



Estd. 1962
"A++" Accredited by
NAAC (2021)
With CGPA 3.52

SHIVAJI UNIVERSITY, KOLHAPUR
416 004, MAHARASHTRA

PHONE : EPABX - 2609000, BOS Section - 0231-2609094, 2609487

Web : www.unishivaji.ac.in Email: bos@unishivaji.ac.in

शिवाजी विद्यापीठ, कोल्हापूर ४१६ ००४, महाराष्ट्र

दूरध्वनी - इपीबीएक्स - २०६०९०००, अभ्यासमंडळे विभाग : ०२३१- २६०९०९४, २६०९४८७

वेबसाईट : www.unishivaji.ac.in ईमेल : bos@unishivaji.ac.in



SU/BOS/Sci & Tech/ 182

Date: 10/06/2026

The Director,
School of Engineering and Technology,
Shivaji University, Kolhapur.

Subject: Regarding revised syllabus of **B. Tech. Part - IV (Sem VII & VIII) degree Programme (Department of Technology)** under the Faculty of Science and Technology as per NEP 2020.

Sir/Madam,

With reference to the subject mentioned above, I am directed to inform you that the university authorities have accepted and granted approval to the revised syllabi, nature of question paper and equivalence of B. Tech. Part - IV (Sem VII & VIII) degree Programme under the Faculty of Science & Technology as per National Education Policy 2020 (NEP 2020).

Sr. No.	Course Syllabus
1	Civil Engineering
2	Mechanical Engineering
3	Computer Science and Technology
4	Chemical Engineering
5	Electronics and Telecommunication Engineering
6	Food Technology

This Syllabus, nature of question and equivalence shall be implemented from the academic year **2026-27** onwards. A soft copy containing the syllabus is attached herewith and it is available on university website www.unishivaji.ac.in>**Syllabus>Syllabus as per NEP-2020.**

The question papers on the pre-revised syllabi of above-mentioned course will be set for the examinations to be held in October/ November 2026 & March / April 2027. These chances are available for repeater students, if any

You are, therefore, requested to bring this to the notice of all students and teachers concerned.

Thanking you,

Yours faithfully,

Dy. Registrar

Copy to: for Information and necessary action

1	The I/c Dean, Faculty of Science & Technology	7	Appointment A & B Section
2	Director, Board of Examinations & Evaluation	8	Affiliation (T.1) (T.2) Section
3	The Chairperson, Respective Board of Studies	9	P.G.Admission Section,
4	Other Exam 4 Section,	10	P.G Seminar Section
5	Eligibility Section,	11	Computer Centre/ IT Cell
6	Internal Quality Assurance Cell (IQAC)		

SHIVAJI UNIVERSITY, KOLHAPUR



Established: 1962

A++ Accredited by NAAC (2021) with CGPA 3.52

New Syllabus for

Final Year B. Tech (Mechanical Engineering)

UNDER

Faculty of Science and Technology

B. Tech (Mechanical Engineering) –Semester VII & VIII

STRUCTURE AND SYLLABUS ACCORDING WITH

NATIONAL EDUCATION POLICY – 2020

WITH MULTIPLE ENTRY AND MULTIPLE EXIT OPTIONS

(TO BE IMPLIMATED FORM ACADEMIC YEAR 2026-27 ONWORDS)



Shivaji University, Kolhapur
School of Engineering & Technology

Final Year B. Tech (Mechanical Engineering), Semester- VII

Teaching & Evaluation Scheme

No	Category	Code	Course Title	Hours per week			Contact Hours	Credits	Evaluation scheme	
									Theory	Practical
				L	T	P			ISE: ESE	IE:EE
1.	Program Core Course	PCC411	Refrigeration and Air Conditioning	03	-	02	05	04	30:70	50:00
2.	Program Core Course	PCC412	Automobile Engineering	03	-	02	05	04	30:70	50:00
3.	Program Core Course	PCC413	Solar Technology and Maintenance	03		02	05	04	30:70	50:00
4.	Program Elective Course	PEC 411	Elective II	03	-	-	03	03	30:70	00:00
5.	Open Elective Course	OEC 411	Open Elective- II	03	-	-	03	03	30:70	00:00
6.	Value Education Course	VEC411	Green Technology & Sustainability	01	-	-	01	01	00:00	50:00
7.	Project Seminar Internship	PSI 411	Major Project Phase I	-	-	02	02	01	00:00	50:50
8.	Project Seminar Internship	PSI 412	MDM based Industry Internship	One month Duration*				03	00:00	50:50
							-	23	500	400
			Total Hours	16	-	08	24	-	-	-

- MDM based industry internship to be completed during any winter/summer vacation slots from 4th semester onwards before 7th semester commencement



Shivaji University, Kolhapur
School of Engineering & Technology

Final Year B. Tech (Mechanical Engineering), Semester- VIII

Teaching & Evaluation Scheme

S.N.	Category	Code	Course Title	Hours per week			Contact Hours	Credits	Evaluation scheme	
				L	T	P			Theory	Practical
									ISE:ESE	IE:EE
1.	Project Seminar Internship	PSI 421	Industrial Internship (Follow up by the Department)	The entire Semester is to be spent in the industry				10	00:00	100:100
2.	Program Elective Course [SWAYAM (NPTEL) or any other MOOCs]	PEC 421	Program Elective III (Through MOOC *)	03	-	-	03	03	30:70	00:00
3.	Humanities and Social Sciences , Management Environmental Course	HSMEC 421	Industrial Safety Engineering (Through MOOC *) OR Management Course	03	-	-	03	03	30:70	00:00
4.	Indian Knowledge Systems	IKS 421	Indian Science, Engineering and Technology (Program Specific IKS) **	02	-	-	02	02	30:70	50:00
5.	Value Education Course	VEC421	Ethics In Engineering Practice (Through MOOC *)	01	-	-	01	01	00:00	50:00
6.	Project Seminar Internship	PSI 422	Major Project Phase II	-	-	02	02	01	00:00	100:100
7.	Project Seminar Internship	PSI 423	MDM based mini Project***	-	-	-	-	02	00:00	50:50
				-	-	-	-	22	300	600
			Total Hours (Other than Internship)	09	-	02	11	-	-	-

*There is an option for End Semester Examination either on the respective MOOC platform or at the course teacher's end through the University System.

** Though the course is to be completed online either through course coordinator or via suitable MOOC if any, the ISE will be coordinated by the course in charge and the ESE will be through University system.

***MDM based mini project to be completed during 4th semester to 8th semester.

Year, Program, Semester	Final Year B. Tech (Mechanical Engineering), Semester- VII						
Course Code	PCC411						
Course Category	Program Core Course						
Course title	Refrigeration and Air Conditioning						
Teaching Scheme and Credits	L	T	P	Total Contact Hours	Total Credits		
	03	-	02	05	04		
Evaluation Scheme	ISE		ESE		IE	EE	Total
	30		70		-	-	100
Pre-requisites (if any)	Knowledge of Engineering Thermodynamics, Fluid Mechanics, Heat and Mass Transfer						
Course Objectives	The course aims to : 1. To understand the fundamentals of refrigeration and air conditioning, Psychrometry 2. To study various refrigeration cycles and evaluate performance using refrigerant property tables. 3. To study and understand the working of different components used in refrigeration systems and properties of refrigerants. 4. To study various vapour absorption systems and basic cryogenic systems. 5. To Understand the basics of psychrometry, air conditioning processes, and different air conditioning systems. 6. To Calculate cooling load for its applications in comfort and industrial air conditioning.						
Course Outcomes	After completing the course, students will be able to: 1. Perform energy balance and COP calculations for basic and advanced cycles. 2. Explain the operational mechanics and select appropriate compressors, condensers, and expansion devices while implementing essential safety controls 3. Classify refrigerants and justify the selection of eco-friendly alternatives based on their Ozone Depletion (ODP) and Global Warming (GWP) potentials . 4. Differentiate the performance and design of Vapour Compression versus Vapour Absorption systems (NH3-H2O and LiBr-H2O) for industrial applications . 5. Use psychrometric charts to calculate air properties and evaluate processes 6. Estimate cooling loads (RSHF/GSHF) and specify suitable Unitary or Central AC systems for residential, commercial, or transport (Automotive/Marine) environments .						

Unit No.	Course Content	Hours
1	Fundamental Thermodynamics of Refrigeration • Concepts :-The Second Law Interpretation, Introduction to Heat pump, Heat Engine and Refrigerator (with Numerical treatment), • Gas Cycles: Carnot cycle, Reversed Carnot cycle, Bell Coleman cycle, Air cycles for aircraft	4
2	• Vapour Compression refrigeration system (VCRS) - Simple Vapour compression cycle, Pressure Enthalpy Diagram and Calculations (Numerical on VCR Cycle) ,Effect of liquid sub cooling & vapour superheating,Actual vapour compression cycle. • Advanced system- Flash gas removal and flash gas inter cooling, Introduction to multi-pressure system (multi-evaporator, multi compressor), multiple / individual expansion valve, • Cryogenics - Liquification of gases via Linde Cycle, Claude Cycle, Cascade system	8
3	System Components & Refrigerant Technology • System Components: Detailed study of Compressor, Condenser, Evaporator, Expansion devices, • Safety controls - Fundamental safety controls in refrigeration circuits Refrigerant Chemistry: a) Classification: Azeotropes, secondary refrigerants, and eco-friendly alternatives. b) Environmental Impact: Global Warming Potential (GWP) and Ozone Depletion Potential (ODP). Vapour Absorption Systems (VAS) • System Design: Basic and practical Vapour Absorption System- Ammonia-Water (NH₃-H₂O) and Lithium Bromide-Water (LiBr-H₂O) systems. • Comparative Analysis: Descriptive comparison between Vapour Compression and Vapour Absorption systems.	8
4	Psychrometry & Air Processing • Air Properties: Detailed study of psychrometric properties, tables, and charts. • Processes: Analysis of heating, cooling, humidification, and dehumidification. • Performance Metrics: Sensible Heat Factor (SHF), Apparatus Dew Point (ADP), Bypass Factor (BPF), and Air Washer performance	6
5	Load Estimation & Comfort Engineering • Thermal Comfort: Human body thermal analysis, Effective Temperature, and Comfort Charts. • Heat Load Calculations: Internal and external heat sources; Load concepts including RSHP, GSHP, and ESHF. • Applied Systems: Transport Air Conditioning (Automotive, Marine, and Railway systems).	6
6	Air Conditioning Systems and Equipment • Unitary Systems: Window, split, multi-split, and package air conditioners. • Central Systems: Air-cooled and water-cooled chillers, AHUs (Air Handling	4

Text Books			
1	“Refrigeration and Air Conditioning” , Arora C P, Tata McGraw Hill		
2	“A course in Refrigeration and Air Conditioning” Arora & Domkundwar, Dhanpat Rai and Sons, Delhi		
3	“Refrigeration & Air Conditioning” , Dr. Sadhu Singh , Khanna Publication		
Reference Books			
1	“Principal of Refrigeration” Dossat Ray J., S.I. Version, Wiley Eastern Limited,		
2	“Refrigeration and Air-conditioning” Manohar Prasad, Wiley Eastern Limited, 1983		
3	“Refrigeration and Air-conditioning” Stocker W.F. and Jones J.W., McGraw Hill International editions 1982		
4	“Basic of Refrigeration and Air Conditioning”, Anantnarayan, Tata McGraw Hill Publications		
5	“Industrial Refrigeration”, Wilbert Stocker, McGraw Hill Publications		
Useful web links			
1	https://www.youtube.com/watch?v=nlsNmhiID74&t=2s		

Year, Program, Semester	Final Year B. Tech (Mechanical Engineering), Semester- VII						
Course Code	PCC411						
Course Category	Program Core Course						
Course title	Refrigeration and Air Conditioning (Lab)						
Teaching Scheme and Credits	L	T	P	Total Contact Hours	Total Credits		
	—	—	02	02	01		
Evaluation Scheme	ISE		ESE		IE	EE	Total
	—		—		50	-	50
Pre-requisites(if any)	Engineering Thermodynamics, Fluid Mechanics , Heat and Mass Transfer						
Course Objectives	The course aims to: 1. To get the knowledge and skills to fulfil needs of industry in future. 2. To perform different experiments and analyze results. 3. To use different tools and techniques in refrigeration and air conditioning 4. To develop a professional and research approach for lifelong learning in refrigeration system.						
Course Outcomes	After completing the course, students will be able to: 1. Express complete understanding of vapour compression cycle. 2. Perform the different experiments of refrigeration and air conditioning. 3. Analyze the different experiments in refrigeration and air conditioning. 4. Write reports in an efficient way.						

Experiment No.	Experiment Title	Hours
1.	Study of basic components of simple vapour compression refrigeration systems.	02
2.	Study and demonstration of refrigeration system.(Domestic Refrigerator/ Water Cooler/ Cold Storage)	02
3.	Study of Vapour Absorption system.	02
4.	Trial on Refrigeration Test Rig.	02
5.	Trial on Ice plant.	02
6.	Trial on two stage cascade system.	02
7.	Trial on heat pump.	02
8.	Study and trial on Window Air conditioning Test Rig.	02
9.	Industrial Visit related to refrigeration and air conditioning system.	02
10.	Market survey of various refrigeration and air conditioning systems which include the Equipment's with related specifications, manufacturers, cost , Presentation of report in the laboratory.	02
	General Instructions: Experiments will be checked after compilation of the trial.	

Year, Program, Semester	Final Year B. Tech (Mechanical Engineering), Semester- VII						
Course Code	PCC412						
Course Category	Program Core Course						
Course title	Automobile Engineering						
Teaching Scheme and Credits	L	T	P	Total Contact Hours	Total Credits		
	3	-	2	5	4		
Evaluation Scheme	ISE		ESE		IE	EE	Total
	30		70		00	00	100
Pre-requisites(if any)	Internal Combustion Engines, Engineering Thermodynamics and Heat and Mass Transfer						
Course Objectives	The course aims to: 1. To study and understand various components, sub-assemblies, and assembly of an automobile. 2. To study the design of various automobile systems. 3. To study and diagnose the effects of various factors on the subassemblies of an automobile 4. To evaluate the performance of an automobile.						
Course Outcomes	On completion of the course, students will be able to 1. Implement the knowledge obtained in theory towards the design procedure of various automobile systems 2. Understand the components and layout of the automobile 3. Analyze the effect of various factors on subsystems of automobiles and remedies can be proposed 4. Evaluate the performance of an automobile						

Unit No.	Course Content	Hours
1	Clutch: Requirements of Clutches, Types of Clutches; Single Plate, Multi-plate, Wet Clutch, Semicentrifugal, Centrifugal. Clutch materials. Clutch operating mechanisms; Mechanical, Electric, Hydraulic, and Vacuum. Free Pedal Play. Transmission: Necessity of gearbox. Sliding mesh, Constant mesh, and Synchromesh Gear selector mechanisms. Overdrives and hydrodynamic torque converter, Troubleshooting and remedies. Propeller Shaft and Axle: Propeller shafts and universal joints, Types and construction, Different types of universal joints and constant velocity joints Types of live axles; semi, three quarter and full floating axles Types of Front Stub Axles; Elliot, Reverse Elliot, Lamoine, and Reverse Lamoine	6
2	Final Drive and Differential: Types of Final drive; spiral, bevel, Hypoid and worm drives. The necessity of differential, Working of differential, Conventional and non-slip differential, Troubleshooting and remedies Steering System:	6

	Steering geometry, Steering requirements, Steering linkages and steering gears. Over steer and understeer, Cornering power, Reversibility of steering gears. Braking System: Requirement of brake, Classification of brakes, Brake Actuation Methods; Mechanical, Hydraulic, Pneumatic, Electro and vacuum brakes. Types of Disc brakes and Drum Brakes, Brake troubleshooting, Introduction to antilock braking system (ABS)	
3	Suspension System Objects of suspension, Basic requirements, Sprung and un-sprung mass, Types of Independent and rigid axle suspension. Air suspension and its features. Pitching, rolling and bouncing. Shock absorbers and its types Wheels and Tyres: Requirements of wheels and tyres. Types of wheels, types of tyres and types of carcass	6
4	Automotive Electrical System: Storage System: Lead-Acid Battery; construction, working, ratings, types of charging methods, Alkaline, ZEBRA, Sodium Sulphur and Swing batteries Charging System Dynamo: Principle of operation, Construction and Working. Regulators, combined current and voltage regulator. Alternator: Principle of operation, Construction, Working. Rectification from AC to DC Starting system: Requirements, Various torque terms used, Starter motor drives; Bendix, Rubber compression, Compression Spring, Overrunning Clutch. Starter motor solenoids and switches	6
5	Body Engineering: Importance of Body design, Materials for body construction-Styling forms-Coach and bus body style, layouts of passenger cars, Bus and truck bodies. Chassis types and structure types: Open, Semi integral and integral bus structure Frames: functions and types of frames, Loads on frames, Load distribution of structure, Location of power plant	6
6	Recent trends in Automobiles: Intelligent Vehicle Systems: Cruise Control, Adaptive Cruise Control (ACC), Electronic Stability Program (ESP), Electronic Brake Distribution (EBD), Traction Control System (TCS), Integrated Starter Alternator (ISA), Introduction to Electric Vehicle (EV), comparison with conventional system.	6
Text Books		
1	Automobile Engineering, Kirpal Singh, Vol I & II, Standard publishers Distributors ,Delhi	
2	The Automobile by Harbans Singh Reyat	
3	The Automobile Engineering by T.R. Banga and Nathu Singh	
Reference Books		
1	Automotive Engineering Fundamentals by Richard Stone, Jeffrey K. Ball,SAE International	
2	Vehicle body engineering by J Powlowski	
3	Automobile Mechanics, N. K. Giri, 8 thEdition, Khanna Publishers	
Useful web links		
1	https://onlinecourses.nptel.ac.in/noc20_de06/preview	
2	https://onlinecourses.nptel.ac.in/noc26_ee27/preview	
3	https://onlinecourses.nptel.ac.in/noc20_ee18/preview	

Year, Program, Semester	Final Year B. Tech (Mechanical Engineering), Semester- VII						
Course Code	PCC411						
Course Category	Program Core Course						
Course title	Automobile Engineering (Lab)						
Teaching Scheme and Credits	L	T	P	Total Contact Hours	Total Credits		
	—	—	02	02	01		
Evaluation Scheme	ISE		ESE		IE	EE	Total
	—		—		50	-	50
Pre-requisites(if any)	Engineering Thermodynamics, Fluid Mechanics , Heat and Mass Transfer						
Course Objectives	The course aims to: 1. Give details components and layout of the automobile 2. To implement the knowledge obtained in theory towards working of various automobile systems 3. To study the effect of various factors on subsystems of automobiles and remedies can be proposed 4. To work out the performance of the automobile						
Course Outcomes	After completing the course, students will be able to: 1. Explain the components and layout of the automobile 2. Apply the knowledge obtained in theory towards working of various automobile systems. 3. Examine the effect of various factors on subsystems of automobiles and remedies can be proposed. 4. Work out the performance of automobiles.						

Experiment No.	Experiment Title	Hours
1.	Study of Traffic Safety Driving Symbols	02
2.	Study and demonstration of four-wheeler chassis layout, Two-wheel and four-wheel drive layouts.	02
3.	Assemble and Disassemble of working of any type of automobile clutch.	02
4.	Assemble and Disassemble of the synchromesh gearbox, final drive and differential	02
5.	Assemble and Disassemble of working Hydraulic braking system.	02
6.	Assemble and Disassemble of front wheel steering geometry and steering mechanism and suspension system of a four-wheeler	02
7.	Study and demonstration of battery, electrical starting, and charging system	02
8.	Visit servicing station for the study of vehicle maintenance, wheel balancing and front wheel alignment, and repairs with relevant visit report.	02
9.	Market survey of any vehicle per student. (compulsory)	02
	General Instructions: • Experiments will be checked after compilation of the trial.	

Year, Program, Semester	Final Year B. Tech (Mechanical Engineering), Semester- VII						
Course Code	PCC 413						
Course Category	Program Core Course						
Course title	Solar Technology and Maintenance						
Teaching Scheme and Credits	L	T	P	Total Contact Hours	Total Credits		
	3		2	5	4		
Evaluation Scheme	ISE		ESE		IE	EE	Total
	30		70				100
Pre-requisites(if any)							
Course Objectives	The course aims to: 1. Understand solar radiation principles and energy conversion mechanisms. 2. Analyze design parameters of solar thermal and solar PV systems. 3. Learn operation, maintenance, troubleshooting, and reliability of solar installations. 4. Develop skills for field inspection, performance testing, and maintenance reporting. 5. Gain hands-on experience with solar modules, inverters, thermal collectors, and monitoring instruments.						
Course Outcomes	After completing the course, students will be able to: 1. Interpret solar radiation data and perform site assessment. 2. Design basic PV and thermal systems. 3. Operate and maintain solar installations. 4. Diagnose solar system faults and suggest corrective actions. 5. Prepare technical maintenance reports and documentation						

Unit No.	Course Content	Hours
1	Introduction to Solar Energy Solar energy scenario in India and worldwide, Types of solar technologies: PV, CSP, Solar Thermal. Solar geometry: declination, hour angle, altitude, azimuth., Radiation components: beam, diffuse, global, Sun-path diagram; measurement instruments (pyranometer).	6
2	Solar Photovoltaic (PV) Systems PV effect & semiconductor basics, Types of modules: Mono, Poly, Thin-film, Bifacial, IV characteristics, fill factor, module interconnections, Inverters (PWM, MPPT, string, micro-inverters), PV system sizing: standalone & grid-connected, Shading analysis & site assessment.	6
3	Solar Thermal Systems Flat Plate & Evacuated Tube Collectors, Concentrating collectors: parabolic dish, trough, solar tower, Heat transfer principles in collectors, Solar water heating systems; solar cooker, dryer, still, Thermal energy storage: sensible, latent, thermochemical.	6
4	Installation & Commissioning of Solar Systems Mechanical mounts, tracking systems, wind load considerations, Electrical components: cables, fuses, breakers, earthing, Testing procedures: polarity, insulation resistance, IV tracing, Safety and standards: IS/IEC compliance, Commissioning protocols and documentation.	6

5	Operation, Maintenance & Troubleshooting Preventive vs. corrective maintenance, Faults: hot spots, PID, inverter failures, junction box issues, Thermal system faults: scaling, stagnation, heat loss, SCADA, remote monitoring, Performance Ratio (PR), CUF, O&M documentation.	6
6	Economics, Policies & Case Studies Solar project economics: CAPEX, OPEX, LCOE. Payback, NPV, IRR, Net metering & policy framework in India, Case studies of rooftop/utility-scale solar installations. Comparison of wind and solar energy in hybrid systems.	6
Text Books		
1	S.P. Sukhatme, Solar Energy – Principles of Thermal Collection and Storage, TMH	
2	Chetan Singh Solanki, Solar Photovoltaics – Fundamentals, Technologies and Applications, PHI	
3	MNRE and IEC Standards for Solar PV Systems	
Reference Books		
1	Duffie & Beckman, Solar Engineering of Thermal Processes, Wiley	
2	G.N. Tiwari, Solar Energy: Fundamentals, Design, Modelling and Applications, Narosa	
3	Roger A. Messenger & Jerry Ventre, Photovoltaic Systems Engineering, CRC Press	
Useful web links		
1	https://onlinecourses.nptel.ac.in/noc21_ge23/preview	
2	https://onlinecourses.nptel.ac.in/noc20_ph21/preview	
3	https://onlinecourses.nptel.ac.in/noc25_ch40/preview	

Year, Program, Semester	Final Year B. Tech (Mechanical Engineering), Semester- VII						
Course Code	PCC 413						
Course Category	Program Core Course						
Course title	Solar Technology and Maintenance (Lab)						
Teaching Scheme and Credits	L	T	P	Total Contact Hours	Total Credits		
	-	-	2	2	1		
Evaluation Scheme	ISE		ESE		IE	EE	Total
	-		-		50	-	50
Pre-requisites(if any)							
Course Objectives	The course aims to: 1. Provide hands-on experience in measuring solar radiation, wind speed . 2. Enable students to test and evaluate the performance of solar PV modules, inverters, charge controllers, thermal collectors 3. Develop practical skills in system installation, alignment, tilt setting, electrical wiring, earthing, and safety procedures. 4. Train students in diagnosing faults, carrying out preventive and corrective maintenance, and preparing O&M reports. 5. Develop the ability to analyze experimental data, interpret performance curves, and relate observations to real-world renewable energy applications.						
Course Outcomes	After completing the course, students will be able to: 1. Measure and interpret solar radiation, wind speed, tilt angle effects, and environmental conditions using standard instruments. 2. Conduct IV curve testing, performance evaluation, and efficiency estimation of solar PV systems and small wind turbines. 3. Perform performance tests on solar thermal systems such as Flat Plate Collectors (FPC), Evacuated Tube Collectors (ETC), solar dryers, and solar cookers. 4. Carry out installation, commissioning checks, electrical testing, and safety procedures for solar and wind energy systems. 5. Troubleshoot common faults in PV systems, inverters, batteries, and small wind turbines using systematic diagnostic methods. 6. Prepare structured laboratory reports including graphs, calculations, performance curves, and maintenance documentation.						

Experiment No.	Experiment Title (any eight)	Hours
1.	Measurement of global, diffuse, and beam radiation using pyranometer/pyroheliometer.	02
2.	Sun-path diagram plotting and estimation of daily solar exposure.	02
3.	IV characteristics of a PV module under various radiation levels.	02
4.	Effect of tilt angle on PV output.	02
5.	Series/parallel connection of PV modules and change in power output.	02
6.	MPPT tracker demonstration	02
7.	Study of solar charge controller and inverter operation.	02

8.	Performance test of a Flat Plate Collector (FPC).	02
9.	Preparation of maintenance checklist for solar PV	02
10.	Fault diagnosis and troubleshooting in PV modules, inverters	02

Year, Program, Semester	Final Year B. Tech (Mechanical Engineering), Semester- VII						
Course Code	PEC411						
Course Category	Program Elective Course						
Course title	INDUSTRIAL AUTOMATION						
Teaching Scheme and Credits	L	T	P	Total Contact Hours	Total Credits		
	3	-	-	3	3		
Evaluation Scheme	ISE		ESE		IE	EE	Total
	30		70		00	00	100
Pre-requisites(if any)	Manufacturing Process and technology, Basic Electronics and Electrical, Industrial Engineering an Operations Research.						
Course Objectives	The course aims to: 1.To introduce students to the fundamentals of manufacturing systems and automation 2. To provide an understanding of different automation technologies used in modern manufacturing. 3. To explore the applications of sensors, actuators, and control systems in industrial automation. 4. To develop problem-solving skills for implementing automation solutions in real-world manufacturing environments. 5. To explore industrial control systems and hardware components used in automation.						
Course Outcomes	After completing the course, students will be able to: 1. Understand the principles of manufacturing automation and its significance in industry. 2. Analyze different types of manufacturing systems and automation strategies. 3. Analyze different types of automated material handling and storage systems. 4. Evaluate the role of sensors, actuators, and control systems in automation. 5. Analyze the design and operation of single station manufacturing cells. 6. Apply assembly line balancing techniques to optimize manual assembly lines. 7. Evaluate the functioning of automated production lines and their control strategies.						

Unit No.	Course Content	Hours
1	Introduction to Manufacturing Systems and Manufacturing Automation : Overview of Manufacturing Systems and Their Evolution, Types of Manufacturing Systems: Job Shop, Batch, Mass, and Continuous Production, Fundamentals of Manufacturing Automation, Types of Automation: Fixed, Programmable, and Flexible, Automation Strategies in Manufacturing, Benefits and Limitations of Automation in Manufacturing, Industry 4.0 and Smart Manufacturing, Role of Artificial Intelligence and Industry 4.0 in Automation.	6

2	Automated Material Handling and Storage Systems: Functions and Types of Automated Material Handling Systems (AMHS), Automated Guided Vehicles (AGVs) and Autonomous Mobile Robots (AMRs), Automated Storage and Retrieval Systems (AS/RS), Conveyor Systems and Robotics in Material Handling	6
3	Sensors, Actuators, and Control Systems in Automation: Types of Sensors: Proximity, Vision, Force, and Temperature Sensors, Actuators: Hydraulic, Pneumatic, and Electric Drives, Programmable Logic Controllers (PLCs): Architecture and Programming, Supervisory Control and Data Acquisition (SCADA) Systems	6
4	Single Station Manufacturing Cells: Fundamentals of Single Station Manufacturing Cells, Machine Cell and Machine Cluster, Manual, Automated, and Semi-Automated Workstations, Machine Tool Automation and CNC Systems, Process Optimization in Single Station Cells	6
5	Manual Assembly Lines – Single Model: Introduction to Manual Assembly Lines and Their Importance, Line Balancing Problems and Methods (Largest Candidate Rule, Kilbridge & Wester Method, Rank Positional Weight Method), Single Model, Poka-Yoke: Motion step Method.	6
6	Automated Production Lines and Assembly Systems: Structure and Working of Automated Production Lines, Transfer Mechanisms: Linear and Rotary Transfer Lines, Control Strategies in Automated Production Systems, Buffering and Accumulation in Production Lines, Types of Automated Assembly Systems, Part Feeding and Orientation Techniques, Design for Automated Assembly (DFA) Principles, Performance Analysis and Economic Justification of Automated Assembly.	6
General Instructions: Assignments (CIE- 10 marks) – A minimum of 6 assignments will be given on the above course curriculum.		
Text Books		
1	Mikell P. Groover, Automation, Production Systems, and Computer Integrated Manufacturing, Addison Wesley; 5th edition, 2020, Prentice-Hall of India Private Limited.	
2	W. Bolton, Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, 6th Edition 2022 Pearson Education Limited.	
3	Frank Lamb, Industrial Automation: Hands On, Tata McGraw Hill.	
Reference Books		
1	Geoffrey Boothroyd, "Assembly Automation and Product Design", CRC, Taylor & Francis Publishers.	
2	N. P. Mahalik, Mechatronics: Principles, Concepts and Applications, Tata McGraw Hill.	
3	S. R. Majumdar, Oil Hydraulic Systems: Principles and Maintenance, Tata McGraw Hill.	
Useful web links		
1	https://onlinecourses.nptel.ac.in/noc22_me50/preview	
2	https://onlinecourses.nptel.ac.in/noc22_me123/preview	

Year, Program, Semester	Final Year B. Tech (Mechanical Engineering), Semester- VII						
Course Code	PEC 411						
Course Category	Program Elective Course (Elective-II)						
Course title	HYDRAULICS AND PNEUMATICS						
Teaching Scheme and Credits	L	T	P	Total Contact Hours	Total Credits		
	03	-	-	3	3		
Evaluation Scheme	ISE		ESE		IE	EE	Total
	30		70		-	-	100
Pre-requisites(if any)	Engineering Physics, Fluid Mechanics and Turbo machinery.						
Course Objectives	The course aims to: 1. Introduce industrial hydraulics and pneumatics their elements, function and their structure 2. Apply physical laws and principles that governs the behavior of fluid power systems 3. Study different ISO/JIC symbol used in hydraulic and pneumatic system. 4. Explain various hydraulic and pneumatic circuit. 5. Explain troubleshooting caused in hydraulic and pneumatic system and general safety rule in fluid power system. 6. Identify application of hydraulic and pneumatic in various industries.						
Course Outcomes	After completing the course, students will be able to: 1. Identify, understand and select various components used in hydraulics system. 2. Make use of ISO/JIC symbols of fluid power systems to prepare fluid power circuits. 3. Develop efficient hydraulic and Pneumatic circuits with their application. 4. Identify troubleshooting of fluid power system and suggest suitable remedial actions to correct it.						

Unit No.	Course Content	Hours
1	INTRODUCTION TO FLUID POWER : a) Classification, Basic Elements of Fluid Power System, comparison of various systems, advantages and limitations, applications of fluid power in various fields of engineering, various hydraulic and pneumatic ISO/JIC Symbols. b) Principle of hydraulic system, functions, properties, Types and selection of hydraulic fluids and effect of temperature and pressure on hydraulic fluids. c) Introduction and Application of pneumatics, Physical properties, Principles, basic requirement of pneumatic system, comparison with hydraulic System.	06
2	HYDRAULIC SYSTEM ELEMENTS : a) Classification, types of seals, sealing material, pipes, hoses, compatibility of seal with fluid, sources of contamination and its control, strainer, filter, heat-exchanger, reservoir. b) Pumps-types, selection of pumps from Gear, vane, piston, screw, ball pump etc. c) Actuators-linear and rotary, hydraulic motors, types of hydraulic cylinders and their mountings. d) Accumulators, intensifier and their applications.	06

3	CONTROL OF FLUID POWER ELEMENTS : a) Requirements of Pressure control, direction control and flow control valves. b) Principle of pressure control valves directly operated and pilot operated pressure relief valve, pressure reducing valve, sequence valves, counter balance valve. c) Principles and Types of direction Control valves-2/2, 3/2, 4/2, 4/3, 5/2. Open center, close center, tandem center, manual operated, mechanical operated solenoid, pilot operated direction control valves, check valves. d) Principles of flow control valves, temperature compensated, pressure compensated temperature and pressure compensated flow control valve.	06
4	ELEMENTS OF PNEUMATIC SYSTEM : a) Air compressor- Types, selection criteria, capacity control, piping layout, fitting and connectors, Pneumatic controls, Direction control valves (two way, three way, four way), check valves, flow control valves, pressure control valves, speed regulators, quick exhaust valves, time delay valve, shuttle valve and twin pressure valve. Solenoid operated, pilot operated valves, Pneumatic actuators, Rotary and reciprocating cylinders–types and their mountings, Air motor – types, Comparison with hydraulic and electric motor. b) Serving of compressed air – types of filters, regulators, lubricators (FRL UNIT), mufflers, dryers.	06
5	A) HYDRAULIC CIRCUITS AND ITS APPLICATION Speed control circuits – Meter-in, Meter-out, Bleed off, Regenerative, Fast approach and slow traverse, Sequence circuits – Travel dependent and Pressure dependent.Synchronizing circuit, Regenerative circuit. B) PNEUMATIC CIRCUITS AND ITS APPLICATION Speed control circuits, Impulse operation circuit.,Sequence circuits, Time delay circuit.	06
6	System Design, Maintenance and Troubleshooting and Servo Controls a) Design of Hydraulic Pumps, Design of Hydraulic motor, Design of Hydraulic Cylinder, Design considerations for Hydraulic Cylinders. b) Maintenance, troubleshooting and safety of hydraulic and pneumatic systems. c) Hydraulic and Pneumatic servo system for linear and rotary motion.	06
Text Books		
1	“Industrial Fluid Power”, S.S. Kuber, Nirali Prakashan, 3rd Edition.	
2	“Hydraulic and Pneumatic”,H.L.Stewart,Industrial Press.	
3	“Industrial Fluid Power”,D. S. Pawaskar, Nishant Prakashan.	
4	“Hydraulics and Pneumatics”, Shaikh and Khan, R.K. Publication.	
5	“Fluid Power with Application”, Esposito, Pearson Education , 7th Edition.	
Reference Books		
1	“Industrial Fluid Power”, S.S. Kuber, Nirali Prakashan, 3rd Edition.	
2	“Hydraulic and Pneumatic”,H.L.Stewart,Industrial Press.	
3	“Industrial Hydraulic”, J. J. Pipenger ,Tata McGraw Hill.	
Useful web links		
1	https://nptel.ac.in/courses/112105046	
2	https://nptel.ac.in/courses/112105423	
3	https://nptel.ac.in/courses/112106300	

Year, Program, Semester	Final Year B. Tech (Mechanical Engineering), Semester- VII						
Course Code	PEC 411						
Course Category	Program Elective Course (Elective-II)						
Course title	MECHANICAL SYSTEM DESIGN						
Teaching Scheme and Credits	L	T	P	Total Contact Hours	Total Credits		
	3	-	-	3	3		
Evaluation Scheme	ISE		ESE		IE	EE	Total
	30		70		-	-	100
Pre-requisites(if any)	Engineering Mechanics, Manufacturing Process, Strength of Materials, Machine design, Engineering Mathematics, Theory of Machines, Dynamics of Machinery, and IC Engines.						
Course Objectives	The course aims to: 1. To develop competency for system visualization and design. 2. To enable student to design cylinders and pressure vessels and to use IS code. 3. To enable student select materials and to design internal engine components. 4. To introduce student to optimum design and use optimization methods to design mechanical components. 5. To enable student to design machine tool gearbox and material handling systems.						
Course Outcomes	After completing the course, students will be able to: 1. Understand the difference between component level design and system level design. 2. Design various mechanical systems like pressure vessels, machine tool gear boxes, material handling systems, etc. for the specifications stated/formulated. 3. Learn optimum design principles and apply it to mechanical components. 4. Handle system level projects from concept to product						

Unit No.	Course Content	Hours
1	Aesthetic and Ergonomic Consideration in Design: Basic types of product forms, Designing for appearance, shape, Design features, Materials, Finishes, proportions, Symmetry, Contrast etc. Morgan's color code. Ergonomic considerations Relation between man, machine and environmental factors. Design of displays and controls. Practical examples of products or equipment's using ergonomics and aesthetic design principles. Creativity concept in designing.	6
2	Design of cylinder and Pressure Vessels Design of Cylinders: Thin and thick cylinders, Lamé's equation, Clavarino's and Birnie's equations, design of hydraulic and pneumatic cylinders, auto-fretage and compound cylinders (No Derivation) gasketed joints in cylindrical vessels (No derivation). Design of Pressure vessel: Modes of failures in pressure vessels, unfired pressure vessels, classification of pressure vessels as per IS: 2825 - categories and types of welded joints, weld joint efficiency, stresses induced in pressure vessels, materials for pressure vessel, thickness of cylindrical shells and design of end closures as per	8

	code, nozzles and openings in pressure vessels, reinforcement of openings in shell and end closures - area compensation method, types of vessel supports (theoretical treatment only).	
3	Design of Belt Conveyor System for Material Handling System concept, basic principles, objectives of material handling system, unit load and containerization. Belt conveyors, Flat belt and troughed belt conveyors, capacity of conveyor, rubber covered and fabric ply belts, belt tensions, conveyor pulleys, belt idlers, tension take-up systems, power requirement of horizontal belt conveyors for frictional resistance of idler and pulleys.	8
4	Design of Gear Boxes for Machine Tool Applications: Determination of variable speed range- Graphical representation of speeds- Structure diagram Deviation diagram- Ray diagram- Selection of optimum ray diagram- Difference between number of teeth of successive gears in a change gear box- Analysis of twelve speed gear box Compound ray diagram	10
5	Design of I. C. Engine Components: Introduction to selection of material for I. C. engine components, Design of cylinder and cylinder head, Design of cylinder liners, Design of piston and piston-pins, Piston rings, Design of connecting rod, Design of crank-shaft and crank-pin.	8
6	Optimization Techniques Introduction to optimization, Introduction to Classical Methods & Linear Programming Problems, Terminology, Design Variables, Constraints, Objective Function, and Problem Formulation. Calculus method, Kuhn-Tucker conditions, Method of multipliers, Linear Programming Problems, single variable optimization problems, multivariable and constrained optimization techniques, and intelligent optimization techniques	6
Text Books		
1	“Design of machine element”, V. B. Bhandari, Tata Mc- Graw Hill Publication, 3rd Edition.	
2	“Mechanical Engineering Design”, Shigley and C. R. Mische, Tata Mc- Graw Hill Publication	
3	“Mechanical Design Analysis”, M. F. Spotts, Prentice Hall Publication	
Reference Books		
1	“Handbook of Gear Design”, Jitin Maitra, Tata Mc-Graw Hill Publication	
2	“Machine Design”, Black P.H. and O. Eugene Adams, Tata Mc- Graw Hill Publication	
3	“Mechanical Design Synthesis with Optimisation Applications”, Johnson R.C., Von Nostrand-Reynold Publicaion.	
Useful web links		
1	https://nptel.ac.in/courses/112106424	
2	https://nptel.ac.in/courses/112107249	
3	https://nptel.ac.in/courses/112106249	

Year, Program, Semester	Final Year B. Tech (Mechanical Engineering), Semester- VII						
Course Code	OEC 411						
Course Category	Open Elective Course (Open Elective-II)						
Course title	COSTING AND COST CONTROL						
Teaching Scheme and Credits	L	T	P	Total Contact Hours	Total Credits		
	03	00	00	03	03		
Evaluation Scheme	ISE		ESE		IE	EE	Total
	30		70		00	00	100
Pre-requisites(if any)	Engineering Economics						
Course Objectives	The course aims to: 1. To discuss the fundamentals of the costing system. 2. To discuss the process of costing for different industries. 3. To illustrate the cost accounting methods. 4. To demonstrate the techniques of costing in cost control and cost reduction areas.						
Course Outcomes	After completing the course, students will be able to: 1. Demonstrate the fundamentals of the Costing System. 2. Apply the costing methods based on the type of industry. 3. Apply the different Cost accounting methods as per requirement. 4. Demonstrate his acquired skills in Cost Control and Cost Reduction						

Unit No.	Course Content	Hours
1	Cost and Cost Estimation Concept of cost, cost unit, cost center, classification of cost, elements of cost, Definition of costing, desirable conditions for a costing system. Cost sheet. Cost Estimating: Definition, purpose and functions of estimation, the estimator's role, constituents of estimates, and estimating procedures.	8
2	Estimation of Weight and Material Cost Process of breaking down product drawing into simpler elements or shapes, estimating the volume, weight and cost. Purchasing procedure, Inventory Valuation by LIFO, FIFO, Weighted average method.	8
3	Estimation of various costs Estimation of fabrication, foundry, forging and machining cost Constitutes, direct cost, indirect cost, Procedure of cost estimation for each type. Machine hour rate: Definition, constituents, direct cost, indirect cost, steps for estimating machine hour rate for conventional machines, CNC lathe and machining centre.	7
4	Overheads Elements of overheads, classification, general considerations for collection, analysis of overheads, different methods for allocation, apportionment, and absorption of overheads.	6

5	Cost Accounting Methods Job costing, Batch costing, Unit costing, Process costing, Contract costing, Activitybased costing	5
6	Cost Control Budget and budgetary control, standard cost, variance analysis, Cost Reduction Areas: Value analysis and Value engineering, Zero Base Budgeting, Cost Volume Profit Analysis, Profit volume ratio.	6
General Instructions: Note: Numerical treatment on units 1, 2, 3, 4 and 5 is essential.		
Text Books		
1	Principles & Practice of Cost Accounting – N. K. Prasad (Book Syndicate Pvt. Ltd.)	
2	A Text Book of Estimating and Costing Mechanical – J.S. Charaya & G. S. Narang (Satya Prakashan)	
3	Practical Problems in Cost Accounting- S. P.Jain and K. L Narang, Kalyani publishes New Delhi	
Reference Books		
1	Cost Accounting- S. P.Jain and K. L Narang, Kalyani publishes New Delhi	
2	Principles and Practices of Costing - Lal and Nigam, Himalaya publishing house.	
3	Cost Management: Ravi M Kishore, Taxmann Publications	
4	Costing Simplified: Wheldom Series – Brown &Owier (ELBS)	
5	Cost Accounting: B. Jawaharlal (TMH)	
6	Cost Accounting, 13/e - B. K. Bhar, (Academic Publishers, Kolkata)	
Useful web links		
1	https://nptel.ac.in/courses/110101132	
2	https://nptel.ac.in/courses/110106511	

Year, Program, Semester	Final Year B. Tech (Mechanical Engineering), Semester- VII						
Course Code	OEC 411						
Course Category	Open Elective Course (Open Elective-II)						
Course title	NANOTECHNOLOGY						
Teaching Scheme and Credits	L	T	P	Total Contact Hours	Total Credits		
	3	-	-	3	3		
Evaluation Scheme	ISE		ESE		IE	EE	Total
	30		70		-	-	100
Pre-requisites(if any)	.Engineering Physics, Engineering Chemistry						
Course Objectives	The course aims to: 1. To discuss the fundamentals of Nanotechnology 2. To introduce the various synthesis and characterization techniques involved in Nanotechnology 3. To explain the different classes of nanomaterials. 4. To review the wide applications of nanotechnology in various technological fields						
Course Outcomes	After completing the course, students will be able to: 1. Understand the fundamentals of nanotechnology 2. Understand various synthesis methods of nanomaterial. 3. Comprehend characterization techniques involved in nanotechnology 4. Recognize different classes of Nanomaterial						

Unit No.	Course Content	Hours
1	Introduction To Nanotechnology Introduction and scientific revolutions, Time and length scale in structures, Definition of a Nanosystem, Dimensionality and size dependent phenomena, Surface to volume ratio, Properties at Nano scale	6
2	Synthesis of Nanomaterials Top down methods, Bottom -up methods, Mechanism of self-assembly	8
3	Characterization Techniques Introduction, Electron microscopes, Scanning probe microscopes, Diffraction techniques, Spectroscopies	8
4	Lithography Introduction, Photolithography, E-beam lithography, Scanning probe lithography, Soft lithography, Nano-imprint lithography	10
5	Different Classes Of Nanomaterials Classification based on dimensionality ,Quantum dots, wells and wires ,Carbon-based nano materials, Carbon Nanotubes and Graphene ,Metal based nano materials ,Metal oxide based nano materials ,Nanocomposites and nanopolymers, Nanoglasses and nano ceramics, Biological nanomaterials	8
6	Applications Medicine and health care ,Electronics, energy, Automobiles, Sports, Textiles, Space and Defense, safety issues, Nanotechnology and Environment	6

Text Books	
1	A Textbook of Nanoscience and Nanotechnology” T. Pradeep,, Tata McGraw Hill Education Pvt. Ltd
2	Nanotechnology: Principles and Practices” Sulabha K. Kulkarni,, Capital Publishing Company.
3	Introduction to Nanoscience and Nanotechnology” Gabor L. Hornyak , H.F. Tibbals , Joydeep Dutta , John J. Moore, CRC Press
Reference Books	
1	Introduction to Nanoscience” Stuart M. Lindsay, Oxford University Press.
2	Nanoscale Science and Technology” Robert Kelsall, Ian Hamley, Mark Geoghegan, John Wiley and Sons
3	K.E. Drexler, Nanosystems, Wiley
Useful web links	
1	http://www.nanotech-now.com/
2	www.nanowerk.com/

Year, Program, Semester	Final Year B. Tech (Mechanical Engineering), Semester- VII						
Course Code	OEC 411						
Course Category	Open Elective Course (Open Elective-II)						
Course title	INTERNET OF THINGS (IoT)						
Teaching Scheme and Credits	L	T	P	Total Contact Hours	Total Credits		
	3	-	-	3	3		
Evaluation Scheme	ISE		ESE		IE	EE	Total
	30		70		-	-	100
Pre-requisites(if any)	.						
Course Objectives	The course aims to: 1. To illustrate key elements of mechatronics, the principle of sensor and its characteristics 2. To demonstrate the utilisation of signal processing & interface systems such as ADC, DAC, Digital I/O 3. To demonstrate the determination of the transfer function by using the block diagram reduction technique 4. To demonstrate the application of different controller modes to an industrial application 5. To demonstrate the development of ladder programming for industrial applications.						
Course Outcomes	After completing the course, students will be able to: 1. Define key elements of mechatronics, the principle of sensor and its characteristics. 2. Utilize the concept of signal processing & interface systems such as ADC, DAC, Digital I/O. 3. Determine the transfer function by using the block diagram reduction technique 4. Apply the concept of different controller modes to an industrial application 5. Develop the ladder programming for industrial application						

Unit No.	Course Content	Hours
1	Introduction to mechatronics, Sensors, Actuators Introduction to Mechatronics, Need, Applications, building blocks of a typical mechatronic system, Sensors: Types of sensors; Motion Sensors – Encoder (Absolute & incremental), Lidar, Eddy Current, Proximity (Optical, Inductive, Capacitive), MEMS Accelerometer; Temperature sensor – Thermocouple, Thermistor, RTD, Pyrometer, Infrared Thermometer; Force / Pressure Sensors – Strain gauges, Piezoelectric sensor; Flow sensors – Electromagnetic, Ultrasonic, Hotwire anemometer; Colour sensor – RGB type; Biosensors – Enzyme, ECG, EMG, Selection of Sensors, Actuators: Stepper & Servo motor; Hydraulic and Pneumatic; linear electrical actuators & Selection of Actuators	10

2	Introduction to IoT Introduction of IoT: Definition and characteristics of IoT, Technical Building blocks of IoT, Device, Communication Technologies, Data, Physical design of IoT, IoT enabling technologies, IoT Issues and Challenges- Planning, Costs and Quality, Security and Privacy, Risks	8
3	Data Acquisition and Embedded Systems Introduction to DAQ, Types, Components of a Data Acquisition System (Sensor, Signal conditioning, processing, controlling and storage/display/action), Data Acquisition: Signal collection, Signal conditioning – Isolation & Filtering, Amplification, Sampling, Aliasing, Sample and hold circuit, Quantization, Analog-to-digital converters (4-bit Successive Approximation type ADC), Digital-to-Analog converters (4-bit R2R type DAC), Data storage, Embedded Systems: Architecture & Characteristics of ES, Types of Embedded systems, Examples of Embedded Systems. Embedded System on Chip (SOC), Components of ES: Hardware and software Hardware components of ES: Power supply: types, characteristics.	8
4	Communication under IoT Communication under IoT Development boards: Types of boards - Arduino, Raspberry pi, Beagle bone, ESP8266, selection criteria, interfacing of sensors with development boards. Communication under IoT: IoT Protocols: MQTT, CoAP, XMPP and AMQP, IoT communication models, IoT Communication technologies: Bluetooth, BLE, Zigbee, Zwave, NFC, RFID, LiFi, wifi, Interfacing of wifi, RFID, Zigbee.	10
5	Machine Learning for IoT – Compact, fast Machine Learning Accelerators for IoT devices: Edge Computing on IoT Devices, IoT Based Smart Buildings, Distributed Machine Learning, Machine Learning Accelerator, Machine Learning Model Optimization, Least-Squares-Solver for Shallow Neural Network: Introduction, Algorithm Optimization, Hardware Implementation	8
6	IoT Security Securing the Internet of Things & Security Architecture, Security and Vulnerability in the Internet of Things, IoT Node Authentication, Data Protection & Security Requirements in IoT Architecture, Security in Enabling Technologies & Existing Security Scheme for IoT, Introduction to the Use Cases and Emerging Standards	6
General Instructions: The course teacher should demonstrate with examples the various principles of IoT and Machine Learning. Real-life examples from industry, domestic, and processing should be considered, demonstrated, and evaluated.		
Text Books		
1	Raj Kamal, Internet of Things: Architecture and Design Principle”, ISBN-13: 978-93-5260- 522-4, McGraw Hill Education (India) 2017	
2	Securing the Internet of Things, Shancang Li Li Da Xu, Syngress, 2017, Elsevier	
3	David Hanes, IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things, Cisco Press, ISBN-13: 978-1-58714-456-1, ISBN-10: 1-58714-456-5, 2017	
Reference Books		
1	Hantao Huang, Hao Yu, “Compact and Fast Machine Learning Accelerator for IoT devices,” Edition: 1st ed. Publisher: Springer Singapore Year: 2019 ISBN: 978-981-13- 3323- 1	
2	Raj Kamal, “Embedded Systems: Architecture, Programming and Design”, 2nd Edition, □ McGraw-Hill, ISBN: 13: 9780070151253	
3	Lyla B. Das, “Embedded Systems: An Integrated Approach” Pearson	
Useful web links		
1	https://nptel.ac.in/courses/106105166	
2	https://nptel.ac.in/courses/108108179	
3	https://nptel.ac.in/courses/108108098	

Year, Program, Semester	Final Year B. Tech (Mechanical Engineering), Semester- VII				
Course Code	VEC411				
Course Category	Value Education Course				
Course title	Green Technology & Sustainability				
Teaching Scheme and Credits	L	T	P	Total Contact Hours	Total Credits
	01	-	-	01	01
Evaluation Scheme	ISE	ESE	IE	EE	Total
	-	-	50	-	50
Pre-requisites(if any)	Environment studies				
Course Objectives	The course aims to: 1. Understand the core principles of sustainability. 2. Explain green technology and eco-innovation concepts. 3. Assess environmental impacts of engineering systems. 4. Identify renewable and resource-efficient alternatives. 5. Integrate sustainable practices in design and operation. 6. Promote responsible and ethical engineering decisions.				
Course Outcomes	After completing the course, students will be able to: 1. Explain sustainability and green engineering principles. 2. Identify major environmental and resource issues. 3. Apply life-cycle and impact assessment tools. 4. Evaluate cleaner and renewable technologies. 5. Design eco-efficient and sustainable solutions. 6. Communicate sustainability ideas effectively.				

Unit No.	Course Content	Hours
I	Sustainability Fundamentals Definition and dimensions of sustainability (environmental, social, economic), Sustainable Development Goals (SDGs) and their engineering relevance, Principles of green engineering and sustainable innovation	2
II	Environmental Challenges & Resource Management Global and local environmental issues, Energy, water, and material resource depletion, Waste generation and its impact across industries	2
III	Green Technologies & Eco-Innovation Concepts and case studies in clean and green technologies, Sustainable materials, cleaner manufacturing, digital sustainability (IoT, AI for energy management), Smart cities, green buildings, and sustainable mobility	3
IV	Life Cycle Thinking & Environmental Assessment Basics of Life Cycle Assessment (LCA), Carbon and water foot printing, Environmental performance indicators and sustainability metrics	3
V	Renewable Energy and Sustainable Systems Solar, wind, hydro, bioenergy, and hydrogen systems, Energy conservation and efficiency improvement, Integration of renewable technologies into engineering design	3

VI	Circular Economy & Sustainable Future Waste-to-wealth concepts, product stewardship, recycling loops, Ethical, economic, and policy aspects of sustainability	2
----	--	---

Text/Reference Books	
I.	Allen, D.T., & Shonnard, D.R. (2001). Green Engineering: Environmentally Conscious Design of Chemical Processes. Prentice Hall, New Jersey.
II.	Anastas, P.T., & Zimmerman, J.B. (2018). The Twelve Principles of Green Chemistry and Engineering. Oxford University Press, Oxford.
III.	Graedel, T.E., & Allenby, B.R. (2010). Industrial Ecology and Sustainable Engineering. Pearson Education, New Jersey.
IV.	Rao, S.S., & Parulekar, A.H. (2022). Sustainable Engineering: Concepts, Design, and Case Studies. McGraw-Hill Education, New Delhi.
V.	Azapagic, A., Perdan, S., & Clift, R. (2004). Sustainable Development in Practice: Case Studies for Engineers and Scientists. John Wiley & Sons, Chichester.
Useful web links	
I	https://nptel.ac.in/courses/127105018
II	https://nptel.ac.in/courses/107103081

Year, Program, Semester	Final Year B. Tech (Mechanical Engineering), Semester- VII						
Course Code	PSI 411						
Course Category	Project Seminar Internship						
Course title	Major Project Phase I						
Teaching Scheme and Credits	L	T	P	Total Contact Hours		Total Credits	
	-	-	2	2		1	
Evaluation Scheme	ISE		ESE		IE	EE	Total
	-		-		50	50	100
Pre-requisites(if any)							
Course Objectives	The course aims to: 1. Discuss identification and definition of complex Mechanical engineering problems using literature survey and industry exposure. 2. Explain formulation of project objectives, scope, and methodology based on Mechanical engineering principles. 3. Develop students’ capability to plan and manage projects considering time, resources, and risks. 4. Discuss evaluation of technical progress through reviews, seminars, and expert feedback. 5. Explain incorporation of professional ethics, safety, sustainability, and societal considerations in project execution. 6. Communicate effective practices						
Course Outcomes	After completing the course, students will be able to: 1. Develop a technically sound project proposal supported by a literature review. 2. Design a feasible project execution plan considering constraints of time, safety, and resources. 3. Monitor and document project progress using structured reviews and milestones. 4. Evaluate project outcomes with respect to engineering feasibility, sustainability, and ethics. 5. Demonstrate professional conduct, teamwork, and independent responsibility.						

Course Content
Project Phase I Load: A batch of maximum three groups of four students per group, shall work under one Faculty member of department. The group of one student is strictly not allowed. Project Phase I Definition: The project phase I work can be a design project / experimental project and or computer simulation project on Mechanical engineering or any of the topics related with Mechanical engineering stream. The project phase I work is allotted in groups on different topics. The students groups are required to undertake the project phase-I during the seventh semester and the same is continued in the eighth semester (Phase-II). Project Phase-I consists of reviews of the work carried earlier and the submission of preliminary report. Report should highlight scope, objectives, methodology, approach and tools to be used like software and others, outline of project and expected results and outcome along with time frame. The project phase I work is to be extended for project phase II at B. Tech (Mech.) Sem. VIII with same group working under guidance of same Faculty member assigned for project phase I.

Project Phase I Term Work:

The term work under project submitted by students shall include

1. Work Diary: Work Diary maintained by group and countersigned by the guide weekly. The contents of work diary shall reflect the efforts taken by project group for
 - a. Searching suitable project work
 - b. Brief report preferably on journals/research or conference papers/books or literature surveyed to select and bring up the project.
 - c. Day to day activities carried out related to project work for entire semester.
 - d. Synopsis.

The group should submit the synopsis in following format

- i. Title of Project
- ii. Names of Students
- iii. Name of Guide
- iv. Relevance
- v. Present Theory and Practices
- vi. Proposed work
- vii. Expenditure
- viii. References

2. The synopsis shall be signed by the each student in the group, approved by the guide and endorsed by the Head of the Department

3. Presentation: The group has to make a presentation in front of the Faculty members of department at the end of semester.

Project Phase I Report Format:

Project Phase I report should be of 25 to 30 pages (typed on A4 size sheets). For standardization of the project phase I reports the following format should be strictly followed.

1. Page Size: TrimmedA4
2. Top Margin: 1.00Inch
3. Bottom Margin: 1.32Inches
4. Left Margin: 1.5Inches
5. Right Margin: 1.0Inch
6. Para Text: Times New Roman 12 Point. Font
7. Line Spacing: 1.5Lines
8. Page Numbers: Right Aligned at Footer. Font 12 Point. Times New Roman
9. Headings: Times New Roman, 14 Point , Bold Face
10. References: References should have the following format

For Books: "Title of Book", Authors, Publisher, Edition

For Papers: "Title of Paper, Authors, Journal/Conference Details, Year

Important Notes:

- Project group should continue maintaining a diary for project and should write (a) Book referred (b) Company visited (c) Person contacted (d) Computer work done (e) Paper referred (f) Creative thinking.
- The Diary along with Project Phase I Report shall be assessed at the time of oral examination
- One copy of the report should be submitted to Institute/ Department, One copy to Guide and one copy should remain with each student of the project group.

Year, Program, Semester	Final Year B. Tech (Mechanical Engineering), Semester- VII						
Course Code	PSI 412						
Course Category	Project Seminar Internship						
Course title	MDM based Industry Internship						
Teaching Scheme and Credits	L	T	P	Total Contact Hours	Total Credits		
	-	-	-	One Month Duration	3		
Evaluation Scheme	ISE		ESE		IE	EE	Total
	-		-		50	50	100
Pre-requisites(if any)							
Course Objectives	The course aims to: 1. To Identify and compare technical and practical issues in industrial as well as in social area. 2. To write, speak and demonstrate well in different contexts. 3. To Prepare a well-organized report of technical writing and innovative thinking. 4. To Demonstrate the ability to describe, interpret and analyze technical issues and develop competence in presentation.						
Course Outcomes	After completing the course, students will be able to: 1. Establish motivation for any topic of interest and develop a thought process for technical presentation. 2. Organize a detailed literature survey and build a document with respect to technical publications. 3. Analysis and comprehension of concept and related data. 4. Effective presentation and improve soft skills.						

Course Content		
1	The course consists of a one-month internship in Minor Specific Industry. Students will be placed in companies or organizations that align with the particular sector. During the internship, students will engage in various activities, including but not limited to: 1. Shadowing industry professionals to observe and learn about different processes and operations. 2. Assisting with ongoing projects or research initiatives within the organization. 3. Participating in hands-on tasks related to their minor sub-specialization, under the guidance of experienced mentors. 4. Attending training sessions, workshops, and seminars conducted by the industry to enhance their knowledge and skills. 5. Engaging in discussions and meetings with supervisors and colleagues to gain insights into industry practices, challenges, and innovations. 6. Documenting their internship experience through reports, presentations, or reflective journals. The period of one month for this internship will be during the winter or summer vacations.	

Course Assessment Process		
1	This particular evaluation will be the part of the structure of 7th Semester. The evaluation for the Industrial Internship course will be conducted as follows: Internal Evaluation (50 marks): • Assessment by course teachers based on students' performance during the internship, including attendance, participation, attitude, and contribution to assigned tasks. • Evaluation by industrial supervisors on students' professional conduct, technical skills, problem solving abilities, and overall performance in the workplace. External Evaluation (50 marks): • Evaluation by an external examiner appointed by the institute, who will assess students' internship reports, presentations, or any other documentation submitted at the end of the internship period. • The external examiner will review the quality of students' reflections on their internship experience, their ability to apply theoretical knowledge to practical situations, and the depth of their understanding of industry practices and challenges. The final grades for the Industrial Internship course will be determined based on the combined assessment from both internal and external evaluations.	

Final Year B. Tech (Mechanical Engineering), Semester- VIII**Teaching & Evaluation Scheme**

S.N.	Category	Code	Course Title	Hours per week			Contact Hours	Credits	Evaluation scheme	
				L	T	P			Theory	Practical
									ISE:ESE	IE:EE
1.	Project Seminar Internship	PSI 421	Industrial Internship (Follow up by the Department)	The entire Semester is to be spent in the industry				10	00:00	100:100
2.	Program Elective Course [SWAYAM (NPTEL) or any other MOOCs]	PEC 421	Program Elective III (Through MOOC *)	03	-	-	03	03	30:70	00:00
3.	Humanities and Social Sciences , Management Environmental Course	HSMEC 421	Industrial Safety Engineering (Through MOOC *) OR Management Course	03	-	-	03	03	30:70	00:00
4.	Indian Knowledge Systems	IKS 421	Indian Science, Engineering and Technology (Program Specific IKS) **	02	-	-	02	02	30:70	50:00
5.	Value Education Course	VEC421	Ethics In Engineering Practice (Through MOOC *)	01	-	-	01	01	00:00	50:00
6.	Project Seminar Internship	PSI 422	Major Project Phase II	-	-	02	02	01	00:00	100:100
7.	Project Seminar Internship	PSI 423	MDM based mini Project***	-	-	-	-	02	00:00	50:50
				-	-	-	-	22	300	600
			Total Hours (Other than Internship)	09	-	02	11	-	-	-

*There is an option for End Semester Examination either on the respective MOOC platform or at the course teacher's end through the University System.

** Though the course is to be completed online either through course coordinator or via suitable MOOC if any, the ISE will be coordinated by the course in charge and the ESE will be through University system.

***MDM based mini project to be completed during 4th semester to 8th semester.

Year, Program, Semester	Final Year B. Tech (Mechanical Engineering), Semester- VIII					
Course Code	PSI 421					
Course Category	Project Seminar Internship					
Course title	Industrial Internship					
Teaching Scheme and Credits	L	T	P	Total Contact Hours	Total Credits	
	Entire Semester to be spent in industry				10	
Evaluation Scheme	ISE		ESE	IE	EE	Total
	-		-	100	100	200
Pre-requisites(if any)	The knowledge of workshop technology, Mini Project					
Course Objectives	The course aims to: 1. Providing exposure to corporate culture. 2. Providing exposure to latest technologies used in the industry. 3. Learning to communicate efficiently. 4. Helping to apply fundamental principles of Mechanical Engineering in real-world problems.					
Course Outcomes	After completing the course, students will be able to: 1. Apply fundamental principles of Mechanical Engineering. 2. Become specialized in a particular technology domain. 3. Become updated with all the latest changes in technological world. 4. Communicate efficiently. 5. Identify, formulate and model problems and find engineering solution based on a systems approach. 6. Get awareness of the social, cultural, global and environmental responsibility as an engineer.					
Course Content						
The Industrial Internship is a full-semester industry-oriented training program conducted in reputed industries, R&D organizations, startups, or government sectors related to Mechanical Engineering. Students work under the guidance of industry and faculty mentors on real engineering problems involving automotive systems, aerospace, robotics, manufacturing processes, thermal power plants, HVAC, and mechatronics or allied areas. The internship emphasizes practical implementation, system understanding, professional ethics, teamwork, and documentation. Students are required to maintain a daily logbook, prepare periodic progress reports, and submit a final technical internship report. The course enhances employability, professional confidence, and industry readiness.						
Guidelines, Rules, and Regulations						
Requirement: All B.Tech Mechanical Engineering students are required to complete an Industrial Internship during the eighth semester of the program. The internship is intended to provide extensive industrial exposure and practical learning experience.						

Duration & Venue: The internship shall be carried out for one full semester in an approved industry, R&D organization, startup, government organization, or reputed mechanical sector (such as OEM plants, fabrication units, or design consultancy firms) relevant to the student's program.

Approval: The internship organization must be recommended by the department and approved by the institute prior to commencement.

Documentation: Students must submit an official offer letter or confirmation letter from the organization to the department before joining. Each student shall be assigned a faculty mentor to monitor progress and provide academic guidance.

Conduct: Students are required to strictly follow the rules, regulations, industrial safety policies (including PPE protocols), confidentiality agreements, and professional ethics of the organization. Any misconduct may lead to cancellation of the internship and disciplinary action.

Changes: Change of internship organization is not permitted without prior written approval from the Head of Department.

Completion: At the end of the internship, students must submit a detailed internship report in the prescribed format along with an Internship Completion Certificate issued by the organization.

Credits: Failure to complete the internship satisfactorily or failure to submit the required documents within the stipulated time shall result in non-award of credits for the course.

Course Assessment

At the end of the internship, the student shall deliver a presentation before a departmental evaluation committee. The assessment shall be based on:

Internship Report: Quality of technical documentation and data analysis.

Presentation: Ability to communicate technical findings and project outcomes.

Technical Competence: Mastery of mechanical tools, software (CAD/CAM/CAE), or machinery.

Problem-Solving: Application of engineering principles to real-world industrial challenges.

Professional Attitude: Evaluation of discipline, teamwork, and ethics.

Internal Evaluation (IE) and End Examination (EE) marks shall be awarded based on the cumulative performance across these criteria.

Year, Program, Semester	Final Year B. Tech (Mechanical Engineering), Semester- VIII				
Course Code	PEC 421				
Course Category	Program Elective Course III (Through MOOC*)				
Course title	Computational Fluid Dynamics				
Teaching Scheme and Credits	L	T	P	Total Contact Hours	Total Credits
	03	-	-	03	03
Evaluation Scheme	ISE	ESE	IE	EE	Total
	30	70	-	-	100
Pre-requisites(if any)	Basic knowledge of Mathematics and Fluid Mechanics				
Course Objectives	The course aims to: 1. Discuss the conservation laws and governing equations for fluid flow 2. Summarize the methods of discretization in computational fluid dynamics (CFD) 3. Demonstrate the skills for solving laminar flow problems 4. Illustrate examples and practice solving turbulent flow problems using appropriate turbulence models				
Course Outcomes	After completing the course, students will be able to: 1. Demonstrate the knowledge and understanding of governing equations to different fluid flow problems 2. Define and setup flow problem properly within CFD context. 3. Gain knowledge and skills in solving laminar flow problems 4. Use CFD software to model relevant engineering flow problems and analyze the CFD results.				

Unit No.	Course Content	Hours
I	Mathematical Modelling of Fluid Flow: Conservation laws & governing equations for fluid flow: Continuity equation, Momentum equation etc. and their derivations, General form of conservation equations, Boundary conditions, Classification of equations, Mathematical modeling practices of basic fluid flow problems and its solution, Methods of flow visualization.	(9h)
II	Methods of Discretization: Introduction to Computational methods, Components and properties of computational methods, Various methods of discretization; Illustration of Finite volume method (FVM) for generalized form of conservation equations, Solution of steady & unsteady diffusion equations, Solution of convection-diffusion equation with illustration of various differencing schemes.	(9h)
III	Solution of Laminar Flow Problems: Basic equations for Laminar flow cases, Calculation of flow field variables, Difficulties involved in solution of momentum equations, Staggered grid, Navier-Stokes solvers, SIMPLE algorithm & its variants, Solution of simple viscous laminar flow problems as Couette flow, Poiseuille flow, boundary layer flows, etc., Implementation of various boundary conditions, Numerical techniques for solution of algebraic equations.	(9h)
IV	Introductory Solution of Turbulent Flow Problems: Important features of turbulent flow, Reynolds average Navier-stoke (RANS) equation, Necessity of turbulence modeling, Different types of turbulence model, Illustrative example and practice.	(9h)

Text/Reference Books	
1.	An Introduction to Computational Fluid Dynamics: The finite volume Method, Versteeg, H.K., and Malalasekera, W.
2.	Computational fluid dynamics – The basics with applications, Anderson, J.D
3.	Computational Methods for Fluid dynamics, Ferziger and Peric
4.	Numerical heat transfer and fluid flow, Patankar, S. V., Hemisphere Publishing Corporation, 2004.
5.	Turbulent flows, Pope S. B., Cambridge university press.
6.	Computer simulation of flow and heat transfer, Ghoshdastidar, P. S., Tata McGraw Hill Publishing Company Ltd., 1998.
Useful web links	
1	COMPUTATIONAL FLUID DYNAMICS, PROF. SUMAN CHAKRABORTY Department of Mechanical Engineering, IIT Kharagpur

Year, Program, Semester	Final Year B. Tech (Mechanical Engineering), Semester- VIII				
Course Code	PEC 421				
Course Category	Program Elective Course III (Through MOOC*)				
Course title	AEROMECHANICS OF UNMANNED AERIAL VEHICLES / DRONES				
Teaching Scheme and Credits	L	T	P	Total Contact Hours	Total Credits
	03	-	-	03	03
Evaluation Scheme	ISE	ESE	IE	EE	Total
	30	70	-	-	100
Pre-requisites(if any)	basics of aerodynamic				
Course Objectives	The course aims to: 1. Understand the diverse classifications of UAVs and their specific applications across civilian and military sectors. 2. Analyze the "System of Systems" architecture, identifying the critical roles of various sub-systems in UAS operations. 3. Explain the fundamental aerodynamic principles of lift, drag, and pitching moments specific to low-speed flight. 4. Evaluate the performance parameters (range, endurance, and rate of climb) for both fuel-powered and battery-powered platforms. 5. Compare the aerodynamic theories of fixed-wing, rotary-wing, and flapping-wing flight. 6. Apply flight dynamics modeling to control and stabilize multi-rotor systems like quadrotors.				
Course Outcomes	After completing the course, students will be able to: 1. Differentiate between fixed-wing, rotary-wing, and flapping-wing configurations based on mission requirements. 2. Calculate stalling speeds, load factors, and wing loading requirements for fixed-wing UAVs. 3. Apply Momentum Theory and Blade Element Theory to predict rotor performance in hover and forward flight. 4. Optimize propulsion systems by accounting for Low Reynolds number effects and Propeller Theory. 5. Assess the impact of unsteady aerodynamics on the flight stability of micro-aerial vehicles (MAVs). 6. Derive the equations of motion for a quadrotor to facilitate autonomous flight control.				

Unit No.	Course Content	Hours
I	Fundamentals of UAS Design Introduction to Unmanned Aerial Vehicles, Types of UAVs, applications, design process and design goals	6

II	Fixed-Wing Aerodynamics & Performance UAS as a System of Systems, description of each sub-system and its role, fixed wing primary control, introduction to aerodynamics, Aerodynamic performance – lift, drag, L/D, effect of pitching moment, wing loading for UAVs, stalling speed,.	6
III	Low Reynolds Number & Propeller Theory Concept of load factor, range, endurance, rate of climb etc. for fixed wing UAVs with fuel as well as battery power, Low Reynolds number aerodynamics, Propeller Theory	6
IV	Rotary-Wing Momentum Theory Momentum theory in climb, descent and forward flight, Blade element theory, rotors in axial and edgewise flight	6
V	Blade Element & Rotor Dynamics Blade Element Momentum Theory, Prandtl tip loss function., Performance of rotary wing UAVs, range, endurance, rate of climb, maximum speed	6
VI	Introduction to flapping wing UAVs and unsteady aerodynamics Flight dynamics of UAVs with focus on Quadrotor Flight dynamics	6

Text/Reference Books	
1.	Introduction to Unmanned Aircraft Systems (3rd Ed, 2021), R. Kurt Barnhart, et al.
2.	Introduction to UAV Systems (5th Ed, 2023), Paul Fahlstrom & Thomas Gleason
3.	Unmanned Aircraft Systems: Design, Development and Deployment, Reg Austin
Useful web links	
1	AEROMECHANICS OF UNMANNED AERIAL VEHICLES / DRONES, PROF. ABHISHEK Department of Aerospace Engineering IIT Kanpur
2	Drone Systems and Control, IISc Bangalore Prof. Suresh Sundaram

Year, Program, Semester	Final Year B. Tech (Mechanical Engineering), Semester- VIII				
Course Code	PEC 421				
Course Category	Program Elective Course III (Through MOOC*)				
Course title	ADVANCED COMPOSITES				
Teaching Scheme and Credits	L	T	P	Total Contact Hours	Total Credits
	03	-	-	03	03
Evaluation Scheme	ISE	ESE	IE	EE	Total
	30	70	-	-	100
Pre-requisites(if any)	-				
Course Objectives	The course aims to: 1. Define the engineering properties of fibers, matrices, and the resulting composite interface. 2. Formulate the elasticity tensor for orthotropic materials and unidirectional laminae. 3. Construct the Classical Lamination Theory (CLT) framework using stiffness matrices. 4. Evaluate failure criteria for both individual laminae and multi-directional laminates. 5. Develop governing differential equations for the structural analysis of composite beams and plates. 6. Analyze the influence of environmental factors				
Course Outcomes	After completing the course, students will be able to: 1. Characterize the micromechanical and macromechanical behavior of composite systems. 2. Calculate the equivalent elastic moduli of a laminate given the stacking sequence and ply properties. 3. Predict the onset of first-ply failure and ultimate laminate failure under complex loading. 4. Solve boundary value problems for composite beams and plates using analytical methods. 5. Model the mechanical behavior of short-fiber composites, accounting for fiber orientation and length distributions. 6. Quantify the reduction in structural integrity caused by moisture absorption and thermal expansion.				

Unit No.	Course Content	Hours
I	Introduction to Composite Mechanics Overview of composite constituents (fiber/matrix), manufacturing-induced properties, and the transition from isotropic to anisotropic material behavior.	(6h)
II	Macro-mechanical Analysis of a Lamina Derivation of the generalized Hooke's Law for orthotropic materials and the transformation of elastic constants for off-axis unidirectional laminae.	(6h)

III	Classical Lamination Theory (CLT)The heart of composite analysis. Development of the (extensional), (coupling), and (bending) matrices to describe the behavior of stacked plies.	(6h)
IV	Failure Theories and Structural Analysis Study of failure envelopes and the application of differential equations to analyze the deflection and buckling of composite beams and rectangular plates.	(6h)
V	Micromechanics of Short Fiber Composites Focus on non-continuous reinforcement. This includes the Halpin-Tsai equations, shear lag models, and the statistical nature of short-fiber reinforcement.	(6h)
VI	Environmental Degradation (Hygrothermal Effects) Analysis of how temperature gradients and moisture concentration profiles induce internal "residual" stresses and alter the glass transition temperature of the matrix.	(6h)

Text/Reference Books	
1.	Mechanics of Composite Materials (2nd Ed), Robert M. Jones
2.	Engineering Mechanics of Composite Materials, Isaac M. Daniel & Ori Ishai
3.	Principles of Composite Material Mechanics , Ronald F. Gibson
Useful web links	
1	ADVANCED COMPOSITES, PROF. NACHIKETA TIWARI Department of Mechanical Engineering IIT Kanpur
2	Introduction to Composites, IIT Kanpur Prof. Nachiketa Tiwari
3	Manufacturing of Composites, IIT Kanpur Prof. J. Ramkumar

Year, Program, Semester	Final Year B. Tech (Mechanical Engineering), Semester- VIII						
Course Code	HSMEC 421						
Course Category	Humanities and Social Sciences, Management, Environmental Course						
Course title	Industrial Safety Engineering (Through MOOC*)						
Teaching Scheme and Credits	L	T	P	Total Contact Hours	Total Credits		
	03	00	00	03	03		
Evaluation Scheme	ISE		ESE		IE	EE	Total
	30		70		00	00	100
Pre-requisites(if any)	NIL						
Course Objectives	The course aims to : 1.Discuss about Industrial safety programs, Industrial laws, regulations. 2. Describe industrial hazards and its risk assessment. 3. Impart Knowledge of accidental prevention techniques to the students. 4. Impart knowledge about occupational health, industrial hygiene. 5.Make students aware about safety auditing and management systems. 6.Discuss pollution prevention techniques.						
Course Outcomes	After completing the course, students will be able to: 1. Realize the basics of Occupational Health Hazards. 2. Introduce about common occupational diseases 3. Introduce the Safe use of machines and tools. 4. Be acquainted with the use of personal protective equipment's (PPE) 5. Recognize principles of accidents prevention. 6. Identify major accident control in industry.						

Unit No.	Course Content	Hours
1	Introduction and Scope Definition of Occupational Health as per WHO/ILO, Occupational Health and Environmental Safety Management – Principles Practices, Common Occupational diseases: Occupational Health Management Services at the work place, Pre-employment, periodic medical examination of workers, medical surveillance for control of occupational diseases and health records.	06
2	Monitoring for Safety, Health and Environment Importance of Industrial safety, role of safety department, Safety committee and function, Role and responsibilities of safety officer, Industrial Hygiene: Definition of Industrial Hygiene, Industrial Hygiene: Control Methods, Substitution, Changing the	06

	process, Local Exhaust Ventilation, Isolation, Wet method, Personal hygiene, housekeeping and maintenance, waste disposal, special control measures.	
3	Safe use of Machines and Tools Ergonomics of machine guarding guards, Guarding of different types of machinery including special precautions for paper, rubber and printing machinery, wood working. Preventive maintenance, periodic checks for safe operation. Associated hazards and their prevention. Working in different areas: Working in confined spaces, Working Underground, Working at heights - use of stairways, clamps, working platforms, ladders of different types, Boatswain's chair and safety harness Working on roofs, Lifting machinery lifts and hoists. Guarding of different types of machinery including special precautions for machine, tools etc. Built-in safety devices, maintenance and repairs of guards, Operation, inspection and maintenance of industrial trucks, loose gears conveyors, Safe working load for mechanical material handling equipments.	06
4	Personal Protective Equipment's (PPE) Need for personal protection equipment, selection, applicable standards, and supply, use, care and maintenance, respiratory and non-respiratory personal protective equipment. Selection of respiratory personal protective devices, Non-respiratory personal protective devices: Head protection, Ear protection. Face and Eye protection. Hand protection, Foot protection, body protection. Working at Heights: Incidence of accidents. Safety features associated with design, construction and use of stairways, ramps, working platforms, gangway.	06
5	Principles of Accidents Prevention Definition: Incident, accident, injury, dangerous occurrences, unsafe acts, unsafe conditions, hazards, error, oversight, mistakes, etc. Accident Prevention : Theories / Models of accident occurrences, Principles of accident prevention, Accident and Financial implications, Hazard identification and analysis, fault tree analysis, Event tree analysis, failure modes and effects analysis, Hazop studies, Job safety analysis – examples, Plant safety inspection - objectives and types check procedure inspection report. Causes of accidents, Types of accidents, accident statistics, Cost of accident, Direct and indirect cost of an accident, accident/ incident reporting, accident Investigation report.	06
6	Plant Design and Housekeeping Plant layout, design and safe distance, Ventilation and heat stress, Significance of ventilation, Natural ventilation, Mechanical ventilation Air conditioning. Safety and good housekeeping, Disposal of scrap and other trade wastes Spillage prevention, Use of colors as an aid of housekeeping, Cleaning methods, Inspection and Checklists.	06

General Instructions: Assignments (CIE- 10 marks) – A minimum 6 assignments will be given on the above course curriculum.	
Text Books	
1	R. K. Jain and Sunil S. Rao , Industrial Safety , Health and Environment Management Systems, Khanna publishers, New Delhi (2006)
2	Krishnan N.V. “Safety Management in Industry” Jaico Publishing House, Bombay, 1997.
3	Frank P Lees - Loss of prevention in Process Industries, Vol. 1 and 2, Butterworth- Heinemann Ltd., London (1991).
Reference Books	
1	Slote. L, Handbook of Occupational Safety and Health, John Willey and Sons, New York.
2	Heinrich H.W. “Industrial Accident Prevention” McGraw-Hill Company, New York, 1980.
3	Grimaldi and Simonds, Safety Management, AITBS Publishers, New Delhi (2001).
4	Blake R.B., “Industrial Safety” Prentice Hall, Inc., New Jersey, 1973
5	The Factories Act with amendments 1987, Govt. of India Publications DGFASLI, Mumbai
6	Slote. L, Handbook of Occupational Safety and Health, John Willey and Sons, New York.
Useful web links	
1	INDUSTRIAL SAFETY ENGINEERING, PROF. JHARESWAR MAITI Department of Industrial & Systems Engineering IIT Kharagpur. https://nptel.ac.in/courses/110105094
2	https://nptel.ac.in/courses/103106071

Year, Program, Semester	Final Year B. Tech (Mechanical Engineering), Semester- VIII					
Course Code	HSMEC 421					
Course Category	Humanities and Social Sciences, Management, Environmental Course					
Course title	SUPPLY CHAIN DIGITIZATION (Through MOOC*)					
Teaching Scheme and Credits	L	T	P	Total Contact Hours		Total Credits
	03	-	-	03		
Evaluation Scheme	ISE		ESE	IE	EE	Total
	30		70	-	-	100
Pre-requisites(if any)	=					
Course Objectives	The course aims to: 1. Analyze the fundamentals of supply chain management and the importance of segmentation in matching supply with demand. 2. Evaluate design and operational strategies, such as postponement and supply portfolios, to enhance organizational agility. 3. Understand the impact of the platform economy and various channel structures (Omni-channel, Dual-channel) on supply chain reach. 4. Apply data analytics—descriptive, predictive, and prescriptive—to solve complex supply chain bottlenecks. 5. Utilize AI/ML frameworks for advanced demand forecasting and network optimization. 6. Assess the role of Industry 4.0 technologies, including Blockchains, Digital Twins, and IoT-based tracking, in building resilient infrastructure.					
Course Outcomes	After completing the course, students will be able to: 1. Design supply chain networks that leverage decentralized and centralized channel structures effectively. 2. Implement postponement strategies to reduce inventory costs and improve service levels. 3. Develop intelligent decision-support tools using AI/ML for real-time demand analytics. 4. Optimize supply chain networks for cost and responsiveness using advanced mathematical modeling. 5. Execute product traceability protocols using modern Information Systems (ERP, WMS, TMS). 6. Construct a roadmap for Industry 4.0 integration, focusing on Digital Control Towers and Blockchain-enabled payments.					

Unit No.	Course Content	Hours
I	Strategic Foundations & Segmentation Fundamentals of Supply Chain Management, Supply Chain Segmentation	6
II	The Digital Business & Platform Economy Supply Chain Design & Operations Strategies (Supply Portfolios, Postponement, etc.), Introduction to Platform Economy, Channel Structures in the Supply Chain	6
III	Supply Chain Analytics Channel Structures in the Supply Chain (Dual Channels, Brick & Mortar, Multi-Channels, Omni Channels), Introduction to Descriptive, Predictive and Prescriptive Analytics	6

IV	Network Optimization & Intelligent Decisions Application of AI/ML in Forecasting & Demand Analytics, Supply Chain Network Optimization	6
V	Digital Infrastructure & Traceability Intelligent Decision Tool Development in Supply Chains, Product Tracking & Traceability, Information Systems (ERP, WMS, TMS, etc.)	6
VI	Industry 4.0 & Emerging Technologies Digital Twins & Control Towers, Industry 4.0, Blockchains and Digital Payments	6

Text/Reference Books	
1.	Supply Chain Management: Strategy, Planning, and Operation, Sunil Chopra and Peter Meindl, Pearson Education
2.	The Digital Supply Chain, Bart L. MacCarthy and Dmitry Ivanov, Elsevier (Academic Press)
3.	Data Science for Supply Chain Forecasting, Nicolas Vandeput, De Gruyter
4.	Digital Supply Networks, Amit Sinha, Bernard Dickman, and Edward Fontanella, McGraw Hill
5.	Logistics and Supply Chain Management, Martin Christopher, Financial Times / Prentice Hall
6.	Introduction to Supply Chain Management Technologies, David Frederick Ross, CRC Press (Taylor & Francis)
Useful web links	
1	Supply Chain Digitization, IIT Bombay Prof. Priyanka Verma Prof. Sushmita Narayana Prof. Debabrata Das
2	Supply Chain Analytics, IIT Roorkee Prof. Rajat Agrawal
3	Operations and Supply Chain Management, IIT Madras Prof. G. Srinivasan

Year, Program, Semester	Final Year B. Tech (Mechanical Engineering), Semester- VIII				
Course Code	HSMEC 421				
Course Category	Humanities and Social Sciences, Management, Environmental Course				
Course title	ENERGY RESOURCES, ECONOMICS AND ENVIRONMENT (Through MOOC*)				
Teaching Scheme and Credits	L	T	P	Total Contact Hours	Total Credits
	03	-	-	03	
Evaluation Scheme	ISE	ESE	IE	EE	Total
	30	70	-	-	100
Pre-requisites(if any)	basic concepts in economics				
Course Objectives	The course aims to: 1. Analyze global and national energy trends using disaggregation by supply and end-use sectors. 2. Evaluate the environmental impact of energy consumption using the Kaya Identity and emission factor calculations. 3. Apply economic evaluation techniques (NPV, IRR, B/C ratio) to determine the viability of energy projects. 4. Model the depletion and transition of finite resources using the McKelvey Diagram and Hubbert's Peak Oil theory. 5. Assess market failures, including externalities and the distinction between public and private goods in the energy sector. 6. Synthesize Life Cycle Analysis (LCA) and Net Energy Analysis to determine the true energy cost of energy.				
Course Outcomes	After completing the course, students will be able to: 1. Construct country-level energy balances to identify energy security and inequality gaps. 2. Perform financial feasibility studies for renewable energy investments considering inflation and discount rates. 3. Predict the duration of fossil fuel reserves based on growth rates and the Hotelling's Rule for non-renewable economics. 4. Quantify the relationship between economic growth and environmental degradation using the Environmental Kuznets Curve. 5. Formulate innovative financing models (Debt/Equity mix) for large-scale energy infrastructure. 6. Evaluate national energy policies based on input-output analysis and primary energy constraints.				

Unit No.	Course Content	Hours
I	Global Energy Flows & Environmental Metrics Energy Flow Diagram, Global Trends in Energy Use, India and World-Disaggregation by supply, end use, Energy and Environment, The Kaya Identity, Emission Factor, Energy and Quality of Life, Energy Inequality, Energy Security, Introduction to Country Energy Balance assignment	

II	Energy Economics & Project Appraisal Energy Economics - Simple Payback Period, Time Value of Money- discount rate, Criteria for Assessing, Energy Projects –(Net Present Value (NPV), Benefit/Cost Ratio (B/C), Inflation, Internal Rate of Return (IRR), Resources & Reserves Growth Rates in Consumption, Estimates of Duration of Fossil Fuels, McKelvey Diagram, Peak oil, Hubbert's model	
III	Resource Dynamics & Depletion Models Materials used in renewable energy (Kuznet's Curve, Betting on the planet, Simon's Change), Non Renewable Energy Economics (Hotelling's Rule), Preferences and Utility, Utility and Social Choice	
IV	Environmental Economics & Social Choice Public and private goods / bads, Demand curves, Externalities, Financing Energy – Debt/ Equity- Sources of funds, innovative financing models	
V	Advanced Energy Analysis (LCA & Net Energy) Input Output Analysis, Primary Energy Analysis, Net Energy Analysis, Examples, Energy Cost of Energy, Life Cycle Analysis of Bioenergy	
VI	Energy Financing & Policy Frameworks Net Energy Examples, Energy Policy, Energy Policy Examples, Practice problems solution	

Text/Reference Books	
1.	Energy Economics: Concepts and Models , Bhattacharyya, Subhes C., Springer
2.	Energy Analysis of 108 Industrial Processes , Harry L. Brown, et al. , Fairmont Press
3.	Energy and the Environment , Robert A. Ristinen and Jack J. Kraushaar , Wiley
Useful web links	
1	ENERGY RESOURCES, ECONOMICS AND ENVIRONMENT, PROF. RANGAN BANERJEE Department of Energy Science and Engineering IIT Delhi

Year, Program, Semester	Final Year B. Tech (Mechanical Engineering), Semester- VII						
Course Code	KS 421						
Course Category	Indian Knowledge System						
Course title	Indian Science, Engineering and Technology (Through MOOC*)						
Teaching Scheme and Credits	L	T	P	Total Contact Hours	Total Credits		
	2	-	-	2	2		
Evaluation Scheme	ISE		ESE		IE	EE	Total
	30		70		50	-	150
Pre-requisites(if any)	Knowledge of Indian culture						
Course Objectives	The course aims to: 1. To introduce students to the foundational principles of Indian traditional knowledge 2. To explore the intersection of traditional practices in agriculture, water harvesting, and medicine 3. To analyze the ancient Indian contributions to core sciences 4. To study the advanced historical techniques in metallurgy, textile manufacturing, and architectural styles. 5. To provide an in-depth understanding of ancient Indian astronomical models, planetary motions, and the mathematical treatises of Aryabhata and Bhaskaracharya. 6. To examine the scientific basis of Ayurveda and Yoga, focusing on the relationship between the human body, mind, and environmental elements (Pancha Maha Bhuta).						
Course Outcomes	After completing the course, students will be able to: 1. Study ancient Indian farming and water-saving methods to find eco-friendly ways to solve today's environmental problems. 2. Use mathematical formulas from ancient Indian scholars (like Aryabhata and Bhaskaracharya) to solve modern math problems. 3. Learn how ancient Indians made strong metals and set up early chemistry labs (Ras-shala) for making medicines and materials. 4. Understand the engineering "tricks" used to build massive temples, rock-cut caves, and historical monuments across different Indian styles. 5. Explain how ancient Indians calculated time, understood gravity (Gurutvakashan), and tracked the movement of planets without modern telescopes. 6. Use the principles of Ayurveda and Yoga to improve mental health and physical well-being in daily life.						

Unit No.	Course Content	Hours
I	Indian Traditional Knowledge; Science and Practices Introduction to the Science and way of doing science and research in India, Ancient Science in Intra & Inter Culture Dialogue & coevolution. Traditional agricultural practices, Traditional water-harvesting practices, Traditional Livestock and veterinary Sciences Traditional Houses & villages, Traditional Forecasting, Traditional Ayurveda & plant based medicine, Traditional writing Technology	5
II	Ancient Indian Science (Physics, Chemistry, Maths) Physics in India: Vaisheshika darshan Atomic theory & law of motion, theory of panchmahabhoota, Brihath Shathaka (divisions of the time, unit of distance), bhaskaracharya (theory of gravity, surya siddhanta & sidhanta shriomani), Chemistry in India Vatsyayana, Nagarjuna, Khanda, Al-Biruni, Vagbhaṭa –building of the ras-shala (laboratory), working arrangements of ras-shala, material and equipment, Yaśodhara Bhaṭṭa-process of distillation, apparatusMathematics in India: Baudhayana's Sulbasutras, Aryabhaṭa, Bhaskaracharya-I, Severus Sebokht, Syria, Brahmagupta, Bhaskaracharya-II, Jyēṣṭhadeva	5
III	Ancient Indian Science (metallurgy, Astronomy, Architecture) Metallurgy in India: Survarṇa(gold) and its different types, prosperities, Rajata(silver), Tamra(copper), Loha(iron), Vanga(tin), Naga / sisa(lead), Pittala(brass) Astronomy in India Vedang Jyotish, aryabhatta siddhanta, Mahabhaskriya, Architecture in India: Nagara (northern style), Vesara (mixed style), and Dravida (southern style), Indian vernacular architecture, Temple style, cave architecture, rock cut architecture, kalinga architecture, chandels architecture, rajput architecture, jain	6
IV	Ancient Indian Science (Textile, Agriculture, Transport) Textile Technology in India: Cotton (natural cellulose fiber), silk, wool (natural protein fibers), bast and leaf fibers, suchhastah, sutradharah (needle and thread – tools for stitching). dyeing, washing spinning and weaving technology, Agriculture in India: krishisuktas, Krishiparashara, Brihatsamhita, Types of crops, Manures, Types of land-devamatruka, nadimatruka, use of animals in warfare, animal husbandry, Animals for medicines. Ancient transport in India	6
V	Ancient Indian Science (Ayurveda & Yoga) Ayurveda for Life, Health and Well-being: Introduction to Ayurveda: understanding Human body and Pancha maha bhuta, the communication between body & mind, health, regimen for wellbeing, introduction to yoga (raja yoga, astang yoga, gyan yoga), understanding of Indian psychological concept, consciousness, tridosha & triguna.	6

Text/Reference Books	
i)	Textbook on IKS by Prof. B Mahadevan, IIM Bengaluru.
ii)	Bhartiya Knowledge Systems by M.C. Bora, Khanna Publishing House.
iii)	Kapur K and Singh A. K (Eds) 2005). Indian Knowledge Systems, Vol. 1. Indian Institute of Advanced Study, Shimla. Tatvabodh of sankaracharya, Central chinmay mission trust, Bombay, 1995.
iv)	Dr. Girish Nath Jha, Dr. Umesh Kumar Singh and Diwakar Mishra, Science 7 and Technology in Ancient Indian Texts, DK Print World limited,
Useful web links	
	Introduction to Ancient Indian Technology, IIT Kanpur Prof. D.P. Mishra https://nptel.ac.in/courses/101104065

Year, Program, Semester	Final Year B. Tech (Mechanical Engineering), Semester- VIII						
Course Code	VEC421						
Course Category	Value Education Course						
Course title	ETHICS IN ENGINEERING PRACTICE (Through MOOC)						
Teaching Scheme and Credits	L	T	P	Total Contact Hours	Total Credits		
	1	-	-	1	1		
Evaluation Scheme	ISE		ESE		IE	EE	Total
	-		-		50	-	50
Pre-requisites(if any)	Engineering as a profession is meant to serve the public by strictly adhering to codes of conduct and placing paramount the health, safety and welfare of public.						
Course Objectives	The course aims to: 1. Develop an understanding of fundamental concepts in ethical reasoning and the nature of professional ethics in engineering practice. 2. Analyse moral problems in engineering using structured frameworks such as ethics-as-design. 3. Understand the professional responsibilities of engineers, including workplace duties, intellectual property rights, and responsibilities in digital and information-driven environments. 4. Recognize and evaluate the ethical obligations of engineers toward society and the environment.						
Course Outcomes	After completing the course, students will be able to: 1. Explain and apply essential ethical reasoning principles to real-life engineering problems and professional scenarios. 2. Evaluate complex moral problems in engineering using the “ethics-as-design” approach and propose ethically justifiable solutions. 3. Demonstrate understanding of engineer responsibilities related to intellectual property, workplace ethics, and digital information management. 4. Assess the environmental and societal impacts of engineering decisions and justify actions aligned with sustainable and responsible engineering practice.						

Unit No.	Course Content	Hours
1	Introduction to Ethical Reasoning and Engineer Ethics	6
2	Professional Practice in Engineering	4
3	Ethics as Design - Doing Justice to Moral Problems	4
4	Central Professional Responsibilities of Engineers	4
5	Computers, Software, and Digital Information	4
6	Rights and Responsibilities Regarding Intellectual Property	4

7	Workplace Rights and Responsibilities	4
8	Responsibility for the Environment	6
General Instructions:		
Text Books		
1	Ethics in Engineering practice and Research (2nd Edition) by Caroline Whitbeck Cambridge	
2	Ethics in Engineering MW Martin and R Schinzinger MC Graw Hill	
3	Engineering Ethics and Environment P a Vesilind and AS Gunn Cambridge	
Reference Books		
1	Charles E. Harris Jr., Michael S. Pritchard, Michael J. Rabins (2018). Engineering Ethics: Concepts and Cases. Cengage Learning, Boston.	
2	Applied Multivariate Statistical Analysis by Dean W. Wichern, Richard A. Johnson, and Richard Johnson	
3	Fleddermann, C.B. (2011). Engineering Ethics. Pearson Education, New Jersey.	
Useful web links		
1	ETHICS IN ENGINEERING PRACTICE PROF. SUSMITA MUKHOPADHYAY Department of Human Resource Management, IIT Kharagpur https://nptel.ac.in/courses/110105097	
2	Business Ethics, IIT Kharagpur Prof. Susmita Mukhopadhyay. https://nptel.ac.in/courses/110105079	

Year, Program, Semester	Final Year B. Tech (Mechanical Engineering), Semester- VIII						
Course Code	PSI 422						
Course Category	Project Seminar Internship						
Course title	Major Project Phase II						
Teaching Scheme and Credits	L	T	P	Total Contact Hours	Total Credits		
	-	-	2	2	1		
Evaluation Scheme	ISE		ESE		IE	EE	Total
	-		-		100	100	200
Pre-requisites(if any)							
Course Objectives	The course aims to: 1. Discuss identification and definition of complex Mechanical engineering problems using literature survey and industry exposure. 2. Explain formulation of project objectives, scope, and methodology based on Mechanical engineering principles. 3. Develop students' capability to plan and manage projects considering time, resources, and risks. 4. Discuss evaluation of technical progress through reviews, seminars, and expert feedback. 5. Explain incorporation of professional ethics, safety, sustainability, and societal considerations in project execution. 6. Communicate effective practices						
Course Outcomes	After completing the course, students will be able to: 1. Develop a technically sound project proposal supported by a literature review. 2. Design a feasible project execution plan considering constraints of time, safety, and resources. 3. Monitor and document project progress using structured reviews and milestones. 4. Evaluate project outcomes with respect to engineering feasibility, sustainability, and ethics. 5. Demonstrate professional conduct, teamwork, and independent responsibility.						

Course Content
Project Phase II Load: A batch of maximum three groups of four students per group, shall work under one Faculty member of department. The group of one student is strictly not allowed. Project Phase II Definition: The project phase II work can be a design project / experimental project and or computer simulation project on Mechanical engineering or any of the topics related with Mechanical engineering stream. The project phase I work is allotted in groups on different topics. The students groups are required to undertake the project phase-I during the seventh semester and the same is continued in the eighth semester (Phase-II). Project Phase-I consists of reviews of the work carried earlier and the submission of preliminary report. Report should highlight scope, objectives, methodology, approach and tools to be used like software and others, outline of project and expected results and outcome along with time frame. The project phase I work is to be extended for project phase II at B. Tech (Mech.) Sem. VIII with same group working under guidance of same Faculty member assigned for project phase I.

Project Phase II Term Work:

The term work under project submitted by students shall include

1. Work Diary: Work Diary maintained by group and countersigned by the guide weekly. The contents of work diary shall reflect the efforts taken by project group for
 - a. Searching suitable project work
 - b. Brief report preferably on journals/research or conference papers/books or literature surveyed to select and bring up the project.
 - c. Day to day activities carried out related to project work for entire semester.
 - d. Synopsis.

The group should submit the synopsis in following format

- i. Title of Project
- ii. Names of Students
- iii. Name of Guide
- iv. Relevance
- v. Present Theory and Practices
- vi. Proposed work
- vii. Expenditure
- viii. References

2. The synopsis shall be signed by the each student in the group, approved by the guide and endorsed by the Head of the Department

3. Presentation: The group has to make a presentation in front of the Faculty members of department at the end of semester.

Project Phase II Report Format:

Project Phase I report should be of 25 to 30 pages (typed on A4 size sheets). For standardization of the project phase I reports the following format should be strictly followed.

1. Page Size: TrimmedA4
2. Top Margin: 1.00Inch
3. Bottom Margin: 1.32Inches
4. Left Margin: 1.5Inches
5. Right Margin: 1.0Inch
6. Para Text: Times New Roman 12 Point. Font
7. Line Spacing: 1.5Lines
8. Page Numbers: Right Aligned at Footer. Font 12 Point. Times New Roman
9. Headings: Times New Roman, 14 Point , Bold Face
10. References: References should have the following format

For Books: "Title of Book", Authors, Publisher, Edition

For Papers: "Title of Paper, Authors, Journal/Conference Details, Year

Important Notes:

- Project group should continue maintaining a diary for project and should write (a) Book referred (b) Company visited (c) Person contacted (d) Computer work done (e) Paper referred (f) Creative thinking.
- The Diary along with Project Phase I Report shall be assessed at the time of oral examination
- One copy of the report should be submitted to Institute/ Department, One copy to Guide and one copy should remain with each student of the project group.

Year, Program, Semester	Final Year B. Tech (Mechanical Engineering), Semester- VIII						
Course Code	PSI 423						
Course Category	Project Seminar Internship						
Course title	MDM based mini Project*						
Teaching Scheme and Credits	L	T	P	Total Contact Hours	Total Credits		
	-	-	-	-	02		
Evaluation Scheme	ISE		ESE		IE	EE	Total
	-		-		50	50	100
Pre-requisites(if any)							
Course Objectives	The course aims to: 1. Enable students to identify and define engineering problems specifically within mechanical systems, manufacturing, or thermal-fluid domains. 2. Develop the ability to plan and execute a mini project using mechanical design principles and scientific research methodologies. 3. Enhance technical problem-solving, analytical thinking, and data-driven decision-making skills. 4. Encourage effective teamwork, leadership, and professional communication through technical presentations and reports. 5. Promote the use of modern engineering tools such as CAD/CAM software, FEA/CFD simulation, and CNC programming in project work. 6. Develop a deep awareness of industrial safety, environmental sustainability, and ethical responsibilities in mechanical engineering practice.						
Course Outcomes	After completing the course, students will be able to: 1. Identify and define a relevant engineering problem within the mechanical engineering. 2. Use engineering knowledge and modern tools (like SolidWorks, ANSYS, or MATLAB) to plan and execute a physical or simulated mini project. 3. Analyze experimental data or simulation results and interpret the mechanical behavior or performance of a system logically. 4. Design or develop a mechanical component, machine assembly, or thermal process to meet specific functional and technical requirements. 5. Demonstrate effective teamwork, clear technical communication, and basic project management skills. 6. Recognize and apply professional ethics, industrial safety standards and environmental considerations in their engineering solutions						

Course Content

MDM Based Mini Project is a dynamic course designed to bridge the gap between classroom learning and real-world application. All the students will engage themselves in a series of tasks and challenge that will enable them to apply theoretical concepts learned in previous courses to solve practical problems. The project work need to be carried out independently covering a range of topics relevant to their field of study, allowing them to explore different facets of the particular discipline and develop versatile skill sets.

Course Assessment Process
This particular evaluation will be the part of 8th Semester of the major structure. The course evaluation for the internals will be at the course teacher end while there will also be the external evaluation of the Project work. The teachers will follow the instructions as below: Evaluation Format: The evaluation may be conducted using a combination of assessment methods, including: • Rubric-based assessment for the project work and its report. • Peer evaluation for project. • Instructor-led discussions or presentations to evaluate communication skills and critical thinking. • Overall course grading based on a weighted average of individual assessments and participation. The evaluation format should be transparent, fair, and aligned with the course objectives and outcomes. Regular feedback and communication with students will ensure that the evaluation process remains supportive of their learning journey.