IPS Academy, Institute of Engineering & Science

(A UGC Autonomous Institute, Affiliated to RGPV, Bhopal)

Mechanical Engineering Department

B. Tech, VI Sem

Scheme

S. No.	Subject Code	Category	Subject Name	Maximum Marks Allotted					Total Marks	Contact Hours per week			Total Credits
				Theory			Practical						
				End Sem.	Mid Sem. Exam.	Quiz/ Assignment	End Sem	Term work / Lab Work & Sessional		L	T	P	
1.	PCC-ME13	PCC	I.C. Engine	60	25	15	-	-	100	3	1	-	4
2.	PCC-ME14	PCC	Mechanical Vibration	60	25	15	-	-	100	3	1	-	4
3.	PCC-ME15	PCC	Power Plant Engg.	60	25	15	-	-	100	3	-	-	3
4.	PCC-ME16	PCC	Dynamics of Machine	60	25	15	-	-	100	3	-	-	3
5.	HSMC-HS06	HSMC	Humanities and Social Sciences Open Courses-II	60	25	15	-	-	100	2	-	-	2
6.	IOC-ME01	IOC	Interdisciplinary Open Course-I	60	25	15	-	-	100	3	-	-	3
7.	LC-ME13(P)	LC	I.C. Engine Laboratory	-	-	-	60	40	100	-	-	2	1
8.	LC-ME14(P)	LC	Mechanical Vibration Laboratory	-	-	-	60	40	100	-	-	2	1
9.	LC-ME15(P)	LC	Dynamics of Machine Laboratory	-	-	-	60	40	100	-	-	2	1
10.	LCC-LCC03	LCC	Liberal Learning Course-III	-	-	-		100	100	-	-	2	1
11.	MLC-MLC 04	MLC	IPR	-	-	-				1	0	0	Audit
Total Academic Engagements and Credits										**18**	**2**	**08**	**23**
Total				**360**	**150**	**90**	**180**	**220**	**1000**	**18**	**2**	**08**	**23**

*MST: Minimum of two mid semester tests to be conducted.

L: Lecture T: Tutorial P: Practical

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Syllabus

PCC – ME13	I.C. Engine	3L: 1T: 0P (4 Hrs)	04 Credits

Pre-requisite(s):
Nil

Course Objective's:

- To understand the operation of internal combustion engines.
- To perform theoretical calculations to obtain thermodynamic efficiencies and then assess operating losses.
- To calculate engine operating parameters.
- To understand the implications of a tradeoff between performance, efficiency, emissions.

Course Content:

Module 1 **(07 hrs)**

Introduction of IC Engine: Internal Combustion Engine: S.I. and C.I. engines of two and four stroke cycles, real cycle analysis of SI and CI engines, determination of engine dimensions, speed, fuel consumption, output, mean effective pressure, efficiency, factors effecting volumetric efficiency, heat balance, performance characteristics of SI and CI engines, cylinder arrangement, firing order, power balance for multi-cylinder engines.

Module-2 **(08 hrs)**

Combustion in SI engines: Flame development and propagation, Pressure-Crank Angle diagram, Stages of Combustion ignition lag, effect of air density, temperature, engine speed, turbulence and ignition timings, physical and chemical aspects, abnormal Combustion, effect of engine and fuel variables on abnormal combustion, pre-ignition, its causes and remedy, salient features of various type combustion chambers.

Module-3 **(07 hrs)**

Combustion in CI Engines: Various stages of combustion in CI Engines, delay period, diesel knock, knock inhibitors, salient features of various types of combustion chambers. Fuel injection in CI engine. Working Principle of fuel pump & fuel injectors, types of nozzles. Fuel injection in SI engine (MPFI, TBI, CRDI), Theory of carburetion, Solex Carburetor, simple problems on carburetion. Fuel metering in CI engines.

Module-4 **(07 hrs)**

Fuel & Combustion: Classification of IC Engine fuels, Desirable characteristics of SI & CI engine fuels, Rating of SI & CI engine fuels, Alternative fuels for SI and CI engine (liquid, gaseous, hydrogen, LPG, CNG, Biogas etc.), Air requirement, Analysis of combustion products, HHV and LHV of fuels. Actual and theoretical combustion process.

Module-5 **(07 hrs)**

Supercharging & Turbo charging: Methods of supercharging, & turbo charging effects of super charging and turbo charging. Engine Modifications for supercharging, supercharging of two stroke engines. microprocessor controlled supercharging. Cooling & lubrication of SI & CI Engines.

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Course Outcomes:

After completion of the course, students will be able to:

1. Discuss the knowledge of internal combustion engine components and fuel Air cycles, Actual and theoretical Cycle.
2. Evaluate the Normal and Abnormal combustion aspect of SI Engines.
3. Evaluate the Concept of Normal and Abnormal combustion aspect of CI Engines and design of combustion chamber
4. Utilize the concept of carburetion and working of Auxiliary system ignition system, Lubrication system Fuel injector and nozzle.
5. Explain the method of supercharging and turbo charging and their Importance.

Text Book:

1. R.K. Rajput, Internal Combustion Engines, Laxmi Publication.
2. V. Ganeshan, Internal Combustion Engines, McGraw Hill Publication.
3. Mathur & Sharma internal combustion engines, Dhanpat rai & sons

References:

1. J.B. Heywood. Internal combustion Engines, Wiley
2. Ganeshan V; Internal Combustion engines; TMH
3. Mathur M L & Sharma RP; A. Course in IC engines; Dhanpat Rai
4. R Yadav, Internal Combustion Engines, Central Publishing House.
5. Halderman JD and Mitchell CD; Automotive Engines theory and servicing; Pearson
6. Dom Kundwar; Internal Combustion Engines; Dhanpat Rai Publications
7. Taylor GF; Internal Combustion Engines Theory & Practice; MIT Press
8. Richard Stone; Introduction to IC Engines; Society of Automotive Engineers (Palgrave Mc Millan)

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PCC-ME14	Mechanical Vibration	3L:1T:0P (4 Hrs)	Credits: 04

Pre-requisite(s):
Theory of Machines

Course Objective's:
To dynamically analyze a mechanical system

Course Content:

Module 1: **(08 Hrs)**

Fundamental Aspects of Vibrations: Vibration and its causes, advantages and disadvantages; engineering applications of vibration; 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: Systems involving angular oscillations: the compound pendulum.

Module 2: **(10 Hrs)**

Damped 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 3: **(10 Hrs)**

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** : 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 4: **(08 Hrs)**

Systems with Muti-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 5: **(06 Hrs)**

Noise Engineering: 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 equipments; hearing conservation and damage risk criteria, daily noise doze.

Course Outcomes:

After completion of the course student will be able:

1. Find natural frequency of SDOF systems.
2. Categorise damped system as under damped or critically damped.
3. Deal with resonant condition.
4. Design and solve real world applications with increased DOF.
5. Design acoustically better applications (Based on SPL, Decibel Scale, Human Comfort Level etc.)

Text Books:

1. Mechanical Vibrations and Noise Engineering; Ambekar AG,3 e, 2006,PHI

Reference Books:

1. Mechanical Vibration , G.K. Grover, 8 e, Nem Chand Publishers.
2. Theory of Vibration with Applications, Thomson , W.T., 5-e, Pearson Education.

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PCC-ME15	Power Plant Engineering	3L:0T: 0P (03 hrs)	Credits: 03

Pre-requisite(s): Nil

Course Objective's:

To introduce students to different aspects of power plant engineering. To familiarize the students to the working of power plants based on different fuels. To expose the students to the principles of safety and environmental issues.

Course Content:

Module 1 **(07 hrs)**

Introduction: Introduction to methods of converting various energy sources to electric power, direct conversion methods renewable energy sources, solar, wind, tidal, geothermal, bio-thermal, biogas and hybrid energy systems, fuel cells, thermoelectric modules, MHD-Converter

Module 2 **(08 hrs)**

Fossil fuel steam stations: Basic principles of sitting and station design, effect of climatic factors on station and equipment design, choice of steam cycle and main equipment, recent trends in turbine and boiler sizes and steam conditions, plant design and layout, outdoor and indoor plant, system components, fuel handling, burning systems, element of feed water treatment plant, condensing plant and circulating water systems, cooling towers, turbine room and auxiliary plant equipment., instrumentation, testing and plant heat balance.

Module 3 **(08 hrs)**

Nuclear Power Station: Importance of nuclear power development in the world and Indian context, Review of atomic structure and radio activity, binding energy concept, fission and fusion reaction, fissionable and fertile materials, thermal neutron fission, important nuclear fuels, moderators and coolants, their relative merits, thermal and fast breeder reactors, principles of reactor control, safety and reliability features.

Module 4 **(07 hrs)**

Hydro-Power Station: Elements of Hydrological computations, rainfall run off, flow and power duration curves, mass curves, storage capacity, salient features of various types of hydro stations, component such as dams, spillways, intake systems, head works, pressure tunnels, penstocks, reservoir, balancing reservoirs, Micro and pico hydro machines, selection of hydraulic turbines for power stations, selection of site.

Module 5 **(08 hrs)**

Power Station Economics: Estimation and prediction of load. Maximum demand, load factor, diversity factor, plant factor and their influence on plant design, operation and economics; comparison of hydro and nuclear power plants typical cost structures, simple problems on cost analysis, economic performance and tariffs, interconnected system and their advantages, elements of load dispatch in interconnected systems.

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Course Outcomes:

After completion of the course student will be able:

1. Understand the conversion of renewable energy system into electrical power.
2. Design & enhance the performance of fossil fuel based power plant.
3. Analyze the nuclear power plant and its safety
4. Design & enhance the performance of hydro based power plant.
5. Determine economics of the power plant of renewable and non renewable / nuclear power system

Text Books:

1. Rajput RK; A text book of Power plant Engg.; Laxmi Publications.

Reference Books:

1. Nag PK; Power plant Engg; TMH
2. Al-Wakil MM; Power plant Technology; TMH
3. Sharma PC; Power plant Engg; Kataria and sons, Delhi
4. Domkundwar; Power Plant Engg; Dhanpatrai & sons.

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PCC-ME16	Dynamics of Machine	3L:0T: 0P (04 hrs)	Credits: 03

Pre-requisite's:
Theory of Machine

Course Objective's:
To equip the student with fundamental knowledge of dynamics of machines so that student can appreciate problems of dynamic force balance, transmissibility of forces, isolation of systems, vibrations. Develop understanding of dynamic balancing, flywheel analysis, gyroscopic forces and moments. .

Course Content:

Module 1 **(09 Hrs)**

Dynamics of Engine Mechanisms: Displacement, velocity and acceleration of piston; turning moment on crankshaft, turning moment diagram; fluctuation of crankshaft speed, analysis of flywheel and Punching Press.

Module 2 **(07 Hrs)**

Governor Mechanisms: Types of governors, characteristics of centrifugal governors, gravity and spring controlled centrifugal governors, hunting of centrifugal governors, inertia governors.

Module 3 **(11 Hrs)**

Balancing of Inertia Forces and Moments in Machines: Balancing of rotating masses, two plane balancing, determination of balancing masses (graphical and analytical methods), balancing of rotors, balancing of internal combustion engines (single cylinder engines, in-line engines, V-twin engines, radial engines, Lanchester technique of engine balancing.

Module 4 **(07 Hrs)**

Friction: Frictional torque in pivots and collars by uniform pressure and uniform wear rate criteria. Boundary and fluid film lubrication, friction in journal and thrust bearings, concept of friction circle and axis, rolling friction.

Module 5 **(08 Hrs)**

Brakes: Band brake, block brakes, Internal and external shoe brakes, braking of vehicles. Dynamometer: Different types and their applications.

Dynamic Analysis of Cams: Response of un-damped cam mechanism (analytical method), follower response analysis by phase-plane method, jump and cross-over shock.

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Course Outcomes:

After completion of this course, students will be able to:

1. Apply an understanding of analytical and graphical approach to engineering problems of turning moment.
2. Understanding the theoretical and practical concepts behind working of Governors and their application for various functions.
3. Analyzing the balancing of rotating masses that can be used in different machineries.
4. Understanding the working principle of pivots and frictional behavior of these pivots and collars.
5. Understand about different brakes and also function of different dynamometer.

Text Books:

1. Ambekar, AG; Mechanism and Machine Theory; PHI
2. Rattan SS; Theory of machines; TMH
3. Sharma and Purohit; Design of Machine elements; PHI
4. Bevan; Theory of Machines.

Reference Books:

1. Ghosh and Mallik; Theory of Mechanisms and Machines; Affiliated East-West Press, Delhi
2. Norton RL; kinematics and dynamics of machinery; TMH
3. Grover; Mechanical Vibrations
4. Balaney; Theory of Machines by
5. Theory of Vibrations by Thomson

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HSMC-HS06	Project Management	2L:0T:0P	2 Credits

Objectives: The objective of this subject is to introduce students with the knowledge, tools, and techniques required to identify, formulate, and solve real-world project-based problems across various engineering domains.

Module 1: Basics of Project Management

Definition, need for project management, Categories of Project, Characteristics of engineering projects, phases of project management life cycle, project management processes, project failure, and Importance of Organizational Structure in Management.

Module 2: Planning, Scheduling & resource allocation of Engineering Projects

Work Breakdown Structure (WBS) and activity sequencing, Scheduling techniques (PERT/CPM), resource allocation and cost estimation, risk identification and planning, Engineering-specific planning challenges. Assignment and Transportation models used in project management

Module 3: Problem Formulation and modelling in project management

Key basics of problem formulation, significance, common faults in problem identification, symptoms, and causes, problem statement, objectives, constraints, decision variables, Concept and importance of modelling in project decision-making, Optimization models, stakeholder Identification, and data required tools and techniques, risk types and its identification.

Module 4: Cost, Quality, and Risk Management

Project quality planning and assurance (TQM, Six Sigma basics), Risk management, Cost-Time-Quality-Safety (CTQS) trade-off analysis, Earned Value Management (EVM), cost-benefit analysis.

Module 5: Computational Approaches in Project Management

Importance of software tools, role of digital transformation in engineering project delivery, data visualization in project management, Microsoft Project and Primavera (P6) along with their applications in project management, Artificial Intelligence in project management

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Course outcome:

Student will be able to

CO1: Understand the fundamentals of project management, including its need, types, life cycle, processes, and organizational context.

CO2: Demonstrate project planning, scheduling, and resource optimization using WBS, PERT/CPM, and cost-risk analysis.

CO3: Students will be able to formulate project problems, apply modelling techniques for optimal decision-making, and analyze stakeholders, data requirements, and risks.

CO4: Apply quality and risk management techniques, evaluate CTQS trade-offs, and measure project performance using EVM and cost-benefit analysis.

CO5: Apply computational tools like Microsoft Project and Primavera P6 to improve project management through digital transformation and data visualization.

Text Books / Reference Books:

1. Construction Planning and Management" by K. Subramanian, Oxford University Press India, ISBN: 9780199456750.
2. Construction Project Management: Theory and Practice, K.K. Chitkara, Tata McGraw-Hill Education.
3. Project Planning and Control with PERT & CPM, B.C. Punmia & K.K. Khandelwal, Laxmi Publications.
4. Construction Management and Planning, S. Seetharaman, CBS Publishers.
5. Project Management: A Managerial Approach – Jack R. Meredith & Samuel J. Mantel
6. Fundamentals of project management by Joseph Heagney, American Management Association.

Suggested list of problems

1. Create network diagram, compute earliest/latest start/finish times, and identify the critical path.
2. Solve problems involving optimal task-person assignments with minimum cost or time.
3. Determine the most cost-effective transportation plan for Engineering projects.
4. Problem statement for an Engineering project involving project crashing.

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LC – ME13(P)	I.C. Engine Laboratory	0L: 0T: 2P (2 Hrs)	01 Credits

List of Experiments:

1. To Study the construction details & working principal of 2-Stroke / 4- Stroke Petrol Engine.
2. To study the constructional details & working principles involved in a 2-Stroke & 4-Stroke Diesel Engines.
3. To Prepare Heat Balance Sheet for a Single Cylinder Two Stroke Petrol Engine Test Rig with Electrical Dynamometer.
4. To draw the heat balance sheet of a Four Stroke Single Cylinder Diesel Engine Test Rig.
5. To draw the heat balance sheet and conduct a performance test on the Four Stroke Single Cylinder petrol Engine.
6. To Study and Determine the effect of A/F Ratio on the performance of the Two-Stroke, Single-Cylinder Petrol Engine.
7. To study and draw the valve timings diagram Four-Stroke, Single-Cylinder Diesel Engine.
8. Study of the lubrication and cooling system in IC Engine.
9. Study of carburetor.
10. Study of ignition system.

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LC-ME14(P)	Mechanical Vibration Laboratory	0L:0T:2P (2 Hrs)	Credits: 01

List of Experiment:

1. To find mass moment of inertia of a rod from its vibration as a compound pendulum.
2. To find damping coefficient and damped and undamped natural frequencies of an under-damped single degree of freedom system from its response to an initial displacement
3. To find MI of an object using Trifilar suspension.
4. To study, experimentally, the response of a SDOF system to harmonic excitation applied to the mass for different values of damping factor.
5. Tune a vibration absorber by varying dynamic system parameters.
6. To study the rotating imbalance and perform modal analysis of rotating shaft.

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LC-ME15(P)	Dynamics of Machine Lab	0L:0T: 2P (02 hrs)	Credits: 01

1. Determine displacement, velocity & acceleration of various parts steam engine using analytical method.

2. To perform experiment on watt and Porter Governors to prepare performance characteristic Curves, and to find stability & sensitivity.

3. To perform experiment on Proell Governors to prepare performance characteristic Curves, and to find stability & sensitivity.

4. To perform experiment Hartnell Governors to prepare performance characteristic Curves, and to find stability & sensitivity.

5. To perform the experiment for static balancing on static balancing machine.

6. To perform the experiment for dynamic balancing on dynamic balancing machine.

7. To perform the experiment for measuring the power by prony brake dynamometer and study various types of dynamometers.

8. To study working of friction clutches using models.

9. Determine displacement, velocity & acceleration of various parts steam engine using analytical method.

10. To find out jump phenomenon of Cams and followers with the help of test kit.

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