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(AICTE Model Curriculum Based Scheme)
Bachelor of Technology (B.Tech.) VII Semester (Mechanical Engineering)

w.e.f. July 2023

S.No.	Subject Code	Category Code	Subject Name	Maximum Marks Allotted					Total Marks	Contact Hours Per Week			Total Credits
				Theory			Practical			L	T	P	
				End. Sem.	Mid Sem. Exam.	Quiz/ Assignment	End Sem.	Lab Work					
1	ME71	PEC	Professional Elective Course-III	70	20	10	-	-	100	3	1	-	4
2	ME72	OEC	Open Elective Course-II	70	20	10	-	-	100	3	1	-	4
3	ME73	PCC	Machine Design-II	70	20	10	30	20	150	3	-	2	4
4	ME74	PCC	Vibration & Noise Control	70	20	10	30	20	150	3	-	2	4
5	ME75	PCC	Refrigeration & Air Conditioning	70	20	10	30	20	150	3	-	2	4
6	ME76	MC	Industrial Training Evaluation	-	-	-	60	40	100	-	-	4	2
			Total	**350**	**100**	**50**	**150**	**100**	**750**	**15**	2	**10**	**22**
7	ME77	DLC	Self-Learning Presentation (SWAYAM/NPTEL/MOOC)	-	-	-	-	-	-	-	-	-	8
8	ME78	MC	NSS/NCC/Swatchhata Abhiyan/Rural Outreach	Qualifier									
Additional Course for Honours or Minor Specialization				Permitted to opt for maximum 8 credits against additional MOOC courses in subject code ME77 for the award of Honours (Minor Specialization).									

Note: 01. Departmental BOS will decide list of three/four elective subjects for each PEC and OEC.
02. MOOC/NPTEL subjects shall be taken with permission of HOD/Coordinator
03. Industrial training presentation & viva shall take place in VII Sem. which students have already done in VI Sem.

Professional Elective Course-III		
S.No.	**Subject Code**	**Subject Name**
1	ME71A	Operation Research & Supply Chain
2	ME71B	Automobile Engineeirng
3	ME71C	Gas Dynamics and Jet Propulsion

Open Elective Course-II		
S.No.	**Subject Code**	**Subject Name**
1	ME72A	Renewable Energy Systems
2	ME72B	Product Design
3	ME72C	Artificial Intelligence

1 hour lecture (L) = 1 credit | 1 hour Tutorial (T) = 1 credit | 2 hour Practical (P) = 1 credit

PEC: Professional Elective Course, OEC: Open Elective Course, PCC: Professional Core Course, DLC: Distance Learning Course, MC: Mandatory Course

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Subject Code	Subject name	Maximum Marks Allotted					Total Marks	Hours/Week			Total Credits
		Theory			Practical						
		End Sem	Mid-sem Exam	Quiz/ Assignment	End sem	Lab Work		L	T	P	
ME71A	Operation Research & Supply Chain	70	20	10	-	-	100	3	1	-	4

Course Objective:

The student will be made to learn.

1. To be familiar with all the OR Techniques and optimization methods.
2. To understand the role of logistics in the supply chain within a focal firm as well as between organisations linked within a given supply chain network.
3. To be familiar with various inventory control techniques.
4. Students will get a clear idea of the decision making and meta-heuristic algorithm.

Course Content:

Module-I

Linear system and distribution models: Mathematical formulation of linear systems by LP, solution of LP for two variables, Simplex method, special cases of LP- transportation and assignment model and their graphical solution, Vogels Approximation Method (VAM) or penalty method, cell evaluation degeneracy, basics Of SW Lindo, Tora, Excel.

Module-II

Supply chain (SCM): Definition, importance, expenditure and opportunities in SCM; integration of inbound, outbound logistics and manufacturing to SCM, flow of material money and information, difficulties in SCM due to local v/s system wide (global) optimization and uncertainties in demand and transportation; Bull-whip effect; customer value; IT, info-sharing and strategic partnerships; plant and warehouse-network configuration; supply contracts and revenue sharing; outsourcing; transportation, cross docking and distribution, forecasting models in SCM; coordination and leadership issues; change of purchasing role and vendor rating, variability from multiple suppliers.

Module-III

Inventory models: Necessity of inventory in process and safety stock, problem of excess inventory and cycle time, JIT/ Lean Mfg.; basics of inventory models with deterministic demand, Classical EOQ Model, ABC, VED and other analysis based on shelf life, movement, size, MRP technique and calculations, lot sizing in MRP, linking MRP with JIT; evolution of MRP to ERP to SCM and e-business.

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Module-IV

(a) Waiting Line Models: Introduction, Input process, service mechanism, Queue discipline, single server (WW1), average length and average time calculations, optimum service rate; basic multiple server models (MIM/s)

(b) Competitive strategy: concept and terminology, assumptions, pure and mixed strategies, two-person zero sum games, saddle point, dominance, graphical, algebraic and LP methods for solving game theory problems.

Module-V:

(a) Network Analysis: Project Planning, Scheduling and Controlling; Project management; Network Techniques and its role in project management, Network logics, Fulkerson's Law, Merits and Demerits of AON Diagrams; Programme Evaluation and Review Technique (PERT), Critical Path Method (CPM), Determination of critical path, Float/Slack.

(b) Meta-heuristics: Definition of heuristic and meta-heuristic algorithms; introduction to Tabu search, Simulated Annealing and Genetic algorithms and solution of travelling salesman, non- linear optimization problems.

Evaluation:

Evaluation will be continuous and integral part of the class as well as through external assessment.

References:

1. Hillier FS and Liberman GJ; Introduction to Operations Research concept and cases; TMH
2. Simchi-Levi, Kerninsky; Designing and managing the supply chain; TMH.
3. Srinivasan G; Quantitative Models In Operations and SCM; PHI Learning
4. 4, Mohanty RP and Deshmukh SG; Supply Chain Management; Wiley India
5. Taha H; Operations research; PHI
6. Sen RP; Operations Research-Algorithms and Applications; PHI Learning
7. Sharma JR; Operations Research; Macmillan
8. Ravindran, Philips and Solberg; Operations research; Wiley India
9. Vollman, Berry et al; Manufacturing planning and control for SCM; TMH.
10. Bowersox DJ, Closs DJ, Cooper MB; Supply Chain LogistiMgt; TMH
11. Burt ON, Dobler DW, StarlingSL; World Class SCM; TMH
12. Bronson R;Theory and problems of OR; Schaum Series; TMH
13. George Hadley; Linear programming; Addison Wesley

Course Out Comes:

Upon successful completion of this Course the Student will be able to:

CO1	Formulate linear programming problems.
CO2	Elaborate optimum solution of transportation problems and forecasting in supply chain.
CO3	Determine average queue length and waiting time of queuing models
CO4	Estimate optimum inventory and cost in inventory models.

Mapping of the course outcomes (COs) with program outcomes (Pos):

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	1								

CO2	1		3									
CO3	1	1		1								1
CO4	2	1	1									

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Subject Code	Subject name	Maximum Marks Allotted					Total Marks	Hours/Week			Total Credits
		Theory			Practical						
		End Sem	Mid-sem Exam	Quiz/ Assignment	End sem	Lab Work		L	T	P	
ME71B	Automobile Engineering	70	20	10	-	-	100	3	1	-	4

Course Objective:

The students will be made to learn.

1. The anatomy of the automobile in general.
2. The location and importance of each part of automobile.
3. The functioning of the engine and its accessories, gear box, clutch, brakes, steering, axles and wheels, suspension, frame, springs and other connections.
4. The effect of automobile emissions on environment and how to control pollution.

Course Contents:

Module-I: Chassis & Body Engineering:

Types, Technical details of commercial vehicles, types of chassis, layout, types of frames, testing of frames for bending & torsion on unutilized body frame, vehicle body and their construction, driver's visibility and methods for improvement, safety aspects of vehicles, vehicle aerodynamics, optimization of body shape, driver's cab design, body materials, location of engine, front wheel and rear wheel drive, four wheel drive.

Module-II: Steering System:

Front axle beam, stub axle, front wheel assembly, Wheel Alignment, principles of types of wheel alignment, front wheel geometry viz. camber, Kingpin inclination, castor, toe-in and toe-out, condition for true rolling motion, centre point steering, directional stability of vehicles, steering gear, power steering, slip angle, cornering power, over steer & under steer, gyroscopic effect on steering gears.

Module-III: Transmission System:

Function and types of clutches, single plate, multi-plate clutch, roller &spring clutch, clutch lining and bonding, double declutching, types of gear boxes, synchronizer, gear materials, determination of gear ratio for vehicles, gear box performance at different vehicle speed, automatic transmission, torque converters, fluid coupling, principle of hydrostatic drive, propeller shaft, constant velocity universal joints, differential gear box, rear axle construction, Introduction to Electric and Hybrid Power train.

Module-IV: Suspension system:

Basic suspension movements, Dependent and Independent Suspension, Independent front & rear suspension, shock absorber, type of springs: leaf spring. coil spring, air spring, torsion bar, location of shackles, power calculations, resistance to vehicle motion during acceleration and breaking, power & torque curve, torque &

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mechanical efficiency at different vehicle speeds, weight transfer, braking systems, dise theory, mechanical, hydraulic & pneumatic power brake systems, performance, self-energization, air-bleeding of hydraulic brakes, types of wheels and tyres, tyre specifications, construction and material properties of tyres & tubes.

Module-V: Electrical and Control Systems:

Storage battery, construction and operation of lead acid battery, testing of battery, principle of operation of starting mechanism, different drive systems, starter relay switch, regulator electric fuel gauge, fuel pump, horn, wiper, lighting system, head light dazzling, signaling devices, battery operated vehicles, choppers, importance of maintenance, scheduled and unscheduled maintenance, wheel alignment, trouble Shooting probable causes & remedies of various systems, microprocessor based control system for automobile, intelligent automobile control systems. Emission standards and pollution control: Indian standards for automotive vehicles-Bharat I, II, III, IV, Euro I to Euro VI norms, fuel. Quality standards, environmental management systems for automotive vehicles, catalytic converters, fuel additives, and modern trends in automotive engine efficiency and emission control.

References:

1. Crouse, Automotive Mechanics TMH
2. Srinivasan S; Automotive Engines TMH
3. Gupta H N; Internal Combustion Engines; PHI
4. Joseph Heitner; Automotive Mechanics, Principles and Practices, CBS Publication
5. Kripal Singh; Automotive Engineering, Khanna Publication
6. Newton and Steeds, Automotive Engineering
7. Emission standards from BIS and Euro-I to Euro-VI

Course Outcomes:

At the completion of this course, students should be able to

CO1	Enlist the major parts of an Automobile.
C02	Analyze the steering, transmission, suspension, electrical and control systems of an Automobile.
C03	Explain the environmental implications of automobile emissions.

Mapping of the course outcomes (COs) with program outcomes (POs):

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1										
CO2	2	2	1									
CO3	2		1				1					

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Subject Code	Subject name	Maximum Marks Allotted					Total Marks	Hours/Week			Total Credits
		Theory			Practical						
		End Sem	Mid-sem Exam	Quiz/ Assignment	End sem	Lab Work		L	T	P	
ME71C	Gas Dynamics and Jet Propulsions	70	20	10	-	-	100	3	1	-	4

Course Objective:

1. Understanding the gas dynamics and of turbo engine fundamentals.
2. Understanding the diffusers and nozzles
3. Understanding the basic principle of jet propulsion and thermodynamic cycles.

Course Content:

Module-I:

Gas Dynamics of Passive Components of Turbo Engines: Fundamentals Of gas dynamics, Energy equation for a non-flow process - Energy equation for a flow process - The adiabatic energy equation - Momentum Equation - Moment of Momentum equation - Stagnation Velocity Of Sound - Stagnation Pressure - Stagnation Density - Stagnation State - Velocity of sound - Critical states — Mach number - Critical Mach number - Various regions of flow.

Module-II:

Analysis of Diffusers and Nozzles: Introduction - Study of Intakes for Subsonic and supersonic engines - Comparison of isentropic and adiabatic processes —Mach number variation - Area ratio as function of Mach numbers - Impulse function - Mass flow rates - Flow through nozzles - Flow through diffusers - Effect of friction - Analysis of intakes for engines - intakes with normal shock — oblique shocks - Study of special nozzles and diffusers.

Module-III:

Study of Compressors: Design and Analysis of compressors - Classification - analysis of centrifugal compressors - velocity triangles -design of impellers and diffusers - analysis of axial flow compressor - analysis of stage - characterization of stage - design of multistage axial flow compressor — Performances analysis of centrifugal and axial flow compressors.

Gas Dynamics of Combustors: Stoichiometry of combustion - calculation air-fuel ratio — gas dynamics of combustors.

Module-IV:

Propulsion Aircraft Propulsion - introduction - Early aircraft engines - Types of aircraft engines - Reciprocating internal combustion engines - Gas turbine engines - Turbo jet engine - Turbo fan engine -

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Turbo- prop engine.Aircraft propulsion theory: thrust, thrust power, propulsive and overall efficiencies - Problems.

Module-V:

Thermodynamic Analysis of Ideal Propulsion Cycles Thermodynamic analysis of turbojet engine - Study of subsonic and engine models - Identification and Selection of optimal parameters. Need for further development - Analysis of Turbojet with after burner. Thermodynamic analysis of turbofan engine - Study of subsonic and supersonic systems - Identification and selection of optimal operational parameters. Design of fuel efficient engines - Mixed flow turbo fan engine - Analysis of Turbofan with after burner. Thermodynamic analysis of turbo-prop engine — Identification and selection of optimal operational parameters.

Evaluation:
Evaluation will be continuous and integral part of the class as well as through external assessment.

References:

1. Nag PK; Power plant Engineering; TMH
2. Thermodynamics by Gordon J. Van Wylen
3. P .K.Nag; Basic and applied Thermodynamics; TMH
4. G anesan; Gas turbines; TMH
5. Heat Engines by V.P. Vasandani& D. S. Kumar
6. R. Yadav Steam and Gas Turbines
7. R. Yadav Thermal Engg.
8. Kadambi & Manohar; an Introduction to Energy Conversion — Vol II. Energy conversion cycles

Course Outcomes:
At the completion of this course, students should be able to

CO1	Explain steam generation and its utilization to thermal power plant.
CO2	Illustrate air compressors and phase change cycles.
CO3	Apply the basic knowledge of thermodynamics to gas dynamics and steam nozzles.
CO4	Analyze heat exchanger and effects of its different parameters.

Mapping of the course outcomes (COs) with program outcomes (Pos):

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2										
CO2	1	2	3									
CO3	1	2	3									
CO4	1	2	3									

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		Theory			Practical						
		End Sem	Mid-sem Exam	Quiz/ Assignment	End sem	Lab Work		L	T	P	
ME72A	Renewable Energy Systems	70	20	10	-	-	100	3	1	-	4

Course Objective:

1. Understanding the solar thermal conversion techniques and photovoltaic conversion of solar energy.
2. Understanding the wind energy conversion systems and wind characteristics curves.
3. Understanding the Biomass conversion systems: biochemical, chemical and thermo chemical
4. Understanding the Principle of ocean, Geothermal, Hydrogen energy conversion system and Fuel cells.

Course Content:

Module-I: SOLAR ENERGY CONVERSION SYSTEMS

Solar Radiation: Introduction to solar energy, Extra-terrestrial and terrestrial, solar constant, radiation measuring instruments. Solar collector, Types of solar collector. Working principle of flat plate solar collector and concentrating solar collector. Modifications in solar collector. Construction and working principle of solar water heater, solar dryer, solar still, Solar cooling and solar refrigeration. Solar photovoltaic: Principle of photovoltaic conversion system, Construction of PV Cell, Module, Penal, Array, Applications of PVC system.

Module-II: WIND ENERGY CONVERSION SYSTEMS

Metrology of wind: wind and its potential, wind speed distribution, windspeed statistics. Weibull, Rayleigh and Normal distribution of wind. Measurement of wind data, Principle of wind energy conversion system; Classification of WECS, advantages and disadvantages of wind energy conversion system. Discuss the design parameters of wind mill. Characteristics Curves of wind turbine, Application Of wind energy.

Module-III: BIOMASS CONVERSION SYSTEMS

Biomass and its production, Classifications of biomass and its potential, physicochemical characteristics of biomass, Biomass conversion techniques: anaerobic digestion, fermentation, chemical reduction, etc. Biogas production mechanism, Types of digesters, biogas plant parameters, manure-utilization and manure values. Thermal gasification of biomass. Biomass Gasification: working principle and its types, Construction and working principle of gasification.

Module-IV: HYDRO POWERCONVERSION SYSTEMS:

Overview of micro, mini and small hydro-power system, potential Of hydropower system, Site selection criteria of hydro power systems, working principle of hydro power conversion system, advantages and limitations of hydro-power system. Ocean thermal Energy. Principle of ocean thermal energy conversion

system, Ocean wave energy and ocean wave energy conversion system. Tidal energy and its conversion system.

Module-V: GEOTHERMAL, HYDROGEN & FUEL CELLS ENERGY:

Origin of geothermal resources, Type of geothermal energy deposits, advantages and disadvantages of geothermal energy system.

Hydrogen energy: Hydrogen production methods, storage, transportation& utilization.

Fuel Cells: Principle of operation of a fuel cell, classifications, advantages and disadvantages of fuel cell.

Evaluation:

Evaluation will be continuous and integral part of the class as well as through external assessment.

References:

1. Kothari, Singal&Rajan; Renewable Energy Sources and Emerging Technologies, PHI Leam
2. Khan, B H, Non Conventional Energy, TMH.
3. Sukhatme S.P. and Nayak, Solar Energy, Principles of Thermal Collection and Storage, TMH.
4. Tiwari and Ghosal, Renewable Energy Resources: basic principle & application, NarosaPubl
5. Koteswara Rao, Energy Resources, Conventional & Non-Conventional, BSP Publication.
6. Chetan Singh Solanki, Solar Photovoltaics: Fundamental, technologies and Application, PHI L
7. AbbasiTanseem and Abbasi SA; Renewable Energy Sources; PHI Leaming
8. Ravindranath NH and Hall DO, Biomass, Energy and Environment, Oxford University Press.
9. Duffie and Beckman, Solar Engineering of Thermal Process, Wiley
10. Nikolai, Khartchenko; Green Power; Tech Book Intemational
11. Tester, Sustainable Energy-Choosing Among Options, PHI Leaming.
12. Godfrey Boyle, Renewable Energy: Power for a sustainable future, Oxford OUP.

Course Outcomes:

At the completion of this course, students should be able to

CO1	Able to develop the concept of energy conversion systems.
CO2	Develop the models of energy conversion systems..
CO3	Estimation of the energy potential at the site.
CO4	Modify & the energy conversion systems for better performance

Mapping of the course outcomes (COs) with program outcomes (Pos):

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	3	1								
CO2	1	2	2									
CO3	1	2	2									
CO4	1	1	1									

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		Theory			Practical						
		End Sem	Mid-sem Exam	Quiz/ Assignment	End sem	Lab Work		L	T	P	
ME72B	Product Design	70	20	10	-	-	100	3	1	-	4

Course objective:

1. Confidence in your own abilities to create a new product.
2. Awareness Of the role of multiple functions in creating a new product (e.g. marketing, finance, industrial design, engineering, production).
3. Ability to coordinate multiple, interdisciplinary tasks in order to achieve a common objective.

Course Content:

Module-I

Basic concepts of engineering products' drawings. Software's applications for preparation of drawings, designs and animations.

Module-Il

Creativity, Concept generation — Intuitive / Rational and as per customers choice amongst alternatives. Needs and wants. Products' specifications and product architecture.

Module-Ill

A brief review of engineering materials and their properties. Concepts of tribology — Friction, Wear and Lubrication

Module-IV

Basic concepts of limits, fits and tolerances in individual components and assemblies. A brief review of process planning, Jigs, Fixtures, manufacturing methods and shop floor practices. Review of drawings and design from industrial and manufacturing aspects. A brief review of quality assessment and control

Module- V

Basic concepts of ergonomics and related proportions. Value Engineering and Value analysis, cost analysis, market impact and feedback data from market to designer. The product life cycle. Intellectual property rights/ Patent procedures and governments' support for export/import substitutions.

References:

1. K. T. Ulrich and S.D.Eppinger," Product design and development".
2. G.E.Dieter, Engineering Design.
3. Product design — Otto, Wood,

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Course Outcomes:

At the completion of this course, students should be able to

CO1	Create 2D & 3D drawing with the help of CAD software.
CO2	Elaborate a set of tools and methods for product design and development.
CO3	Discuss the role of multiple functions in creating a new product (e.g. marketing, finance, industrial design, ergonomics, and production).

Mapping of the course outcomes (COs) with program outcomes (Pos):

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	3	1								
CO2	1	2	2									
CO3	1	2	2									

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		Theory			Practical						
		End Sem	Mid-sem Exam	Quiz/ Assignment	End sem	Lab Work		L	T	P	
ME72C	Artificial Intelligence	70	20	10	-	-	100	3	1	-	4

Course Objective:

1. Understanding the artificial intelligence techniques.
2. Understanding the State space search.
3. Understanding the knowledge of Representation Predicate Logic.

Course Content:

Module-I

Scope of Al Games theorem, natural language processing, vision and speech processing, robotics, expert systems, Al techniques- search knowledge, abstraction.

Module-II

Problem solving State space search; Production systems, search space control: depth first, breadth-first search, heuristic search - hill climbing, best-first search, branch and bound. Problem Reduction, Constraint Satisfaction End, Means-End Analysis

Module-III

Knowledge Representation Predicate Logic: unification, modus pones, resolution, dependency directed backtracking. Rule based Systems: forward reasoning, conflict resolution, backward reasoning, use of no backtracks. Structured Knowledge Representation: semantic net slots, exceptions and default frames, conceptual dependency, scripts.

Module-IV

Handling uncertainty and learning: Non-monotonic reasoning, probabilistic reasoning, use of certainty factors, fuzzy logic, Concept of learning, learning automation, genetic algorithm, learning by inductions, neural network.

Module-V

Robotics: Robot Classification, Robot Specification, notation Direct and Inverse Kinematics: Co-ordinates Frames, Rotations, and Homogeneous Coordinates.

Reference Text books-

1. E. Rich and K. Knight, "Artificial intelligence", MH, 2nd ed., 1992.
2. N.J. Nilsson, "Principles of Al", Narosa Publ. House, 2000.
3. Robin R Murphy, Introduction to Al Robotics PHI Publication, 2000
4. D. W. Patterson, "Introduction to Al and Expert Systems", PHI, 1992.

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5. R. J. Schalkoff, "Artificial Intelligence - an Engineering Approach", McGraw Hill Int. Ed., Singapore, 1992.
6. George Lugar, .Al-Structures and Strategies for and Strategies for Complex Problem solving, 4/e, 2002 Pearson Educations.

Course Outcomes:

At the completion of this course, students should be able to

CO1	Al Games theorem,
C02	Problem solving State space search.
C03	Handling uncertainty and learning and Robotics.

Mapping of the course outcomes (COs) with program outcomes (POs):

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	2									
CO2	1	2	1	1								
CO3	1	2	3	3	3	1						

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Subject Code	Subject name	Maximum Marks Allotted					Total Marks	Hours/Week			Total Credits
		Theory			Practical						
		End Sem	Mid-sem Exam	Quiz/ Assignment	End sem	Lab Work		L	T	P	
ME73	Machine Design -II	70	20	10	30	20	150	3	-	2	4

Course Objective

1. Understand the design concepts of belt, rope and chain drives.
2. Able to design different types of gears.
3. Able to design I.C. Engine components, different types of couplings and power screw.

Course Contents:

Module-I: **Design of Belt, Rope and Chain Drives:**

Methods of power transmission, design of flat belt drive and V-belt drive; Design of chain drives, roller chain and its selection; Design of rope drives.

Module-II: **Spur and Helical Gears:**

Force analysis of gear tooth, AGMA Bending stress equation and AGMA Contact stress equation, modes of failure, beam strength, Lewis equation, form factor, formative gear and virtual number of teeth; Gear materials; Surface strength and wear of teeth; strength against wear, Design of straight tooth spur gear and Helical Gears.

Module-III: **Bevel Gears:**

Application of bevel gear, formative gear and virtual number of teeth; Force analysis; Lewis equation for bevel gears; Strength against wear; Design of bevel gear.

Module-IV: **Design of I.C. Engine Components:**

General design considerations in IC engines; design of cylinder; design of piston and piston-rings; design of connecting rod; design of crankshaft.

Module-V: **Design of Miscellaneous Components:**

Design of Flanged coupling; Rigid coupling and Flexible coupling, Design of Pressure vessels subjected to internal pressure, Design of power screw.

References:

1. Shigley J.E.; Machine Design; TMH

2. BhandariVB; Design of Machine Elments; TMH

3. Sharma CS and Purohit K; Design of Machine Elements; PHI Learning.

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4. Hall and Somani; Machine Design; Schaum Series; TMH

5. Wentzell TH; Machine Design; Cegage Learning

6. Sharma & Agrawal; Machine Design; Katson

7. Kulkarni SG; Machine Design; TMH

8. Abdul Mubeen; Machine Design; Khanna Publishers

9. Juvinall RC, Marshek KM; Fundamentals of Machine Component Design; Wiley

10. Norton R; Design Of Machinery; TMH

11. P.C.Gope- Machine Design

Note: PSG Design data book and/or Mahadevan and Reddy's Mechanical design data book are to be provided/ permitted in exam hall (duly verified by authority)

Course Outcomes:

At the completion of this course, students should be able to

CO1	Analyze belt, rope and chain drives.
C02	Select different types of transmission elements.
C03	Examine I.C. Engine components (cylinder, piston, piston rings, connecting rod and crank shaft)

Mapping of the course outcomes (COs) with program outcomes (POs):

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	2									
CO2	1	2	1	1								
CO3	1	2	3	3	3	1						

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Machine Design –II Lab

List of Experiments: (Can be modified/expanded further)

1. Design of belt, rope and chain drives.
2. Design of spur and helical gear.
3. Design of bevel gears.
4. Design of I. C. Engine components.
5. Design of miscellaneous components.

Course Outcomes:

At the completion of this course, students should be able to

CO1	Design the various different machine components.
C02	Select the various machine components for desired output.

Mapping of the course outcomes (COs) with program outcomes (POs):

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	2									
CO2	1	2	1	1								

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COURSE CONTENTS **w.e.f. July 2023**

Subject Code	Subject name	Maximum Marks Allotted					Total Marks	Hours/Week			Total Credits
		Theory			Practical						
		End Sem	Mid-sem Exam	Quiz/ Assignment	End sem	Lab Work		L	T	P	
ME74	Vibration & Noise Control	70	20	10	30	20	150	3	-	2	4

Course Objective

1. Learn the basic concepts and principles of vibration in mechanical systems.
2. Learn the fundamental damped free and undamped free vibration.
3. Learn the basic principle of noise engineering.

Course Contents:

Module-I:

Fundamental Aspects of Vibrations: Vibration, main causes, advantages and disadvantages; engineering applications of vibration and noise; vector method of representing harmonic motion; characteristics of vibration, harmonic analysis and beats phenomenon, work done by harmonic forces on harmonic motion; periodic, non-harmonic functions- Fourier series analysis; evaluation of coefficients of Fourier series;
Elements of vibratory system: Lumped and distributed parameter systems.

Undamped free Vibrations: Derivation of differential equation of motion: the energy method, the method based on Newton's second law of motion, and Rayleigh's method. Solution of differential equation of motion: Natural frequency of vibration. Systems involving angular oscillations: the compound pendulum.

Module-II:

Damped Free Vibrations: Viscous damping: coefficient of damping; damping ratio; under damped, over damped and critically damped systems; logarithmic decrement; frequency of damped free vibration; Coulomb or dry friction damping; frequency, decay rate and comparison of viscous and Coulomb damping; solid and structural damping; slip or interfacial damping.

Module-III:

Harmonically excited Vibration: One degree of freedom- forced harmonic vibration; vector representation of forces; excitation due to rotating and reciprocating unbalance; vibration Isolation, force and motion transmissibility; absolute and relative motion of mass (Seismic Instruments). Whirling Motion and Critical Speed: Whirling motion and Critical speed: Definitions and significance. Critical —speed of a vertical, light —flexible shaft with single rotor: with and without damping. Critical Speed of a shaft carrying multiple discs (without damping), Secondary critical speed.

Module-IV:

Systems with Two Degrees of Freedom: Un-damped free vibration of 2 d.o.f and principal modes of vibration; torsion vibrations; Forced, Un-damped vibrations with harmonic excitation; Coordinate coupling; Dynamic vibration absorber; torsion Vibration Absorber; Pendulum type of dynamic vibration.

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Module-V:

Noise Engineering —Subjective response of sound: Frequency and sound dependent human response; the decibel scale; relationship between, sound pressure level (SPL), sound power level and sound intensity scale; relationship between addition, subtraction and averaging, sound spectra and Octave band analysis; loudness; weighting networks; equivalent sound level, auditory effects of noise; hazardous noise, exposure due to machines and equipment's; hearing conservation and damage risk criteria, daily noise doze.

Noise Sources, Isolation and Control: Major sources of noise on road and in industries, noise due to construction equipment's and domestic appliances, industrial noise control, strategies- noise control at source (with or without sound enclosures), noise control along the path (with or without partitions and acoustic barriers); noise control at the receiver, ear defenders, earplugs, semi-insert protectors.

Evaluation:

Evaluation will be continuous and integral part of the class as well as through external assessment.

References:

1. Ambekar A.G., 'Mechanical Vibrations and Noise Engineering' , PHI.
2. Meirovitch Leonard,'Element of Vibration Analysis', TMH.
3. Dukikipati R V, Srinivas J,'Text book of Mechanical Vibrations' , PHI.
4. Kelly SG and kudari SK,'Mechanical Vibrations' ,Schaum Series, TMH.
5. Thomson , W.T., 'Theory of Vibration with Applications', C.B.S Pub & distributors .
6. Singiresu Rao, 'Mechanical Vibrations', Pearson Education.
7. G.K. Grover, 'Mechanical Vibration', Nem chand and Bross , Roorkee.

Course Outcomes:

At the completion of this course, students should be able to-

CO1	Analyze Undamped and Damped free vibration systems.
CO2	Evaluate the two Degrees of Freedom.
CO3	Explain Whirling motion and critical speed in Harmonically excited Vibration.
CO4	Evaluate sound pressure level (SPL), sound power level and sound intensity.

Mapping of the course outcomes (COs) with program outcomes (Pos):

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	1	1								
CO2	1	1	2									
CO3	1	1	2									
CO4	1	1	2		1							

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Vibration & Noise Control Lab

List of Experiments: (Can be modified/expanded further)

1. To find out effect of load on natural frequency of vibrations of a lever pin supported at one end carrying adjustable load on a vertical screwed bar and spring supported at some intermediate point (i) When the dead weight of rods is neglected and (ii) when their dead weight is taken into account .
2. To find out frequency of damped free vibration and rate of decay of vibration-amplitude in the system.
3. To find out natural frequency and damped free frequency of a torsion pendulum and, hence to find out coefficient of damping of the oil;
4. To observe the phenomenon of 'whirl' in a horizontal light shaft and to determine the critical speed of the shaft.
5. To observe the mode shapes of a spring-connected, double pendulum and hence to demonstrate the phenomenon of beats.
6. To demonstrate the principle of tuned Undamped Dynamic Vibration Absorber and to determine the effect of mass-ratio (of main and auxiliary mass) on the spread of the resulting natural frequencies;
7. To take measurements of sound Pressure Level (SPL) and to carry out octave band analysis of a machine using Noise Level Meter.

Evaluation:

Evaluation will be continuous and integral part of the class followed by the final practical examination as well as through external assessment

Course Outcomes:
At the completion of this course, students should be able to-

CO1	Analyze Undamped and Damped free vibration
CO2	Evaluate the two Degrees of Freedom
CO3	Explain whirling motion and critical speed in Harmonically excited Vibration.
CO4	Evaluate sound pressure level (SPL), sound power level and sound intensity

Mapping of the course outcomes (COs) with program outcomes (Pos):

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	1	1								
CO2	1	1	2									
CO3	1	1	2									
CO4	1	1	2		1							

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Bachelor of Technology (B.Tech.) VII Semester (Mechanical Engineering)

COURSE CONTENTS **w.e.f. July 2023**

Subject Code	Subject name	Maximum Marks Allotted					Total Marks	Hours/Week			Total Credits
		Theory			Practical						
		End Sem	Mid-sem Exam	Quiz/ Assignment	End sem	Lab Work		L	T	P	
ME75	Refrigeration & Air Conditioning	70	20	10	30	20	150	3	-	2	4

Course: Objective

1. Learn the basic concepts and principles of refrigeration and air conditioning.
2. Learn the fundamental analysis methodology of refrigeration.
3. Learn the basic process and systems of air conditioning.
4. Will apply the course knowledge to do a design project of HV AC system.

Course Contents:

Module-I

Introduction: Principles and methods of refrigeration freezing; mixture cooling by gas reversible expansion, throttling, Joule Thomson effect and reverse Carnot cycle; unit of refrigeration, coefficient of vortex tube & thermoelectric refrigeration, adiabatic demagnetization; air refrigeration cycles- Joule's cycle Boot-strap cycle, reduced ambient cycle and regenerative cooling cycles.

Module-II

Vapour compression system: Vapor compression cycle, p-h and t-s diagrams, deviations from theoretical cycle, sub-cooling and super heating, effects of condenser and evaporator pressure on cop; multi-pressure system: removal of flash gas, multiple expansion & compression with flash inter cooling; low temperature refrigeration: production of low temperatures, cascade system, dry ice, production of dry ice, air liquefaction system,,

Module-III

(a) **Vapour absorption system:** Theoretical and practical systems such as aqua-ammonia, Electrolux & other systems;

(b) **Steam jet refrigeration:** Principles and working, simple cycle of operation, description and working of simple system,

(c) **Refrigerants:** nomenclature & classification, desirable properties, common refrigeration, comparative study, leak detection methods, environment friendly refrigerants and refrigerant mixtures, brine and its properties

Module-IV

Psychometric: Calculation of psychrometric properties of air by table and charts; psychrometric processes: sensible heating and cooling, evaporative cooling, cooling and dehumidification, heating and humidification, mixing of air stream, sensible heat factor; principle of air conditioning, requirements of comfort air

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conditioning, ventilation standards, infiltrated air load, fresh air load human comfort, effective temperature & chart, heat production & regulation of human body,

Module-V

Air conditioning: Calculation of summer & winter air conditioning load, bypass factor of coil, calculation of supply air rate & its condition, sensible heat factor, grand sensible heat factor, effective sensible heat factor, dehumidified air quantity. Problems on cooling load calculation. Air distribution and ventilation systems Evaluation: Evaluation will be continuous and integral part of the class as well as through external assessment.

References:

I. Arora CP: Refrigeration and Air Conditioning; TMH
2. Sapali SN; Refrigeration and Air Conditioning; PHI.
3. Anantha Narayan; Basic Refrigeration and Air conditioning; TMH
4. Manohar Prasad; Refrigeration and Air Conditioning; New Age Pub
5. Ameen; Refrigeration and Air Conditioning; PHI
6. pita; Air conditioning Principles and systems: an energy approach; PHI
7. Stoecker W.F, Jones J; Refrigeration and Air conditioning; McGH, Singapore
8. Jordan RC and Priester GB Refrigeration and Air Conditioning, PHI USA

Course Outcomes:

At the completion of this course, students should be able to

CO1	Explain the principle les and methods of refrigeration.
CO2	Evaluation of VCRS and vapour absorption systems and applications.
CO3	Analyze psychrometric properties and processes.
CO4	Elaborate the heating and cooling load for a given AC system.

Mapping of the course outcomes (COs) with program outcomes (Pos):

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1		2									
CO2	1	3	1									
CO3	1	2	2									
CO4	1	2	1	2								

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Refrigeration & Air Conditioning Lab

List of Experiments: (Can be modified/expanded further)

1. General Study of vapor compression refrigeration system.
2. General Study of Ice Plant
3. General Study and working of cold storage
4. General Study Trane Air Condition (Package Type).
5. General Study of Electrolux Refrigeration
6. General Study One tone Thermax refrigeration unit.
7. General Study of Water cooler
8. General Study of Psychrometers (Absorption type)
9. General Study of Leak Detectors (Halide Torch).
10. General Study and working of Gas charging Rig.
11. General Study of window Air Conditioner.
12. General Study and working of Vapor compression Air conditioning Test rig.
13. Experimentation on Cold Storage of Calculate COP & Heat Loss.
14. Experimentation on Vapor compression Air Conditioning test rig.
15. Changing of Refrigerant by using Gas Charging Kit.

Evaluation:

Evaluation will be continuous and integral part of the class followed by the final practical examination as well as through external assessment

Course Outcomes: (Lab)

At the completion of this course, students should be able to

CO1	Explain the principle les and methods of refrigeration.
CO2	Analyze the Electrolux Refrigeration system and Psychrometric processes.
CO3	Elaborate the working of Gas charging Rig.
CO4	Formulate the problem and solution of window AC.

Mapping of the course outcomes (COs) with program outcomes (Pos):

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1		2									
CO2	1	2	1	1								
CO3	1	2	2									
CO4	1	2	1	2								

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