraw Hill Publishers, New Delhi.
3. Deb S.R., Robotics Technology and Flexible Automation, TMH Publishers, New Delhi.
Reference Books:
1. Richard D. Klafter, Robotic Engineering: An Integrated Approach, Pearson Publications, New Jersey.
2. K. S. Fu, Ralph C. Gonzalez and C.S.G. Lee, Robotics, control, sensing, vision, Mc Graw Hill, New York.
3. Ashitava Ghosal, Robotics fundamental concepts and analysis, Oxford Higher Education, India
Question Paper Pattern:
Sessional Exam: The question paper for Sessional Examination shall be for 40 marks. The question paper shall consist of Four questions and all questions are compulsory. Question No.1 shall contain Five compulsory short answer questions for a total of Ten marks. Question No.2 to 4 shall be EITHER/OR Type for Ten marks each. Student shall Answer any one of them. Each of these questions may contain sub-questions. End Examination: The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions and all questions are compulsory. Question No.1 shall contain Ten compulsory short answer questions for a total of Twenty marks (with Two short answer questions from each unit). Question No.2 to 6 shall be EITHER/OR Type for Ten marks each and shall cover one Unit of the Syllabus for each question. Student shall Answer any one of them. Each of these questions may contain sub-questions.

PRODUCT LIFECYCLE MANAGEMENT (PLM)								
VI Semester: All Branches Except CE						Scheme: 2023		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
OE605	OE- II	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
		3	0	0	3	30	70	100
Sessional Exam Duration: 2 Hrs					End Exam Duration: 3 Hrs			
Course Outcomes: At the end of the course the student will be able to								
CO1:	Understand Product life cycle management process.							
CO2:	Understand different steps in Product development process.							
CO3:	Get knowledge on Product data management							
CO4:	Understand the implementation of PLM and its impact on the organization							
CO5:	Understand core functions of PLM and supply chain and ERP systems							
UNIT – I								
Organization Business Models (MTS, MTO, CTO, ETO Etc), Basics of Enterprise Systems (PLM, ERP, MES), Background, Overview, Need, Benefits, and Concept of Product Life Cycle, Components / Elements of PLM, Emergence of PLM, Significance of PLM, Differences between PLM and PDM								
UNIT – II								
Integrated Product development process-Conceive-Specification, Concept design, Design-Detailed design, Validation and analysis (Simulation), Tool design, Realize-Plan manufacturing, Manufacture, Build/Assemble, Test(quality check).								
UNIT – III								
Workflow Processes, Design Collaboration, Processes Management, Document Management, Visualization, Bill of Materials (BOM) Management – Lab exercises.								
UNIT – IV								
Engineering Change Control, Configuration Management, Manufacturing Process Management, Variant Management, Classification PLM Architecture, Various PLM tools, Data Modeling, Security management.								
UNIT – V								
CAD Integrations, Information authoring tools (e.g., MCAD, ECAD, Technical publishing), Core functions (e.g., data vaults), Data Flow to Other systems such as Supply chain and ERP systems. (4 hours for lab exercises)								
Text Books:								
1. Grieves, Michael, Product Lifecycle Management, McGraw-Hill publishers.								
2. Antti Saaksvuori and Anselmi Immonen, Product Life Cycle Management, Springer publications								
Reference Books:								
1. Kari Ulrich and Steven D. Eppinger, Product Design & Development, McGraw Hill International								
2. Burden, Rodger PDM: Product Data Management, Resource Publications.								
Question Paper Pattern:								
Sessional Exam: The question paper for Sessional Examination shall be for 40 marks. The question paper shall consist of Four questions and all questions are compulsory. Question No.1 shall contain Five compulsory short answer questions for a total of Ten marks. Question No.2 to 4 shall be EITHER/OR Type for Ten marks each. Student shall Answer any one of them. Each of these questions may contain sub-questions.								
End Examination: The question paper for End Examination shall be for 70 marks. The Question								

paper shall contain Six Questions and all questions are compulsory. Question No.1 shall contain Ten compulsory short answer questions for a total of Twenty marks (with Two short answer questions from each unit). Question No.2 to 6 shall be EITHER/OR Type for Ten marks each and shall cover one Unit of the Syllabus for each question. Student shall Answer any one of them. Each of these questions may contain sub-questions.

DIGITAL ELECTRONICS (DE)								
VI Semester: All Branches Except ECE						Scheme: 2023		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
OE606	OE-II	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
		3	0	0	3	30	70	100
Sessional Exam Duration: 2 Hrs					End Exam Duration: 3 Hrs			
Course Outcomes : After the completion of the course students will be able to								
CO1:	Learn Boolean algebra, logic simplification techniques, and combinational circuit design.							
CO2:	Analyze combinational circuits like adders, sub tractors, and code converters.							
CO3:	Explore combinational logic circuits and their applications in digital design.							
CO4:	Understand sequential logic circuits, including latches, flip-flops, counters, and shift registers.							
CO5:	Gain knowledge about programmable logic devices and digital IC's.							
UNIT – I								
Logic Simplification and Combinational Logic Design: Review of Boolean Algebra and De Morgan's Theorem, SOP & POS forms, Canonical forms, Introduction to Logic Gates, Ex-OR, Ex-NOR operations, Minimization of Switching Functions: Karnaugh map method, Logic function realization: AND-OR, OR AND and NAND/NOR realizations.								
UNIT – II								
Introduction to Combinational Design 1: Binary Adders, Subtractors and BCD adder, Code converters - Binary to Gray, Grayto Binary, BCD to excess3, BCD to Seven Segment display.								
UNIT – III								
Combinational Logic Design 2: Decoders, Encoders, Priority Encoder, Multiplexers, Demultiplexers, Comparators, Implementations of Logic Functions using Decoders and Multiplexers.								
UNIT – IV								
Sequential Logic Design: Latches, Flip-flops, S-R, D, T, JK and Master-Slave JK FF, Edge triggered FF, set up and hold times, Ripple counters, Shift registers.								
UNIT – V								
Programmable Logic Devices: ROM, Programmable Logic Devices (PLA and PAL). Digital IC's: Decoder (74x138), Priority Encoder (74x148), multiplexer (74x151) and de-multiplexer (74x155), comparator (74x85).								
Text Books:								
1. M Morris Mano and Michel D Ciletti, Digital Design, 5th Edition, Pearson Education, 1999 2. Zvi Kohavi and Nirah K Jha, Switching theory and Finite Automata Theory, 2nd Edition, Tata McGraw Hill, 2005.								
Reference Books:								
1. Charles H Roth, Jr., Fundamentals of Logic Design, 5th Edition, Brooks/cole Cengage Learning, 2004.								
Online Learning Resources:								
1. http://ndma.gov.in/ (Home page of National Disaster Management Authority) 2. http://www.ndmindia.nic.in/ (National Disaster management in India, Ministry of Home Affairs). 3. www.odihpn.org , Disaster Preparedness Programme in India. A Cost Benefit Analysis, Commissioned and Published by the Humanitarian Practice Network 'at ODI HPN.								

4. www.empowerpoor.org, Drought in India: Challenges and Initiatives; Poorest Areas in Civil Society (PACS) Programme. [2001–2008]

Question Paper Pattern:

Sessional Exam: The question paper for Sessional Examination shall be for 40 marks. The question paper shall consist of Four questions and all questions are compulsory. Question No.1 shall contain Five compulsory short answer questions for a total of Ten marks. Question No.2 to 4 shall be EITHER/OR Type for Ten marks each. Student shall Answer any one of them. Each of these questions may contain sub-questions.

End Examination: The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions and all questions are compulsory. Question No.1 shall contain Ten compulsory short answer questions for a total of Twenty marks (with Two short answer questions from each unit). Question No.2 to 6 shall be EITHER/OR Type for Ten marks each and shall cover one Unit of the Syllabus for each question. Student shall Answer any one of them. Each of these questions may contain sub-questions.

FOUNDATIONS OF OPERATING SYSTEMS (FOS)								
VI Semester: CE, EEE, ME and ECE						Scheme: 2023		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
OE607	OE-II	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
		3	0	0	3	30	70	100
Sessional Exam Duration: 2 Hrs					End Exam Duration: 3 Hrs			
Course Outcomes : At the end of the course, students will be able to								
CO1:	Describe the basics of the operating systems, mechanisms of OS to handle processes, threads, and their communication.							
CO2:	Understand the basic concepts and principles of operating systems, including process management, memory management, file systems, and Protection.							
CO3:	Make use of process scheduling algorithms and synchronization techniques to achieve better performance of a computer system.							
CO4:	Illustrate different conditions for deadlock and their possible solutions, memory management and its allocation policies.							
CO5:	Design and implement file systems, focusing on file access methods, directory structure, free space management, and also explore various protection mechanisms.							
UNIT – I								
Operating Systems Overview: Introduction, Operating system functions, Operating systems operations, Computing environments, Free and Open-Source Operating Systems System Structures: Operating System Services, User and Operating-System Interface, system calls, Types of System Calls, system programs, Operating system Design and Implementation, Operating system structure, Building and Booting an Operating System, Operating system debugging.								
UNIT – II								
Processes: Process Concept, Process scheduling, Operations on processes, Inter-process communication. Threads and Concurrency: Multithreading models, Thread libraries, Threading issues. CPU Scheduling: Basic concepts, Scheduling criteria, Scheduling algorithms, Multiple processor scheduling.								
UNIT – III								
Synchronization Tools: The Critical Section Problem, Peterson’s Solution, Mutex Locks, Semaphores, Monitors, Classic problems of Synchronization. Deadlocks: system Model, Deadlock characterization, Methods for handling Deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from Deadlock.								
UNIT – IV								
Memory- Management Strategies: Introduction, Contiguous memory allocation, Paging, Structure of the Page Table, Swapping. Virtual Memory Management: Introduction, Demand paging, Copy on-write, Page replacement, Allocation of frames, Thrashing. Storage Management: Overview of Mass Storage Structure, HDD Scheduling.								
UNIT – V								
File System: File System Interface: File concept, Access methods, Directory Structure; File system Implementation: File-system structure, File-system Operations, Directory implementation, Allocation method, Free space management; File-System Internals: File System Mounting, Partitions and Mounting, File Sharing. Protection: Goals of protection, Principles of protection, Protection Rings, Domain of protection, Access matrix.								
Text Books:								
1. Silber schatz A, Galvin P B, Gagne G, Operating System Concepts, 10th Edition, Wiley, 2018.								

2. Tanenbaum A S, Modern Operating Systems, 4th Edition, Pearson , 2016
Reference Books:
1. Stallings W, Operating Systems -Internals and Design Principles, 9th edition, Pearson, 2018
2. D.M Dhamdhare, Operating Systems: A Concept Based Approach, 3rd Edition, McGraw-Hill, 2013
Online Learning Resources:
1. https://nptel.ac.in/courses/106/106/106106144/
Question Paper Pattern:
Sessional Exam: The question paper for Sessional Examination shall be for 40 marks. The question paper shall consist of Four questions and all questions are compulsory. Question No.1 shall contain Five compulsory short answer questions for a total of Ten marks. Question No.2 to 4 shall be EITHER/OR Type for Ten marks each. Student shall Answer any one of them. Each of these questions may contain sub-questions. End Examination: The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions and all questions are compulsory. Question No.1 shall contain Ten compulsory short answer questions for a total of Twenty marks (with Two short answer questions from each unit). Question No.2 to 6 shall be EITHER/OR Type for Ten marks each and shall cover one Unit of the Syllabus for each question. Student shall Answer any one of them. Each of these questions may contain sub-questions.

FOUNDATIONS OF MACHINE LEARNING (FML)								
VI Semester: CE and ECE					Scheme: 2023			
Course Code	Category	Hours/Week			Credits	Maximum Marks		
OE608	OE-II	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
		3	0	0	3	30	70	100
Sessional Exam Duration: 2 Hrs					End Exam Duration: 3 Hrs			
Course Outcomes : At the end of the course, students will be able to								
CO1:	Identify machine learning techniques suitable for a given problem.							
CO2:	Solve the problems using various machine learning techniques.							
CO3:	Design application using machine learning techniques.							
CO4:	Understand and explore Supervised Learning techniques.							
CO5:	Understand and explore unsupervised learning techniques.							
UNIT – I								
Introduction to Machine Learning & Preparing to Model: Introduction: What is Human Learning? Types of Human Learning, what is Machine Learning? Types of Machine Learning, Problems Not to Be Solved Using Machine Learning, Applications of Machine Learning, State-of-The-Art Languages/Tools in Machine Learning, Issues in Machine Learning Preparing to Model: Introduction, Machine Learning Activities, Basic Types of Data in Machine Learning, Exploring Structure of Data, Data Quality and Remediation, Data Pre-Processing.								
UNIT – II								
Modelling and Evaluation & Basics of Feature Engineering: Introduction, selecting a Model, training a Model (for Supervised Learning), Model Representation and Interpretability, Evaluating Performance of a Model, Improving Performance of a Model Basics of Feature Engineering: Introduction, Feature Transformation, Feature Subset Selection.								
UNIT – III								
Bayesian Concept Learning & Supervised Learning: Classification: Introduction, Why Bayesian Methods are Important? Bayes' Theorem, Bayes' Theorem and Concept Learning, Bayesian Belief Network. Supervised Learning: Classification: Introduction, Example of Supervised Learning, Classification Model, Classification Learning Steps, Common Classification Algorithms-k-Nearest Neighbour(kNN), Decision tree, Random forest model, Support vector machines.								
UNIT – IV								
Supervised Learning: Regression: Introduction, Example of Regression, Common Regression Algorithms-Simple linear regression, Multiple linear regression, Assumptions in Regression Analysis, Main Problems in Regression Analysis, Improving Accuracy of the Linear Regression Model, Polynomial Regression Model, Logistic Regression, Maximum Likelihood Estimation.								
UNIT – V								
Unsupervised Learning: Introduction, Unsupervised vs Supervised Learning, Application of Unsupervised Learning, Clustering – Clustering as a machine learning task, Different types of clustering techniques, Partitioning methods, K- Medoids: a representative object-based technique, Hierarchical clustering, Density-based methods-DBSCAN Finding Pattern using Association Rule- Definition of common terms, Association rule, The apriori algorithm for association rule learning, Build the apriori principle rules.								
Text Books:								
1. Saikat Dutt, Subramanian Chandra mouli, Amit Kumar Das, Machine Learning,								

Pearson, 2019.

Reference Books:

1. Ethern Alpaydin, "Introduction to Machine Learning", MIT Press, 2004.
2. Stephen Marsland, "Machine Learning -An Algorithmic Perspective", Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.
3. Andreas C. Müller and Sarah Guido, "Introduction to Machine Learning with Python: A Guide for Data Scientists", Oreilly.

Online Learning Resources:

1. Andrew Ng, "Machine Learning B.Techning"
2. <https://www.deeplearning.ai/machine-learning- B.Techning/>
3. Shai Shalev-Shwartz , Shai Ben-David, "Understanding Machine Learning: From Theory to Algorithms" , Cambridge University Press.
4. <https://www.cse.huji.ac.il/~shais/UnderstandingMachineLearning/index.html>

Question Paper Pattern:

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WEB TECHNOLOGIES (WT)								
VI Semester: CE, EEE, ME and ECE					Scheme: 2023			
Course Code	Category	Hours/Week			Credits	Maximum Marks		
OE609	OE-II	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
		3	0	0	3	30	70	100
Sessional Exam Duration: 2 Hrs					End Exam Duration: 3 Hrs			
Course Outcomes : At the end of the course, students will be able to								
CO1:	Design a Web Page using Text Formatting Tags, Hyperlinks.							
CO2:	Develop a webpage with Images, Tables Hyperlinks, Lists, and CSS.							
CO3:	Design dynamic web pages using JavaScript.							
CO4:	Design a Form using HTML Forms & Controls.							
CO5:	Understand the basic concepts of PHP and database connection using XAMPP Server.							
UNIT – I								
HTML5: Overview of HTML5 and other web technologies, HTML5 and its essentials, Fundamentals of HTML5, Working with Text and organizing Text in HTML, Working with Links and URLs.								
UNIT – II								
Images: Working with Images, Image Maps, Creating Tables, Frames CSS: Overview of CSS, Backgrounds and Color Gradients in CSS, Fonts and Text Styles, List Styles, Table Layouts								
UNIT – III								
JavaScript: Overview of java script, Functions, Events, Java script Objects, Working with Browser Objects, Document Object, Document Object Model, Validation, Errors, and Exception Handling in JavaScript.								
UNIT – IV								
Forms: What's a Form? What Controls are available? Creating a Form and adding HTML Controls, Submitting Data from forms, Customizing Controls in CSS, Form validation using Java Script, Interactive Elements.								
UNIT – V								
Introduction to PHP: Installing and Configuring PHP: Building PHP with Apache on Windows, The Basics of PHP scripts. The Building blocks of PHP: Variables, Data Types, Operators and Expressions, Constants. Creating Forms, Accessing Form Input with User defined Arrays, Combining HTML and PHP code on a single Page, XAMPP Server configuration.								
Text Books:								
1. HTML5 Black Book, 2nd Edition, Dreamtech Press, 2016								
2. Deitel and Deitel and Nieto, –Internet and World Wide Web - How to ProgramI, Prentice Hall, 5th Edition, 2011.								
3. Julie C. Meloni, PHP MySQL and Apache, SAMS Teach yourself, Pearson Education (2007).								
Reference Books:								
1. Web Technologies, Uttam K. Roy, Oxford Higher Education., 1st edition, 10th impression, 2015.								
2. Robert Pattinson, Beginners Guide for HTML and CSS Web Design and Web Development, 2018.								
3. Jeffrey C and Jackson, –Web Technologies A Computer Science Perspective Pearson Education, 2011.								

4. Gopalan N.P. and Akilandeswari J., —Web Technology, Prentice Hall of India, 2011.

Online Learning Resources:

1. <https://www.tutorialspoint.com/Html/index.htm>
2. <https://www.w3.org/Style/CSS/>
3. <https://www.w3schools.com/php/>

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End Examination: The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions and all questions are compulsory. Question No.1 shall contain Ten compulsory short answer questions for a total of Twenty marks (with Two short answer questions from each unit). Question No.2 to 6 shall be EITHER/OR Type for Ten marks each and shall cover one Unit of the Syllabus for each question. Student shall Answer any one of them. Each of these questions may contain sub-questions.

INTRODUCTION TO INFORMATION SYSTEMS (IIS)								
VI Semester: CE, EEE, ME and ECE						Scheme: 2023		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
OE610	OE-II	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
		3	0	0	3	30	70	100
Sessional Exam Duration: 2 Hrs					End Exam Duration: 3 Hrs			
Course Outcomes : At the end of the course, students will be able to								
CO1:	Understand the concepts of Computer architecture and functionalities of System Software.							
CO2:	Understand the page replacement and CPU Scheduling Algorithms							
CO3:	Understand the phases of software development life cycle and process models.							
CO4:	Design ER model for real life scenarios							
CO5:	Apply SQL commands to create, update, modify, retrieve and normalization on the databases.							
UNIT – I								
Fundamentals of Computers & Computer Architecture: Introduction, Organization of a small computer, Central Processing Unit, Execution cycle, Instruction categories, measure of CPU performance, Memory, Input/output devices, BUS, addressing modes System Software: Assemblers, Loaders and linkers, Compilers and interpreters.								
UNIT – II								
Operating System: Introduction, Memory management schemes, Page replacement algorithms, Process management, CPU scheduling algorithms. Software engineering: Software engineering: Introduction to Software engineering, Life cycle of a software project, software Development models.								
UNIT – III								
Relational Database Management System: Introduction to DBMS, the database technology, data models, Database Users. Entity Relationship (E-R) Modeling: Introduction, Notations, Modeling E-R Diagrams, Case Studies, Merits and Demerits of E-R modeling.								
UNIT – IV								
Structured Query Language (SQL): Introduction to SQL, Data types, Data Definition language commands, Data Manipulation Language Commands and Data control Language Commands, Candidate Key, Primary key, Foreign key, Select Clause, Where Clause, Logical Connectives – AND, OR, Range Search, Pattern Matching, Order By, Group By, Set Operations – Union, Intersect and Minus, Aggregate Functions, Join Operations								
UNIT – V								
Normalization: Introduction, Need for Normalization, Process of Normalization, Types of Normal Forms (1NF, 2 NF, 3 NF & BCNF), Merits and Demerits of Normalization.								
Text Books:								
1. Campus Connect Foundation Program – Computer Hardware and System Software Concepts, Programming Fundamentals- Vol. – 1, INFOSYS								
2. Campus Connect Foundation Program – Relational Database Management System, Client Server Concepts, Introduction to Web Technologies - Vol. – 4, INFOSYS								
3. Henry F. Korth& Abraham Silberschatz, - Data Base System Concepts, 5th Edition, 2005, Mc Graw hill								
Reference Books:								
1. M. Morris Mano [2011], [3 rd Edition], Computer system architecture, Pearson								

Education, 2011
2. Sommerville [2008], [7th Edition], Software Engineering, Pearson education.
3. Raghu Ramakrishna and Johannes Gehrke [2003], [3rd Edition], Data Base Management Systems, TATA McGraw Hill
4. Tanenbaum [2000], Modern Operating System, Pearson Education
Online Learning Resources:
1. https://www.w3schools.com/sql/
2. https://www.geeksforgeeks.org/dbms/
3. https://www.tutorialride.com/software-engineering/software-engineering-tutorial.htm
Question Paper Pattern:
Sessional Exam: The question paper for Sessional Examination shall be for 40 marks. The question paper shall consist of Four questions and all questions are compulsory. Question No.1 shall contain Five compulsory short answer questions for a total of Ten marks. Question No.2 to 4 shall be EITHER/OR Type for Ten marks each. Student shall Answer any one of them. Each of these questions may contain sub-questions. End Examination: The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions and all questions are compulsory. Question No.1 shall contain Ten compulsory short answer questions for a total of Twenty marks (with Two short answer questions from each unit). Question No.2 to 6 shall be EITHER/OR Type for Ten marks each and shall cover one Unit of the Syllabus for each question. Student shall Answer any one of them. Each of these questions may contain sub-questions.

OPTIMIZATION TECHNIQUES (OT)								
VI Semester: CE, EEE, CSE and ECE						Scheme: 2023		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
OE611	OE-II	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
		3	0	0	3	30	70	100
Sessional Exam Duration: 2 Hrs					End Exam Duration: 3 Hrs			
Course Outcomes : At the end of the course, students will be able to								
CO1:	Understand the meaning, purpose, tools of Operations Research and linear programming in solving practical problems in industry.							
CO2:	Interpret the transportation models' solutions and infer solutions to the real-world problems.							
CO3:	Develop mathematical skills to analyze and solve nonlinear programming models arising from a wide range of applications.							
CO4:	Apply the concept of non-linear programming for solving the problems involving non linear constraints and objectives							
CO5:	Apply the concept of unconstrained geometric programming for solving the problems L2, L3 involving non-linear constraints and objectives.							
UNIT – I								
Linear programming I: Introduction, Applications of Linear Programming, Standard form of a Linear Programming Problem, Geometry of Linear Programming Problems, Basic Definitions in Linear Programming. Simplex Method, Simplex Algorithm and Two phase Simplex Method, Big-M method.								
UNIT – II								
Linear programming II: Duality in Linear Programming Symmetric Primal-Dual Relations, General Primal-Dual Relations, Duality Theorem, Dual Simplex Method, Transportation Problem and assignment problem, Complementary slackness Theorem								
UNIT – III								
Non-linear programming: Unconstrained Optimization Techniques Introduction: Classification of Unconstrained minimization methods, Direct Search Methods: Random Search Methods: Descent Method and Fletcher Powell Method, Grid Search Method								
UNIT – IV								
Non-linear programming: Constrained Optimization Techniques Introduction, Characteristics of a constrained problem, Random Search Methods, complex method, Sequential linear programming, Basic approach in methods of Feasible directions, Zoutendijk's method of feasible directions: direction finding problem, determination of step length, Termination criteria.								
UNIT – V								
Geometric Programming : Unconstrained Minimization Problems: solution of unconstrained geometric programming using differential calculus and arithmetic-geometric inequality.								
Constrained minimization Problems: Solution of a constrained geometric programming problem, primal-dual programming in case of less-than inequalities, geometric programming with mixed inequality constraints.								
Text Books:								
1. Singiresu S Rao., Engineering Optimization: Theory and Practices, New Age Int. (P) Ltd. Publishers, New Delhi.								

2. J. C. Panth, Introduction to Optimization Techniques, (7-e) Jain Brothers, New Delhi.

Reference Books:

1. Harvey M. Wagner, Principles of Operation Research, Printice-Hall of India Pvt. Ltd. New Delhi.

2. Peressimi A.L., Sullivan F.E., Vhl, J. J. Mathematics of Non-linear Programming, Springer – Verlag.

Question Paper Pattern:

Sessional Exam: The question paper for Sessional Examination shall be for 40 marks. The question paper shall consist of Four questions and all questions are compulsory. Question No.1 shall contain Five compulsory short answer questions for a total of Ten marks. Question No.2 to 4 shall be EITHER/OR Type for Ten marks each. Student shall Answer any one of them. Each of these questions may contain sub-questions.

End Examination: The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions and all questions are compulsory. Question No.1 shall contain Ten compulsory short answer questions for a total of Twenty marks (with Two short answer questions from each unit). Question No.2 to 6 shall be EITHER/OR Type for Ten marks each and shall cover one Unit of the Syllabus for each question. Student shall Answer any one of them. Each of these questions may contain sub-questions.

PHYSICS OF ELECTRONIC MATERIALS AND DEVICES (PEMD)								
VI Semester: All Branches					Scheme: 2023			
Course Code	Category	Hours/Week			Credits	Maximum Marks		
OE612	OE-II	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
		3	0	0	3	30	70	100
Sessional Exam Duration: 2 Hrs					End Exam Duration: 3 Hrs			
Course Outcomes : At the end of the course, students will be able to								
CO1:	Understand crystal growth and thin film preparation							
CO2:	Summarize the basic concepts of semi conductors							
CO3:	Illustrate the working of various semi conductor devices							
CO4:	Analyze various luminescent phenomena and the devices based on the concepts							
CO5:	Explain the working of different display devices							
UNIT – I								
Fundamentals of Materials Science: Introduction, Phase rule, Phase Diagram, Elementary idea of Nucleation and Growth, Methods of crystal growth. The basic idea of point, line, and planar defects. Concept of thin films, preparation of thin films, Deposition of thin film using sputtering methods (RF and glow discharge).								
UNIT – II								
Semiconductors: Introduction, charge carriers in semiconductors, effective mass, Diffusion and drift, Diffusion and recombination, Diffusion length. The Fermi level & Fermi-Dirac distribution, Electron and Hole in quantum well, Change of electron-hole concentration- Qualitative analysis, Temperature dependency of carrier concentration, Conductivity and mobility, Effects of temperature and doping on mobility, High field effects.								
UNIT – III								
Physics of Semiconductor Devices: Introduction, Band structure, PN junctions and their typical characteristics under equilibrium and under bias, Hetero junctions, Transistors, MOSFETs.								
UNIT – IV								
Excitons and Luminescence: Luminescence: Different types of luminescence, basic definitions, Light emission in solids, Inter-band luminescence, Direct and indirect gap materials. Photo luminescence: General Principles of photoluminescence, Excitation and relaxation, OLED, Quantum-dot. Electro-luminescence: General Principles of electroluminescence, light emitting diode, diode laser.								
UNIT – V								
Display devices: LCD, three-dimensional display: Holographic display, light-field displays: Head-mounted display, MOEMS (Micro-Opto-Electro-Mechanical Systems) and MEMS displays.								
Text Books:								
1. S O Kasap, Principles of Electronic Materials and Devices, McGraw-Hill Education(India)Pvt.Ltd.,4th edition,2021.								
2. Semiconductor physics & devices: basic principles, 4th Edition, McGraw-Hill, 2012.								
Reference Books:								
1. B G Streetman and S Banerjee, Solid State Electronic Devices, PHI Learning,6th edition								
2. Eugene A Irene, Wiley, Electronic Materials Science,2005								

3. Grover and Jamwal, Dhanpat Rai and Co., Electronic Components and Materials, New Delhi., 2012.

4. Wei Gao, Zhengwei Li, Nigel Sammes, An Introduction to Electronic Materials for Engineer, World Scientific Publishing Co. Pvt. Ltd. 2nd Edition, 2011

Online Learning Resources:

1. https://nptel.ac.in/courses/113/106/113106062/https://onlinecourses.nptel.ac.in/noc20_ph24/preview

Question Paper Pattern:

Sessional Exam: The question paper for Sessional Examination shall be for 40 marks. The question paper shall consist of Four questions and all questions are compulsory. Question No.1 shall contain Five compulsory short answer questions for a total of Ten marks. Question No.2 to 4 shall be EITHER/OR Type for Ten marks each. Student shall Answer any one of them. Each of these questions may contain sub-questions.

End Examination: The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions and all questions are compulsory. Question No.1 shall contain Ten compulsory short answer questions for a total of Twenty marks (with Two short answer questions from each unit). Question No.2 to 6 shall be EITHER/OR Type for Ten marks each and shall cover one Unit of the Syllabus for each question. Student shall Answer any one of them. Each of these questions may contain sub-questions.

CHEMISTRY OF POLYMERS AND APPLICATION (CPA)								
VI Semester: All Branches					Scheme: 2023			
Course Code	Category	Hours/Week			Credits	Maximum Marks		
OE613	OE-II	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
		3	0	0	3	30	70	100
Sessional Exam Duration: 2 Hrs					End Exam Duration: 3 Hrs			
Course Outcomes : At the end of the course, students will be able to								
CO1:	Classify the polymers, explain polymerization mechanism, differentiate addition, condensation polymerizations, Describe measurement of molecular weight of polymer							
CO2:	Describe the physical and chemical properties of natural polymers and Modified cellulotics.							
CO3:	Differentiate Bulk, solution, suspension and emulsion polymerization, Describe fibers and elastomers, Identify the thermosetting and thermo polymers.							
CO4:	Identify types of polymer networks, describe methods involve in hydrogel preparation, Explain applications of hydrogels in drug delivery							
CO5:	Explain classification and mechanism of conducting and degradable polymers							
UNIT – I								
Polymers-Basics and Characterization: Basic concepts: monomers, repeating units, degree of polymerization, linear, branched and network polymers, classification of polymers,								
Polymerization: addition, condensation, copolymerization and coordination polymerization. Average molecular weight concepts: number, weight and viscosity average molecular weights, polydispersity and molecular weight distribution. Measurement of molecular weight: End group, viscosity, light scattering, osmotic and ultracentrifugation methods, analysis and testing of polymers.								
UNIT – II								
Natural Polymers & Modified Cellulotics: Natural Polymers: Chemical & Physical structure, properties, source, important chemical modifications, applications of polymers such as cellulose, lignin, starch, rosin, shellac, latexes, vegetable oils and gums, proteins.								
Modified Cellulotics: Cellulose esters and ethers such as Ethyl cellulose, CMC, HPMC, cellulose acetals, Liquid crystalline polymers; specialty plastics- PES, PAES, PEEK, PEA.								
UNIT – III								
Synthetic Polymers: Addition and condensation polymerization processes– Bulk, Solution, Suspension and Emulsion polymerization. Preparation and significance, classification of polymers based on physical properties. Thermoplastics, Thermosetting plastics, Fibers and elastomers, General Applications. Preparation of Polymers based on different types of monomers, Olefin polymers(PE,PVC), Butadiene polymers(BUNA-S,BUNA-N), nylons, Urea-formaldehyde, phenol – formaldehyde, Melamine Epoxy and Ion exchange resins.								
UNIT – IV								
Hydrogels of Polymer Networks: Definitions of Hydrogel, polymer networks, Types of polymer networks, Methods involved in hydrogel preparation, Classification, Properties of hydrogels, Applications of hydrogels in drug delivery.								
UNIT – V								
Conducting and Degradable Polymers:								
Conducting Polymers: Introduction, Classification, Mechanism of conduction in Poly Acetylene, Poly Aniline, Poly Thiophene, Doping, Applications.								
Degradable Polymers: Introduction, Classifications, Examples, Mechanism of degradation.								

poly lactic acid, Nylon-6, Polyesters, applications.

Text Books:

1. Billmayer, A Text book of Polymer science
2. G.S.Mishra, Polymer Chemistry
3. Gowariker, Polymer Chemistry

Reference Books:

1. K J Saunders, Chapman and Hall, Organic polymer Chemistry
2. B Miller, Prentice Hall, Advanced Organic Chemistry
3. Premamoy Ghosh, Polymer Science and Technology, 3rd edition, McGraw-Hill, 2010.

Question Paper Pattern:

Sessional Exam: The question paper for Sessional Examination shall be for 40 marks. The question paper shall consist of Four questions and all questions are compulsory. Question No.1 shall contain Five compulsory short answer questions for a total of Ten marks. Question No.2 to 4 shall be EITHER/OR Type for Ten marks each. Student shall Answer any one of them. Each of these questions may contain sub-questions.

End Examination: The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions and all questions are compulsory. Question No.1 shall contain Ten compulsory short answer questions for a total of Twenty marks (with Two short answer questions from each unit). Question No.2 to 6 shall be EITHER/OR Type for Ten marks each and shall cover one Unit of the Syllabus for each question. Student shall Answer any one of them. Each of these questions may contain sub-questions.

ACADEMIC WRITING AND PUBLIC SPEAKING (AWPS)								
VI Semester: All Branches					Scheme: 2023			
Course Code	Category	Hours/Week			Credits	Maximum Marks		
OE614	OE-II	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
		3	0	0	3	30	70	100
Sessional Exam Duration: 2 Hrs					End Exam Duration: 3 Hrs			
Course Outcomes : At the end of the course, students will be able to								
CO1:	Understand various elements of Academic Writing							
CO2:	Identify sources and avoid plagiarism							
CO3:	Demonstrate the knowledge in writing a Research paper							
CO4:	Analyse different types of essays							
CO5:	Assess the speeches of others and know the positive strengths of speakers							
CO6:	Build confidence in giving an impactful presentation to the audience							
UNIT – I								
Introduction to Academic Writing:								
Academic Writing: Introduction								
Essential Features of Academic Writing: Courtesy, Clarity, Conciseness, Correctness, Coherence, Completeness								
Types of Academic Writing: Descriptive, Analytical, Persuasive, Critical writing								
UNIT – II								
Academic Journal Article:								
Art of condensation: summarizing and paraphrasing								
Abstract Writing								
Writing: Project Proposal, an application for internship, Technical/Research/Journal Paper Writing, Conference Paper Writing								
Editing and Proofreading								
Understanding and avoiding Plagiarism								
UNIT – III								
Essay Writing & Writing Reviews:								
Types of Essays: Compare and Contrast Essay, Argumentative Essay, Exploratory Essay								
Features and analysis of sample essays								
Writing a Book Report								
Summarizing								
Writing a Book/Film Review								
Writing a Statement of Purpose (SoP)								
UNIT – IV								
Public Speaking:								
Public Speaking: Introduction, Nature, characteristics, and significance								
Presentation skills: 4 P's of Presentation, Stage Dynamics, Answering Strategies during presentations								
Analysis of impactful speeches								
Types of speeches for academic events								
UNIT – V								

Public Speaking and Non-Verbal Delivery: Body Language, Facial Expressions, Kinesics, Oculistics, Proxemics, Haptics, Chronemics, Paralanguage, Signs
Text Books:
1. Critical Thinking, Academic Writing and Presentation Skills: MG University Edition Paperback – 1 January 2010 Pearson Education; First edition (1 January 2010)
2. Pease, Allan & Barbara. The Definitive Book of Body Language RHUS Publishers, 2016
Reference Books:
1. Alice Savage, Masoud Shafiei Effective Academic Writing, 2Ed., 2014 Oxford University Press.
2. Shalini Verma, Body Language, S Chand Publications 2011.
3. Sanjay Kumar and Pushpalata, Communication Skills 2E 2015, Oxford.
4. Sharon Gerson, Steven Gerson, Technical Communication Process and Product, Pearson, New Delhi, 2014
5. Elbow, Peter. Writing with Power. OUP USA, 1998
Online Learning Resources:
1. https://youtu.be/NNhTIT81nH8
2. https://www.youtube.com/watch?v=478ccrWKY-A
3. https://www.youtube.com/watch?v=nzGo5ZC1gMw
4. https://www.youtube.com/watch?v=Qve0ZBmJMh4
5. https://courses.lumenlearning.com/publicspeakingprinciples/chapter/chapter-12-nonverbal-aspects-of-delivery/
6. https://onlinecourses.nptel.ac.in/noc21_hs76/preview
7. https://archive.nptel.ac.in/courses/109/107/109107172/#
8. https://archive.nptel.ac.in/courses/109/104/109104107/
Question Paper Pattern:
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MATHEMATICAL FOUNDATION OF QUANTUM TECHNOLOGIES (MFQT)								
VI Semester: All Branches					Scheme: 2023			
Course Code	Category	Hours/Week			Credits	Maximum Marks		
OE615	OE-II	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
		3	0	0	3	30	70	100
Sessional Exam Duration: 2 Hrs					End Exam Duration: 3 Hrs			
Course Outcomes : At the end of the course, students will be able to								
CO1:	Understand the Transformation theory and Hilbert space							
CO2:	Analyze the properties and operators of Hilbert space and apply Eigen values to it.							
CO3:	Apply statistics to measure theory, uncertainty relations and radiation theory.							
CO4:	Evaluate problems on reversibility, equilibrium and macroscopic measurements.							
CO5:	Formulate problems of composite system and measuring process							
UNIT – I								
Introductory Considerations: The origin of the Transformation Theory, The Original Formulation of Quantum Mechanics, The Equivalence of the two Theories: (i) The Transformation Theory, (ii) Hilbert Space.								
UNIT – II								
Abstract Hilbert Space: The definition of Hilbert space, The Geometry of Hilbert space, Degression on the Conditions A-E, Closed linear Manifolds, Operators in Hilbert space, The Eigen Value Problem, Continuation, Initial Consideration concerning the Eigenvalue Problem, Degression on the Existence and Uniqueness of solutions of the Eigenvalue Problems, Cumulative operators, The Trace.								
UNIT – III								
The Quantum Statistics: The statistical assertions of quantum mechanics, the statistical interpretation, Simultaneous Measurability and Measurability in General, Uncertainty Relations, Projections as Propositions, Radiation Theory.								
UNIT – IV								
Deductive Development of the Theory and General Considerations: The fundamental basis of the statistical theory, Conclusions from Experiments. Measurement and reversibility, Thermodynamics Considerations, Reversibility and equilibrium problems, The Macroscopic Measurement.								
UNIT – V								
The Measuring Process: Formulation of the problems, Composite systems, discussion of the Measuring process.								
Text Books:								
1. John von Neumann and Robert T Beyer, Mathematical Foundations of Quantum Mechanics, Princeton Univ. Press (1996).								
2. M D Srinivas, Measurements and Quantum Probabilities, University Press, Hyderabad.								
Reference Books:								
1. Leonard Schiff, Quantum Mechanics, Mc, Graw Hill (Education) (2010)								
2. Parthasarathy. K. R., Mathematical Foundations of Quantum, Hindustan Book Agency, New Delhi.								
3. Gerad Tesch, Mathematical Methods in Quantum Mechanics with application to Schrodinger. operators, Graduate Studies in Mathematics, 99, AMS, Providence, 2009								
Question Paper Pattern:								
Sessional Exam: The question paper for Sessional Examination shall be for 40 marks. The								

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