Shirpur Education Society's

R. C. Patel Institute of Technology, Shirpur

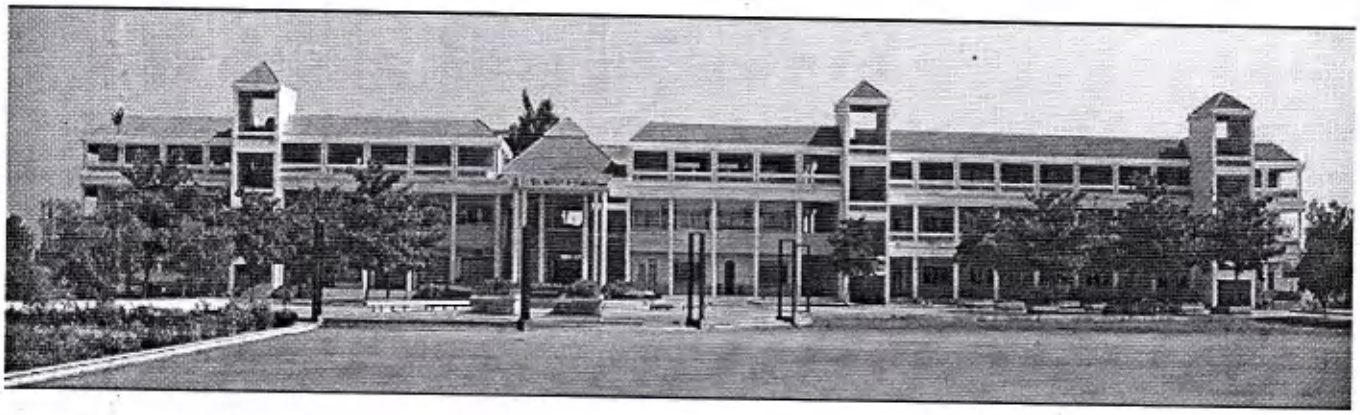
(An Autonomous Institute)

Mechanical Department R.C.P.I.T. OFFICE SEAL SHIRPUR

Course Structure and Syllabus

Third Year B.Tech. (Mechanical Engineering)

with effect from Year 2022-23



Shahada Road, Near Nimzari Naka, Shirpur, Maharashtra 425405
Ph: 02563 259 802, Web: www.rcpit.ac.in

Semester-V (w.e.f. 2022-23)

Sr	Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme (CA)				ESE	Total	Credit
				L	T	P	TA	Term Test 1 (TT1)	Term Test 2 (TT2)	Best of (TT1 & TT2)			
							[A]			[B]	[C]	[A+B+C]	
1	PC	PCME5010T	Automotive Prime Movers	3	-	-	20	15	15	15	65	100	3
2	PC	PCME5010L	Automotive Prime Movers Laboratory	-	-	2	25	-	-	-	25	50	1
3	PC	PCME5020T	Heat Transfer	3	-	-	20	15	15	15	65	100	3
4	PC	PCME5020L	Heat Transfer Laboratory	-	-	2	25	-	-	-	25	50	1
5	PC	PCME5030T	Mechanical Vibrations	3	-	-	20	15	15	15	65	100	3
6	PC	PCME5030L	Mechanical Vibrations Laboratory	-	-	2	25	-	-	-	25	50	1
7	PC	PCME5040T	Industrial Electronics and Controls	3	-	-	20	15	15	15	65	100	3
8	PC	PCME5040L	Industrial Electronics and Controls Laboratory	-	-	2	25	-	-	-	25	50	1
9	PE	PEME5051T	Machine Tool Engineering	3	-	-	20	15	15	15	65	100	3
		PEME5052T	Renewable Energy Systems										
		PEME5053T	Quality Engineering										
10	PC	PCME5060L	Python for Mechanical Engineering	-	-	2	25	-	-	-	25	50	1
11	HM	HMME5070T	Professional and Business Communication	2	-	-	50	-	-	-	-	50	2
12	PJ	PJME5080L	Semester Project III	-	-	2	25	-	-	-	25	50	1
13	HM	HMME5090L	Employability Skill Development Program- II	-	-	2	50	-	-	-	-	50	1
			Total	17	-	14	350	75	75	75	475	900	24

PC-Professional Course, PE- Professional Elective, HM-Humanity and Management, PJ-Project,

Semester-VI (w.e.f. 2022-23)

Sr	Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme (CA)				ESE	Total	Credit
				L	T	P	TA	Term Test 1 (TT1)	Term Test 2 (TT2)	Best of (TT1 & TT2)			
							[A]			[B]	[C]	[A+B+C]	
1	PC	PCME6010T	Machine Design I	3	-	-	20	15	15	15	65	100	3
2	PC	PCME6010L	Machine Design I Laboratory	-	-	2	25	-	-	-	25	50	1
3	PC	PCME6020T	Refrigeration and Air Conditioning	3	-	-	20	15	15	15	65	100	3
4	PC	PCME6020L	Refrigeration and Air Conditioning Laboratory	-	-	2	25	-	-	-	25	50	1
5	PC	PCME6030T	Mechatronics	3	-	-	20	15	15	15	65	100	3
6	PC	PCME6030L	Mechatronics Laboratory	-	-	2	25	-	-	-	25	50	1
7	PC	PCME6040T	Power Engineering	3	-	-	20	15	15	15	65	100	3
8	PC	PCME6040L	Power Engineering Laboratory	-	-	2	25	-	-	-	25	50	1
9	PE	PEME6051T	Smart Materials	3	-	-	20	15	15	15	65	100	3
		PEME6052T	Design of Heat Exchanger Equipments										
		PEME6053T	Reliability Engineering										
10	PC	PCME6060L	Database Management Systems	-	-	2	25	-	-	-	25	50	1
11	PJ	PJME6070L	Project Stage I	-	-	2	25	-	-	-	25	50	2
12	MC	MCME6080T	Environmental Studies	1	-	-	-	-	-	-	-	-	-
			Total	16	-	12	250	75	75	75	475	800	22

PC-Professional Course, PE- Professional Elective, MC-Mandatory Course, PJ-Project, HM-Humanity and Management

Prepared by

Checked by

BOS Chairman

Dean Academic/~~Dy.~~ Director

~~C.O.E.~~

Director

Mechanical Department OFFICE SEAL SHIRPUR

Shirpur Education Society's

R. C. Patel Institute of Technology, Shirpur
(An Autonomous Institute)

Syllabus Booklet
Mechanical Engineering

Third Year B.Tech

With effect from Academic Year 2022-23

Shahada Road, Near Nimzari Naka, Shirpur, Maharashtra 425405
Ph: 02563 259 802, Web: www.rcpit.ac.in

Automotive Prime Movers (PCME5010T)

Teaching Scheme
Lectures : 3 Hrs./week
Credit : 3

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 20 Marks
End Sem Exam : 65 Marks
Total: 100 Marks

Prerequisite:

Knowledge of thermodynamics and heat transfer.

Course Objectives:

1. To study the components of an internal combustion engine and its systems.
2. To familiarise with different systems in SI CI engines.
3. To analyse engine performance and emissions.
4. To acquaint with modern hybrid and electric powertrains.

Course Outcomes:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain the construction and working of internal combustion engines.	L2	Understand
CO2	Demonstrate the working systems of spark ignition and compression ignition engines.	L3	Apply
CO3	Demonstrate the engine cooling, lubrication and super-charging systems.	L3	Apply
CO4	Analyse various engine performance parameters.	L4	Analyze
CO5	Describe the different hybrid and electric powertrain systems.	L2	Understand

Course Contents

Unit-I

10 Hrs

Introduction: Classification of I.C. Engines, Components of I.C. Engines and their materials, Four stroke, two stroke engines and their comparison, Scavenging in two stoke engines; Fuel-air cycles and their analysis, Actual working cycle, Valve timing diagram.

Spark Ignition (SI) Engines

Fuel supply system: Air-Fuel mixture requirements for steady state and transient operations, Simple carburettor and its applications.

Fuel Injection systems: Single-point and Multipoint injection systems, Gasoline Direct Injection. Engine Control Unit (ECU), Important sensors actuators, Open loop and closed loop modes of operation.

Ignition systems: Battery ignition system, Magneto ignition system, Electronic ignition systems.

Combustion: Combustion phenomenon in SI Engines, Pressure-crank angle diagram, Abnormal combustion, Factors affecting combustion and detonation, Types of combustion chambers.

Unit-II

09 Hrs

Compression Ignition (CI) Engines:

Fuel Injection Systems: Air injection systems, Airless/solid injection systems, Common rail, individual pump, distributor and unit systems. Injection pumps, Fuel injector, Types of nozzle, fuel atomization and spray structures, Electronically controlled unit fuel injection system.

Combustion: Combustion phenomenon in C I engines, Stages of combustion, Delay period, Knocking, Pressure-Crank angle diagram, Factors affecting combustion and knocking, Types of combustion chambers.

Unit-III

06 Hrs

Engine cooling systems: Necessity of engine cooling, Cooling systems and their comparison: Air cooling, Liquid cooling, Troubleshooting maintenance.

Engine lubrication systems: Types of lubricants and their properties, SAE rating of lubricants, Types of lubrication systems and their applications.

Supercharging/Turbo-charging: Objectives and limitations, Methods, types and different arrangements of superchargers and turbochargers.

Unit-IV

09 Hrs

Engine Performance Emissions:

Measurement and analysis of engine performance parameters, Performance characteristic of SI and CI engines, Effect of load and speed on engine performance heat balance sheet. Engine exhaust control methods, Bharat Stage VI emission norms and control, Alternative fuels: Ethanol, Bio-diesel, CNG, LPG, Hydrogen, merits, demerits and engine modifications.

Unit-V

08 Hrs

Hybrid powertrain: Different components of hybrid engines and hybrid powertrain designs, degree of hybridization. Hybrid vehicle operating modes.

Electric powertrain: Electric BLDC motor, PMS motor, torque-speed characteristics, controllers, performance limits, and applications.

Current trends: Camless engine, Variable valve timing, Stratification in GDI engines, LHR engine, HCCI engine six stroke engine.

Text Books

1. Internal Combustion Engine, V Ganesan, 4th Edition, 2017, McGraw Hill
2. Internal Combustion Engine, Mathur and Sharma, 2014, Dhanpat Rai Publications
3. Internal Combustion Engines, H. N. Gupta, 2nd Edition, 2012, PHI
4. Internal Combustion Engines, R K Rajput, 3rd Edition, 2016, Laxmi Publications
5. Internal Combustion Engines Fundamentals, John B. Heywood, 2nd Edition, 2018, McGrawHill

Reference Books

1. Internal Combustion Engines, Willard W. Pulkrabek, 2nd Edition, 2013, Pearson Education.
2. Introduction to Internal Combustion Engines, Richard Stone, 4th Edition, 2012, Palgrave Publication
3. Automotive Electrical and Electronic Systems, Tom Denton, 5th Edition, 2017, Routledge
4. Modern Electric, Hybrid Electric, and Fuel Cell Vehicles, Mehrdad, Yimin, Sebastian, Ali, 3rd Edition, CRC Press

Evaluation Scheme:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper will be based on the entire syllabus summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Automotive Prime Movers Laboratory

(PCME5010L)

Practical Scheme

Practical : 2 Hrs./week

Credits : 1

Examination Scheme

Teacher Assessment : 25 Marks

End Sem Exam : 25 Marks

Total: 50 Marks

List of Laboratory Experiments

Part A: Study of systems in terms of constructional details and functions (Any 3)

1. 2 Stroke / 4 Stroke Engines.
2. Carburettor and auxiliary circuits.
3. Ignition system in SI engines.
4. Fuel injection system in CI engines.

Part B: Performance based experiments (Any 4)

1. Morse Test on petrol engine.
2. Speed Test on petrol or/and diesel engine.
3. Load Test on diesel engine.
4. Heat Balance test on diesel or petrol engines.
5. Experimental determination of Air fuel ratio and volumetric efficiency of the engine.

Evaluation Scheme:

Continuous Assessment (A):

Term work shall consist of minimum 7 experiments, minimum 2 assignments, case-study/report on latest developments in I.C. engines/hybrid technology.

The distribution of marks shall be as follows:

1. Performance in Experiments: 05 Marks
2. Journal Submission: 05 Marks

3. Viva-voce: 05 Marks

4. Subject Specific Lab Assignment/Case Study: 10 Marks

The final certification and acceptance of laboratory journal/manual/report will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the teacher assessment.

End Semester Examination (C):

Oral / Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Heat Transfer (PCME5020T)

Teaching Scheme

Lectures : 3 Hrs./week

Credit : 3

Examination Scheme

Term Test : 15 Marks

Teacher Assessment : 20 Marks

End Sem Exam : 65 Marks

Total: 100 Marks

Prerequisite:

1. Basic Knowledge of physical science related to heat
2. Basic concepts learnt in fluid mechanics with respect to boundary conditions

Course Objectives:

1. To Study basic heat transfer concepts applicable for steady state and transient conditions
2. To Study mathematical modelling and designing concepts of heat exchangers

Course Outcomes:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain the mechanism of heat transfer by conduction and analyse various types of onedimensional heat conduction problems.	L2	Understand
CO2	Explain the mechanism of heat transfer by convection and analyse free and forced convection problems.	L2	Understand
CO3	Find the rate of heat transfer by radiation and analyse the effect of radiation shield in radiation exchange between two surfaces.	L1	Remember
CO4	Explain different types of heat exchangers and analyse heat exchanger using LMTD and NTU method.	L2	Understand

Heat Transfer (PCME5020T)

Teaching Scheme

Lectures : 3 Hrs./week

Credit : 3

Examination Scheme

Term Test : 15 Marks

Teacher Assessment : 20 Marks

End Sem Exam : 65 Marks

Total: 100 Marks

Prerequisite:

1. Basic Knowledge of physical science related to heat
2. Basic concepts learnt in fluid mechanics with respect to boundary conditions

Course Objectives:

1. To Study basic heat transfer concepts applicable for steady state and transient conditions
2. To Study mathematical modelling and designing concepts of heat exchangers

Course Outcomes:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain the mechanism of heat transfer by conduction and analyse various types of onedimensional heat conduction problems.	L2	Understand
CO2	Explain the mechanism of heat transfer by convection and analyse free and forced convection problems.	L2	Understand
CO3	Find the rate of heat transfer by radiation and analyse the effect of radiation shield in radiation exchange between two surfaces.	L1	Remember
CO4	Explain different types of heat exchangers and analyse heat exchanger using LMTD and NTU method.	L2	Understand

Course Contents

Unit-I

12 Hrs

Basic concepts of heat transfer: Definition, its importance in engineering applications, Physical Mechanism, Governing laws of heat transfer, Conduction mode: Thermal conductivity, Thermal diffusivity, Convection mode: Free and Forced convection, Heat transfer Coefficient, Radiation mode: Emissivity, transmissivity, reflectivity, absorptivity, Black body, Grey body, Opaque body, Steady and unsteady heat transfer, One dimensional, two dimensional and three dimensional heat transfer, Thermal resistance concept in heat transfer, Thermal contact resistance.

Conduction: Three-dimensional differential equation for Conduction with heat generation in unsteady state in the Cartesian-coordinates, Solution of Fouriers equation for one-dimensional steady state Conduction through isotropic materials of various configurations such as plane wall, cylinder and sphere, composite wall, composite cylinders and composite spheres.(For cylindrical and spherical walls, derivation of Fouriers three-dimensional equation is NOT included.) Critical thickness of insulation and its importance.

Unit-II

08 Hrs

Heat transfer from Extended Surface: Extended Surfaces and Transient Heat Conduction, Heat transfer from finned surface, Solutions for heat transfer through rectangular fins. Types of fins and their applications. Effectiveness and Efficiency of fins. Unsteady state heat transfer: Lumped system analysis, One dimensional transient problem analytical solution, Heisler charts. Difference Methods in Heat Conduction: Introduction, Numerical Errors, Accuracy, One Dimensional steady state problems.

Unit-III

08 Hrs

Convection: Natural and Forced convection, hydrodynamic and thermal boundary layers. Heat transfer coefficient. Effect of various parameters such as physical properties of the fluid, system geometry, fluid flow etc. on heat transfer coefficient. Physical significance of dimensionless numbers such as Nusselt's Number, Grashoff s Number, Prandtl's Number, Reynolds Number and Stanton's Number. Principle of dimensional analysis. Application of dimensional analysis to Convection for finding heat transfer coefficient. Empirical relations and their use for forced internal and external convection.

Unit-IV

07 Hrs

Radiation: Basic laws of radiation, Black body radiation, Plancks law, Kirchhoffs law, Wein displacement law, Lambert cosine law, Radiation intensity, Radiation heat exchange between black bodies, Shape factor algebra, Radiation heat exchange between nonblack bodies, Electrical network approach for radiation heat exchange: Radiosity and irradiation, Radiation shield

Unit-V

07 Hrs

Heat Exchangers: Classification of heat exchangers. Logarithmic Mean Temperature Difference, Correction factor and effectiveness of heat exchangers. Effectiveness as a function of Number of Transfer Units and heat capacity ratio. Overall heat transfer coefficient, Fouling factor. Design consideration for Heat Exchangers.

Boiling and Condensation: Boiling heat transfer, Pool boiling: different regimes and pool boiling curve, Flow boiling: Different Regimes and Boiling curve, Condensation heat transfer, Film condensation, Dropwise Condensation

Heat Pipe: Introduction and application

Text Books

1. Introduction to thermodynamics and Heat transfer; Yunus A Cengel; 2017; McGraw Hill International
2. Heat and Mass Transfer; PK Nag; 2011; McGraw Hill Education
3. Heat and Mass Transfer; R K Rajput; 2018; S Chand and company

Reference Books

1. Fundamentals of Heat and Mass Transfer; Incropera, D P DeWitt; 2007; Wiley India
2. Heat Transfer; P S Ghoshdastidar; 2012; Oxford University Press
3. Heat and Mass Transfer; R Rudramoorthy, L Malaysamy; Pearson
4. Heat Transfer; J P Holman; 2017; Mcgraw Hill
5. Heat Transfer; S P Sukhatme; 2005; University Press
6. Heat and Mass Transfer; Mahesh Rathod; 2006; Laxmi Publication

Evaluation Scheme:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper will be based on the entire syllabus summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Heat Transfer Laboratory (PCME5020L)

Practical Scheme

Practical : 2 Hrs./week

Credits : 1

Examination Scheme

Teacher Assessment : 25 Marks

End Sem Exam : 25 Marks

Total: 50 Marks

List of Laboratory Experiments: (Any Six)

1. Measurement of thermal conductivity of solid/liquid
2. Measurement of heat transfer coefficient in natural convection
3. Measurement of heat transfer coefficient in forced convection
4. Measurement of Emissivity of Grey surface
5. Unsteady state heat transfer in cylinder/rod/wall
6. Determination of fin efficiency and fin effectiveness
7. Measurement of critical heat flux
8. Estimation of overall heat transfer coefficient and effectiveness of heat exchanger
9. Numerical modeling of any heat transfer problem using FDM

Any other experiment based on syllabus may be included, which would help the learner to understand topic/concept in depth.

Evaluation Scheme:

Continuous Assessment (A):

Term work shall consist of minimum 6 experiments, minimum 3 assignments, case-study/report on latest developments in I.C. engines/hybrid technology.

The distribution of marks shall be as follows:

1. Performance in Experiments: 05 Marks
2. Journal Submission: 05 Marks
3. Viva-voce: 05 Marks

4. Subject Specific Lab Assignment/Case Study: 10 Marks

The final certification and acceptance of laboratory journal/manual/report will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the teacher assessment.

End Semester Examination (C):

Oral / Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Mechanical Vibrations(PCME5030T)

Teaching Scheme

Lectures : 3 Hrs./week

Credit : 3

Examination Scheme

Term Test : 15 Marks

Teacher Assessment : 20 Marks

End Sem Exam : 65 Marks

Total: 100 Marks

Prerequisite:

1. Basic Knowledge of Engineering Mechanics
2. Basic Knowledge of Kinematics of Machinery

Course Objectives:

1. To study basic concepts of vibration analysis
2. To acquaint with the principles of vibration measuring instruments
3. To acquaint with the practices of monitoring health conditions of the systems

Course Outcomes:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Develop mathematical model to represent dynamic system.	L6	Create
CO2	Evaluate natural frequency of mechanical element / system.	L5	Evaluate
CO3	Analyze response of mechanical element / system, executing free and forced vibration.	L4	Analyze
CO4	Estimate the values of various elements of vibrating systems, required to achieve vibration isolation and control.	L2	Understand
CO5	Analyze working of vibration measuring instruments.	L4	Analyze

Course Contents

Unit-I

09 Hrs

Basic Concepts of Vibration: Introduction, Elements of Vibrating Systems, Degrees of Freedom of Vibrating System, Classification of Vibrating Systems, General steps in analysis of vibrations

Free Vibrations of Single-Degree-of-Freedom Systems: Free Undamped Vibrations Translational and Torsional System (Newtons Second Law, D Alemberts Principle, Rayleighs Energy Method to be included)

Free Vibrations with Viscous Damping: Derivation of Equation of Motion, Logarithmic Decrement, Energy Dissipated in Viscous Damping (Numerical on Translational and Torsional Systems to be included)

Free Vibration with Coulomb Damping: Equation of Motion, Translational and Torsional Systems with Coulomb Damping

Unit-II

09 Hrs

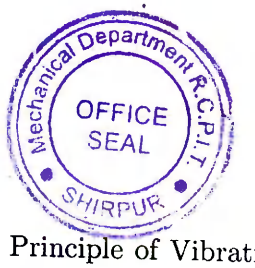
Two-Degree-of-Freedom Systems (Undamped Systems): Introduction, Mode Shapes, Analysis of Undamped Systems - Translational and Torsional Systems, using Newtons second law, and LaGranges Equations

Multi Degree of Freedom System (Undamped Systems): Introduction, Derivation of Equation of Motion of Systems using Newtons Second Law, Influence Coefficients, Equations in Matrix Form, Eigenvalue Problems, Determination of Natural Frequencies and Mode Shapes using Dunkerleys Formula, Rayleighs Method, and Holzers Method

Unit-III

07 Hrs

Harmonically Excited Vibration: Introduction, Equations of Motion for Forced Vibrations, - Translational and Torsional Systems (including systems under support excitation, systems with rotary and reciprocating un balance).



Unit-IV

09 Hrs

Vibration Measurement and Applications: Working Principle of Vibration Measuring Instruments (Un-damped and damped) - Vibrometer, Accelerometer, and Velometer

Machine Condition Monitoring and Diagnosis: Severity Criteria, Machine Maintenance, Mon-

itoring Techniques (Time-Domain Analysis, Statistical Methods and Frequency Domain Analysis) Instrumentation Systems FFT Analyzer, Choice of Monitoring Parameter,

Effects of Vibrations on environment, and society: Sustainable Design, Ergonomic Design (Paper Review)

Unit-V

08 Hrs

Rotor Dynamics: Single rotor systems - whirling of rotating shafts, critical speed of Damped Undamped system, Multirotor systems Analysis of Reciprocating Rotating Unbalance (graphical approach)

Vibration Isolation: Vibration Isolation System with Rigid Foundation, Flexible Foundation (including Partially Flexible Foundation), Vibration Isolation System with Base Motion, Shock Isolation, Active Vibration Control

Text Books

1. Mechanical Vibrations, S. S. Rao, 6th Edition, 2017, Pearson Education

Reference Books

1. Mechanical Vibrations, G. K. Grover, Paper Back Edition, 2009, Nem Chand Bros.
2. Fundamentals of Mechanical Vibration, S. Graham Kelly, 2nd edition (Hardcover), 2000, Tata McGraw Hill
3. Schaum's Outline of Theory and Problems of Mechanical Vibration, William W. Seto, McGraw Hill
4. Theory and Practice of Mechanical Vibrations, J. S. Rao, K. Gupta, 2nd edition, 1999, New Age International Publications

Evaluation Scheme:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.

2. Total duration allotted for writing each of the paper is 1 hr.

3. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper will be based on the entire syllabus summing up to 65 marks.

2. Total duration allotted for writing the paper is 3 hrs.

Mechanical Vibrations Laboratory

(PCME5030L)

Practical Scheme

Practical : 2 Hrs./week

Credits : 1

Examination Scheme

Teacher Assessment : 25 Marks

End Sem Exam : 25 Marks

Total: 50 Marks

List of Laboratory Experiments

(Recommended, but not limited to): Minimum eight experiments to be performed.

Note: Open-source software can be used as an alternative to licensed software like MATLAB

1. Experimental determination of natural frequency of compound pendulum and an equivalent simple pendulum system
2. Experimental determination of natural frequency of spring mass system under going longitudinal vibrations
3. Experimental determination of natural frequency of single rotor and two-rotor vibratory system
4. Experimental determination of damping coefficient of any system / media
5. Experimental balancing of multi-rotor system
6. Experimental measurement of vibration response of a system
7. Experimental verification of principle of Gyroscopic Couple
8. Study effects of vibrations using MEMS gyro model (MATLAB / Simulink)
9. Study characteristic behavior of SDOF system under going forced vibrations using MATLAB programming
10. Study of damped and un-damped vibrations using MATLAB
11. Study of forced vibrations USING MATLAB SIMULINK
12. Simulation based study of rotary un-balanced forces
13. Write a program in MATLAB simulating / analyzing behavior of simple or compound pendulum

14. Find MI of irregularly shaped solid body using trifilar suspension (Virtual Lab Simulation)

15. Write a Program in MATLAB simulating / analyzing behavior of simple or compound pendulum

Evaluation Scheme:

Continuous Assessment (A):

1. Term work shall consist of minimum 8 experiments and 5 assignments. Assignments can be given in form of tutorials or programming exercises.

2. Programming / simulation-based exercises using MATLAB, MATLAB Simulink, PYTHON Programming, or any other programming tools can be incorporated as a part of assignments or lab work.

The distribution of marks shall be as follows:

1. Performance in Experiments: 05 Marks

2. Journal Submission: 05 Marks

3. Viva-voce: 05 Marks

4. Subject Specific Lab Assignment/Case Study: 10 Marks

Research based assignment, such as mini project or paper writing with focus on ergonomic design, green technology can also be given as an assignment (recommended but not mandatory)

The final certification and acceptance of laboratory journal/manual/report will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the teacher assessment.

End Semester Examination (C):

Oral / Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Industrial Electronics and Control

(PCME5040T)

Teaching Scheme

Lectures : 3 Hrs./week

Credit : 3

Examination Scheme

Term Test : 15 Marks

Teacher Assessment : 20 Marks

End Sem Exam : 65 Marks

Total: 100 Marks

Prerequisite: Knowledge of basic electronic devices like Diodes, BJT etc. and basic digital electronics

Course Objectives:

1. To study power electronic switches and circuits and their applications
2. To familiarise Op amp and digital circuits and their applications
3. To acquaint with basics of microprocessor and microcontroller
4. To study concept of mathematical modelling of the control system
5. To acquaint with control system under different time domain

Course Outcomes:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Illustrate construction, working principles and applications of power electronic switches.	L4	Analyze
CO2	Identify rectifiers and inverters for dc and ac motor speed control.	L1	Remember
CO3	Develop circuits using OPAMP and timer IC555.	L6	Create
CO4	Identify digital circuits for industrial applications.	L1	Remember
CO5	Design mathematical model of system/process for standard input responses.	L6	Create
CO5	Analyze error and differentiate various types of control systems and time domain	L4	Analyze

Course Contents

Unit-I — 08 Hrs

Microprocessor and Microcontrollers:

Overview of generic microprocessor, architecture and functional block diagram, Comparison of microprocessor and microcontroller MSP430 architecture, assembly language programming, C compiler programming, basics of interfacing with external input / output devices (like reading external analog voltages, digital input output)

Applications of microcontroller: Temperature measurement, Speed Measurement using Proximity Sensor, Piezoelectric Actuator Drive

Unit-II — 08 Hrs

Motors:

Review and comparison of DC motors and AC induction motors, Basic principles of speed control of AC induction motor

Basics of BLDC motor, Linear Actuator motor, Servo Motor

Motor Specifications, suitability of each motor for various industrial applications, Selection and sizing of motors for different applications. Applications for pumps, conveyors, machine tools, Microcontroller based speed control for Induction Motor.

Unit-III — 07 Hrs

Control System: Introduction to control systems, Classification of control system. Open loop and closed loop systems.

Mathematical modelling of control systems, concept of transfer function, Block diagram algebra

Unit-IV — 11 Hrs

Stability Analysis: Control system design and analysis by Root Locus Method, Control system Design by Frequency response method, stability margin, Nyquist diagram, Bode diagram

P, I and D control actions, P, PI, PD and PID control systems, Transient response: Percentage overshoot, Rise time, Delay time, Steady state error, PID tuning (manual), Zigler Method

Unit-V — 08 Hrs

Discrete Control System PLC (Programming Logic Control) Theory:

Introduction to PLC, Architecture, Ladder Logic programming for different types of logic gates, Latching, Timers, Counter, Practical Examples of Ladder Programming

Reference Books

1. Power Electronics M.H. Rashid, Prentice-Hall of India
2. Power Electronics, P S Bhimbra
3. Power Electronics, Vedam Subramanyam, New Age International
4. Power Electronics, Ned Mohan, Undeland, Robbins, John Wiley Publication
5. Electronic Devices and Circuits, Robert Boylestad and Louis Nashelsky, Prentice-Hall
6. Industrial Electronics and Control by S K Bhattacharya, S Chatterjee, TTTI Chandigarh
7. Modern Digitals Electronic, Jain R P, Tata McGraw Hill 8. Digital principal and Application, Malvino and Leach, Tata McGraw Hill
8. Fundamentals of Microcontrollers and Embedded System, Ramesh Gaonkar, PENRAM 10. MSP430 Microcontroller Basics, John H. Davies, Newnes
9. Modem Control engineering: by KOgata, Prentice Hall
10. Control systems by DhaneshManik, Cengage Learning
11. Engineering Metrology and Measurementsby N V Raghavendra and L Krishnamurthy, Oxford University Press 8. Instrumentation and Control System, W. Bolton, Elsevie

Evaluation Scheme:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper will be based on the entire syllabus summing up to 65 marks.

2. Total duration allotted for writing the paper is 3 hrs.

Industrial Electronics and Control Laboratory

(PCME5040L)

Practical Scheme	**Examination Scheme**
Practical : 2 Hrs./week	Teacher Assessment : 25 Marks
Credits : 1	End Sem Exam : 25 Marks
	Total: 50 Marks

List of Laboratory Experiments

Minimum six from 1-9 and four from 10-14, in all minimum ten experiments need to be performed out of the list given below.

1. MOSFET / IGBT as a switch
2. Single phase Bridge inverter with rectifier load
3. OPAMP as integrator
4. Implementing study of gates and Logic Operations like, NOT, AND, OR
5. Realization of basic gates using universal gates
6. Light dimmer circuit using Diac-Triac
7. Speed control of DC motor
8. Speed control of induction motor
9. Simple microcontroller-based application like Temp Measurement/ Speed Measurement using Proximity Sensor/ Piezoelectric Actuator Drive
10. Microcontroller based speed control for Induction Motor
11. Experiments on feedback control systems and servomechanisms
12. System Identification of any one of the sensors.
13. Experiment on frequency response system identification
14. Experiment on transient state response of a control system.

Evaluation Scheme:

Continuous Assessment (A): Term work shall consist of minimum 6 experiments and 5 assignments.

The distribution of marks shall be as follows:

1. Performance in Experiments: 05 Marks
2. Journal Submission: 05 Marks
3. Viva-voce: 05 Marks
4. Subject Specific Lab Assignment/Case Study: 10 Marks

Research based assignment, such as mini project or paper writing with focus on ergonomic design, green technology can also be given as an assignment (recommended but not mandatory)

The final certification and acceptance of laboratory journal/manual/report will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the teacher assessment.

End Semester Examination (C):

Oral / Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Machine Tool Engineering(PEME5051T)

Teaching Scheme

Lectures : 3 Hrs./week

Credit : 3

Examination Scheme

Term Test : 15 Marks

Teacher Assessment : 20 Marks

End Sem Exam : 65 Marks

Total: 100 Marks

Prerequisite: Knowledge of Engineering Drawing, Applied Physics, Manufacturing Processes, Advanced Manufacturing Processes.

Course Objectives:

1. To study tool engineering and tool economics.
2. To study concept and design aspect of press tool used for sheet metal forming.
3. To learn principle and design aspects of Jigs and Fixtures.

Course Outcomes:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Analyse various single and multipoint cutting tools with tool nomenclature as per standards and their design principles.	L4	Analyze
CO2	Analyse tool life and economics of machining.	L4	Analyze
CO3	Understand design principles of press tool components for piercing and blanking operation.	L1	Understand
CO4	Illustrate design principles of press tool components in bending and drawing operation.	L4	Analyze
CO5	Understand appropriate combination of tools, jigs and fixture, suitable for a particular machining operation.	L1	Understand

Course Contents

Unit-I

12 Hrs

Tool engineering:

Different systems of tool nomenclature like ASA, MRS, ORS and NRS, Interrelationship among different systems of nomenclature for tool angles, Constructional features of solid tool, tipped tools, mechanically held regrind able insert type tools and throw away tip type tools, Design principles of shanks, cutting tip and chip breakers for HSS and Carbide tools, ISO coding system for tipped tools and tool holders

Design principles of Milling cutters, Broach tool and Forming Tool.

Unit-II

04 Hrs

Tool life and machining economics:

Definition, flank wear and crater wear, criteria for tool failure, effect of cutting parameters and tool geometry on tool life, Taylors tool life equation, Effect of cutting parameters on tool life, Components of product cost, Optimum cutting velocity for minimum cost of production and maximum production rate.

Unit-III

07 Hrs

Sheet metal forming operations:

Piercing and blanking

Design principles of Press tool elements viz. Punches methods of retaining punches, Die block, Stripper, Pilot, etc. Methods of reducing cutting loads on press tools, Different types Die sets and its selection.

Unit-IV

10 Hrs

Bending and drawing

Theory of Bending, Spring back and measures to control it, Calculations for blank development of simple bent components, minimum bend radius, types of bending dies.

Theory of Drawing, Metal flow in drawing and forming operations; reduction ratio and redrawing limits, draw clearance, drawing and blank holding forces for cylindrical draws only. Blank development of cup.

Defects in drawn as well as bent parts, Presses selection for drawing/forming operations.

Basic construction and working of Bending and Drawing dies.

Miscellaneous dies: Basic construction working of Shaving dies, Trimming dies, Compound dies, Combination dies, Coining dies, Embossing dies, Simple Progressive and Compound Progressive dies. Energy overloading and press safety devices.

Unit-V

12 Hrs

Jigs and Fixtures:

Need for Jigs and Fixtures, elements of Jigs and Fixtures, basic construction of Jig and Fixture,

Location locating devices: Locating principles: degrees of freedom, redundant location, fool-proofing, nesting, Locators: locators that control work piece on flat surfaces, location of cylindrical surfaces, conical locators, centralizers.

Clamping clamping devices: Requirement of clamping system, position of clamps, types of clamps, clamping devices; examples of typical clamps (multiple clamping and equalizing devices, quick acting clamping mechanisms such as link, toggle, cam, eccentric, pneumatic, hydraulic and electric devices), component distortion under clamping and cutting forces, Material used for different clamping devices of jigs/fixture and recommended hardness.

Construction of drill jig: Introduction, selection of location, supporting and clamping faces /points, cutting tools and means of guiding and supporting Jigs, various types of Jig bushes,

Construction of milling fixture: Introduction, Selection of location, supporting and clamping faces /points choice, tool setting block and Tennon.

Indexing jig fixture: Introduction, application of indexing, Essential features of an indexing jig /fixture, Indexing devices.

Text Books

1. Tool Design by C. Donaldson and V. C. Goold, 4th edition (2012), Tata McGraw Hill Publications.

Reference Books

1. Fundamentals of Modern Manufacturing, Mikell P Groover, 4th edition (2010), John Wiley Sons.
2. Jigs and Fixtures, P H Joshi, 3rd edition (2010), Tata Mc Graw Hill.

3. Introduction to Jigs and Tool design, M. H. A. Kempster, 3rd edition, Butterworth Heinemann Ltd.

4. Processes and Materials of Manufacture, R A Lindberg, 4th edition, PHI.

5. Press Tools Design and Construction by P H Joshi, 4th Edition (1996), S. Chand Publishing.

6. Fundamentals of Metal Machining and Machine Tools, Geoffrey Boothroyd, Winston A. Knight, 3rd Edition (2006), CRC press Taylor and Francis group.

7. ASM Handbook, Vol. 16: Machining by Joseph R. Davis, 9th edition, ASM International.

8. Fundamentals of Metal Cutting and Machine Tools by B. L. Juneja, G. S. Sekhon and Nitin Seth, 2nd Edition (2003), New Age International

9. Metal Cutting Theory and Cutting Tool Design, by V. Arshinov and G. Alekseev, Mir publishers, Moscow.

10. Typical Examples and Problems in Metal Cutting and Tool Design, by N. Nefedov and K. Osipov, Mir publishers, Moscow.

Evaluation Scheme:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.

2. Total duration allotted for writing each of the paper is 1 hr.

3. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper will be based on the entire syllabus summing up to 65 marks.

2. Total duration allotted for writing the paper is 3 hrs.

Renewable Energy Systems(PEME5052T)

Teaching Scheme

Lectures : 3 Hrs./week

Credit : 3

Examination Scheme

Term Test : 15 Marks

Teacher Assessment : 20 Marks

End Sem Exam : 65 Marks

Total: 100 Marks

Prerequisite: Knowledge of Energy science, Energy sources.

Course Objectives:

1. To study working principles of various renewable energy sources and their utilities.
2. To study economics of harnessing energy from renewable energy sources.

Course Outcomes:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain the need of different renewable energy sources.	L2	Understand
CO2	Discuss importance of renewable energy sources.	L2	Understand
CO3	Discuss various renewable energy sources in Indian context.	L2	Understand
CO4	Calculate and analyse utilization of solar and wind energy.	L4	Analyze
CO5	Illustrate design of biogas plant.	L4	Analyze
CO6	Explain basics of hydrogen energy.	L2	Understand

Course Contents

Unit-I

04 Hrs

Introduction to Energy Sources: Renewable and non-renewable energy sources, Need for Renewable Energy Sources, Energy Consumption as a measure of Nation's development; Strategy for meeting the future energy requirements, Global and National scenarios, Prospects of renewable energy sources, Present status and current installations, Introduction to Hybrid Energy Systems, various MNRE programmes.

Unit-II

12 Hrs

Solar Energy: Merits and demerits, Solar radiation - beam and diffuse radiation, solar constant, earth sun angles, attenuation and measurement of solar radiation, local solar time, derived solar Angles, sunrise, sunset and day length, Methods of Solar Radiation estimation. Solar Energy collection devices and Classification: Flat plate collectors, concentrating collectors, Solar air heaters-types, solar driers, storage of solar energy-thermal storage, solar pond, solar water heaters, solar distillation, solar still, solar cooker, solar heating cooling of buildings, Solar Photovoltaic systems applications.

Unit-III

10 Hrs

Wind Energy: Principle of wind energy conversion; Basic components of wind energy conversion systems; wind mill components, various types and their constructional features; design considerations of horizontal and vertical axis wind machines: analysis of Aerodynamic forces acting on wind mill blades and estimation of power output; wind data and site selection Considerations.

Unit-IV

08 Hrs

Energy from Biomass: Biomass conversion technologies, Biogas generation plants, classification, advantages and disadvantages, constructional details, site selection, digester design consideration, filling a digester for starting, maintaining biogas production, Fuel properties of biogas, utilization of biogas.

Hydrogen Energy: Methods of Hydrogen production, Hydrogen Storage, Fuel Cells and Types of Fuel Cells.

Unit-V

08 Hrs

Geothermal Energy: Estimation and nature of geothermal energy, geothermal sources and Resources like hydrothermal, geo-pressured hot dry rock, magma. Advantages, disadvantages and Application of geothermal energy, prospects of geothermal energy in India.

Energy from the ocean: Ocean Thermal Electric Conversion (OTEC) systems like open cycle, closed cycle, Hybrid cycle, prospects of OTEC in India. Energy from tides, basic principle of tidal power, single basin and double basin tidal power plants, advantages, limitation and scope of tidal energy. Wave energy and power from wave, wave energy conversion devices, advantages and disadvantages of wave energy.

Reference Books

1. Non-conventional energy sources, G.D. Rai, 6th edition, 1988, Khanna Publishers.
2. Renewable Energy: Power for a Sustainable Future, Edited by Godfrey Boyle, 3rd Edition, 2012, Oxford University Press.
3. Solar Energy: Principles of Thermal Collection and Storage, S. P. Sukhatme, J K Nayak, 4th edition, 2017, TMH.
4. Solar Energy: Fundamentals and Applications, H.P. Garg, Jai Prakash, 1st revised edition, 1997, TMH.
5. Wind Power Technology, Joshua Earnest, 2014, PHI Learning.
6. Renewable Energy Sources, J. W. Twidell, Anthony D. Weir, 1986, ELBS Pub.
7. Energy Conversion Systems, R. D. Begamudre, 1998, New Age International (P) Ltd., Publishers.
8. Solar Photovoltaics: Fundamentals, Technologies and Applications, C S Solanki, 3rd Edition, 2013, PHI Learning
9. Biomass Regenerable Energy, D. D. Hall and R. P. Grover, John Wiley, New York.
10. Wind and Solar Power Systems, Mukund R Patel, 2nd edition, 2005, CRC Press.
11. . Wind Energy Explained: Theory, Design and Application, J F Manwell, J. C. McGowan, A. L. Rogers, John Wiley and Sons
12. Magneto Hydrodynamics, Kuliovsky, Lyubimov, 3rd edition, 2014, Addiso publishers.

Evaluation Scheme:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper will be based on the entire syllabus summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Quality Engineering(PEME5053T)

Teaching Scheme

Lectures : 3 Hrs./week

Credit : 3

Examination Scheme

Term Test : 15 Marks

Teacher Assessment : 20 Marks

End Sem Exam : 65 Marks

Total: 100 Marks

Prerequisite: Knowledge of Probability and Statistics.

Course Objectives:

1. Understand basic quality management principles.
2. Understand the relationship of the quality engineer to the quality system.
3. Analyse the relationship of statistics to a process.
4. Understand process capability and use statistical process control to monitor a process.
5. Generate acceptance sampling plans and identify and use technical quality tools.
6. Apply problem-solving tools and basic statistical concepts, process control and process capability plans, acceptance sampling, and attribute controls.

Course Outcomes:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain the importance of Quality for survival and growth of any business.	L4	Analyze
CO2	Prepare and interpret the control charts for variables and attributes.	L3	Apply
CO3	Evaluate Process capability and determine tolerance limits.	L5	Evaluate
CO4	Apply ANOVA test and determine the degree of relation between independent variables.	L3	Apply
CO5	Elaborate significance of quality and application of Six Sigma in service sector.	L1	Understand

Course Contents

Unit-I

08 Hrs

Introduction:

Different Definitions and Dimensions of Quality, Historical Perspective, Contribution of Renowned Quality Gurus, Total Quality Management Basic Philosophy, Approach, Barriers.

Mindset of Quality Improvements:

High quality of product and service and their associated customer satisfaction are the key to the survival and growth for any enterprises. Management culture advocating a total commitment to customer satisfaction through continuous improvement and innovation in all aspects of the business must be discussed in detail.

Unit-II

10 Hrs

Introduction to Control charts, Construction and application. Chance and assignable causes of process variation, Statistical basis of the control chart for variable, Attribute control charts p, nnp, c and u charts.

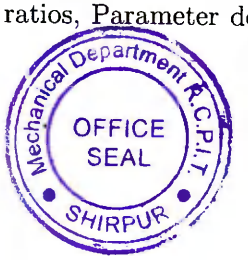
Acceptance Sampling Fundamental, OC Curves, Sampling Plans for Attributes, Signal and double sampling plans, Multiple and Sequential sampling plans, sampling plans for variables Demo on use of software like MS Excel, Minitab and JMP for control charts and acceptance sampling.

Unit-III

08 Hrs

Tolerance Design:

Process Capability Analysis, Process Capability Ratios, Functional limits, tolerance design for Ntype. L-type and S-type characteristics, tolerance allocation for multiple components. Parameter and Tolerance Design: Introduction to parameter design, signal to noise ratios, Parameter design strategy, some of the case studies on parameter and tolerance designs.



Unit-IV

10 Hrs

Introduction to Design of Experiments: Introduction, Methods, Taguchi approach, Achieving robust design, Steps in experimental design. Introduction to ANOVA, Need for ANOVA, NO-way ANOVA, One way ANOVA, Two-way ANOVA, ANOVA for four level factors, multiple level factors. Introduction to t-test, f-test and hypothesis in connection with ANOVA.

Demo on use of software like MS Excel, Minitab and JMP for DOE.

Unit-V

06 Hrs

Quality in Service Sectors:

Characteristics of Service Sectors, Quality Dimensions in Service Sectors, Measuring Quality in Different Service Sectors, Six sigma DMAIC methodology, and tools for process improvement,six sigma in services and small organizations, statistical foundations, statistical methodology.

Text Books

1. Introduction to Statistical Quality Control; D. C. Montgomery; Edition 6 ; 2009 ; John Wiley Sons
2. Taguchi Methods explained: Practical steps to Robust Design; Tapan P. Bagchi; 1993; Prentice Hall Pvt. Ltd., New Delhi.
3. Managing for Total Quality; N. Logothetis; 1997; Prentice Hall of India

Reference Books

1. Statistical Quality Control; Grant and Leavenworth; 1996; McGraw-Hill
2. Statistical Quality Design and Control; R.E. DeVor, T. Chang, J .W. Sutherland, 2007; Prentice Hall
3. Managing Quality; D.A. Garvin;1988; Free Press
4. Introduction to Quality Engineering; G. Taguchi; 1986; Asian productivity organisation
5. Poor Quality Cost; H.J. Harrington; 1987; Tayler and Francis
6. Quality Engineering Using Robust Design; M.S. Phadke;1989; Prentice Hall
7. Quality Control and Industrial Statistics; Acheson J. Duncan; Fifth Edition;1986; IRWIN
8. Quality Engineering off-line methods and applications; Chao-Ton Su; 2016; CRC Press Taylor Francis Group.
9. Statistical Methods for Quality Assurance; Stephen B. Vardeman,J. Marcus Jobe; Second Edition ; 2016 ; Springer-Verlag

Evaluation Scheme:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper will be based on the entire syllabus summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Python for Mechanical Engineering

(PCME5060L)

Practical Scheme

Practical : 2 Hrs./week

Credits : 1

Examination Scheme

Teacher Assessment : 25 Marks

End Sem Exam : 25 Marks

Total: 50 Marks

Course Objectives:

1. To understand the coding environment of Python Programming
2. To apply python coding skills for various Mechanical problems

Course Outcomes:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand the coding environment of Python software.	L1	Understand
CO2	Understand the basics of Python.	L1	Understand
CO3	To read, analyse and visualize data.	L1,L2,L4	Remember, Understand, Analyze
CO4	To apply the python skills for Mechanical problems.	L3	Apply

Unit-I 04 Hrs

Introduction to Python: Python history, Introduction to Anaconda, Spyder IDE, how to go about programming, understanding of the layout of the programming environment and spyder.

Unit-II 07 Hrs

Basics of Python: Assignment Statement, variable and datatypes, Loops, Strings, Lists,Operators, Arrays, Sorting, Functions and Dictionaries.

Unit-III 07 Hrs

Data Handling and Manipulation: Reading Data, Introduction to Pandas Dataframe and Numpy, Data Visualization, exploratory Data Analysis.

Unit-IV 10 Hrs

Using Python for Mechanical Applications (Design, Thermal and Manufacturing)

List of Laboratory Experiments

1. To take input from user and print the sum, smaller no, larger no.
2. At least two programs involving operations related to Basics of Python.
3. At least two programs related to Data handling and manipulation
4. Python applied to Mechanical Applications At least 3

Any other experiment based on syllabus may be included, which would help the learner to understand topic/concept.

Reference Books

1. Problem Solving and Programming; S. Kuppuswamy, S. Malliga, C.S. Kanimozhi Selvi, K. Kousalya; 2019; Tata McGraw Hill.
2. Introducing Python Modern Computing in Simple Packages; Bill Lubanovic; 1st edition; 2014; O'Reilly Media

3. Python: The Complete Reference; Martin C; 1st edition; 2018; Tata MacGrawHill

4. Core Python Programming; R. Nageswara Rao; 2nd edition; 2018; DreamTech Press

5. Let Us Python; Yashavant Kanetkar; 2019; BPB Publication

Evaluation Scheme:

Continuous Assessment (A): Term work shall consist of minimum 7 experiments and 1 Mini Project.

The distribution of marks shall be as follows:

1. Performance in Experiments: 05 Marks
2. Journal Submission: 05 Marks
3. Viva-voce: 05 Marks
4. Subject Specific Lab Assignment/Case Study: 10 Marks

The final certification and acceptance of laboratory journal/manual/report will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the teacher assessment.

End Semester Examination (C):

Oral / Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Professional and Business Communication

(HMME5070T)

Practical Scheme	**Examination Scheme**
Lectures : 2 Hrs./week	Teacher Assessment : 50 Marks
Credits : 2	Total : 50 Marks

Prerequisite: Basic course in Effective Communication Skills.

Course Objectives:

1. To inculcate professional and ethical attitude at the workplace
2. To enhance communication and interpersonal skills
3. To develop effective presentation skills
4. To hone written skills for technical documentation

Course Outcomes:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Plan, organize and write technical documents like reports, proposals and research papers in the prescribed format using appropriate language and style with an understanding of ethics in written communication.	L6	Create
CO2	Apply techniques of writing resume, participating in a group discussion and facing interviews.	L3	Apply
CO3	Develop interpersonal skills in professional and personal situations.	L6	Create
CO4	Understand the documentation process of meetings and conduct meetings in a professional manner.	L2	Understand
CO5	Understand communication across cultures and work ethics.	L2	Understand
CO6	Design and deliver effective presentations using Power Point.	L6	Create

Unit-I Technical Writing 08 Hrs

Report Writing: Types of report, parts of formal report, collection of data and survey analysis, pre-writing of report, language and style in reports, formatting of reports, referencing in report

Proposal Writing: Types of technical proposals, format of proposal, language and style, presentation of proposal

Technical Paper Writing: Parts of a technical paper, language and formatting, referencing in IEEE format

Plagiarism: Types of plagiarism, consequences of plagiarism

Unit-II Employment Skills 06 Hrs

Group Discussion: Purpose of a GD, types of GD, criteria for evaluating a GD, Dos and Donts of a GD, Tips to be successful in GD

Cover Letter Resume Writing: Format and content of cover letter, types of resume, structure, content and formatting of resume

Interview Skills: Types and modes of interview, Preparation for interview, Dos and Donts of interview, frequently asked questions during interview

Unit-III:Introduction to Interpersonal Skills 06 Hrs

Emotional Intelligence: Definition, difference between IQ and EQ, how to develop EQ

Leadership: Types of leadership, leadership styles, case studies

Team Building: Difference between group and team, importance of team work, strategies to be a good team player

Time Management: Importance of time management, cultural views of time, 80/20 rule, time wasters, setting priorities and goals,

Conflict Management: Types of conflicts, strategies to manage conflict, case studies.

Unit-IV Meetings and Documentation 02 Hrs

Planning and preparation for meetings, strategies for conducting effective meetings, notice, agenda and minutes of a meeting, business meeting etiquettes

Unit-V Cross-cultural communication and Ethics 03 Hrs

Communication across cultures, professional and work ethics, responsible use of social media, intro-

duction to Intellectual Property Rights

Unit-VI Presentation Skills 02 Hrs

Presentation strategies, overcoming stage fear, techniques to prepare effective PowerPoint presentation

List of Assignments

1. Business Proposal (PowerPoint presentation)
2. Resume writing
3. Interpersonal Skills (documentation of activity)
4. Meetings and Documentation (Notice, Agenda, Minutes of Mock Meetings)
5. Business ethics
6. Presentation Skills

Any other experiment based on syllabus may be included, which would help the learner to understand topic/concept.

Reference Books

1. Fred Luthans, Organizational Behavior, McGraw Hill, edition
2. Lesiker and Petit, Report Writing for Business, McGraw Hill, edition
3. Huckin and Olsen, Technical Writing and Professional Communication, McGraw Hill
4. Wallace and Masters, Personal Development for Life and Work, Thomson Learning, 12th edition
5. Heta Murphy, Effective Business Communication, Mc Graw Hill, edition
6. Sharma R.C. and Krishna Mohan, Business Correspondence and Report Writing, Tata McGraw-Hill Education
7. Ghosh, B. N., Managing Soft Skills for Personality Development, Tata McGraw Hill. Lehman,
8. Bell, Smith, Management Communication Wiley India Edition, 3rd edition.
9. Dr. Alex, K., Soft Skills, S Chand and Company
10. Subramaniam, R., Professional Ethics Oxford University Press.

Evaluation Scheme:

Continuous Assessment (A): Term work shall consist of minimum 6 assignments, Group Discussion and Power Point Presentation based on the written report

The distribution of marks shall be as follows:

1. Assignments: 25 Marks
2. Project Report and Presentation: 15 Marks
3. Group Discussion: 10 Marks

The final certification and acceptance of laboratory journal/manual/report will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the teacher assessment.

Semester Project-III (PJME5080L)

Practical Scheme
Practical : 02 Hrs./week
Credit : 01

Examination Scheme
Teacher Assessment : 25 Marks
End Sem Exam : 25 Marks
Total : 50 Marks

Course Objectives:

Students are expected to design, simulate/implement a project based on the knowledge acquired from current semester subjects.

Course Outcomes:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Conduct a survey of several available literatures in the preferred field of study.	L4	Analyze
CO2	Demonstrate various/alternate approaches to complete a project.	L2	Understand
CO3	Ensure a collaborative project environment by interacting and dividing project work among team members.	L3	Apply
CO4	Present their project work in the form of a technical report / paper and thereby improve the technical communication skill.	L3	Apply
CO5	Demonstrate the ability to work in teams and manage the conduct of the research study.	L2	Understand

Semester Project:

The purpose of introducing semester project at second year level is to provide exposure to students with a variety of projects based on the knowledge acquired from the semester subjects. This activity is supposed to enrich their academic experience and bring enough maturity in student while selecting the project. Students should take this as an opportunity to develop skills in implementation, presentation and discussion of technical ideas/topics. Therefore, proper attention shall be paid to the content of semester project report which is being submitted in partial fulfillment of the requirements of the Second Year and it is imperative that a standard format be prescribed for the report.

Each student shall work on project approved by departmental committee approved by the Head of Department, a group of 03 to 05 students (max allowed: 5 students in extraordinary cases, subject to the approval of the department committee and the Head of the department) shall be allotted for each Semester Project. Each group shall submit at least 3 topics for the Semester Project. The departmental committee shall finalize one topic for every group. Semester Project Title or Theme should be based on knowledge acquired during semester. The project work shall involve sufficient work so that students get acquainted with different aspects of knowledge acquired from semester subjects.

Student is expected to:

- Select appropriate project title based on acquired knowledge from current semester subjects.
- Maintain Log Book of weekly work done(Log Book Format will be as per Table 1).
- Report weekly to the project guide along with log book.

Assessment Criteria:

- At the end of the semester, after confirmation by the project guide, each project group will submit project completion report in prescribed format for assessment to the departmental committee (including project guide).
- Assessment of the project (at the end of the semester) will be done by the departmental committee (including project guide).

Prescribed project report guidelines:

Size of report shall be of minimum 25 pages. Project Report should include appropriate content for:

- Introduction
- Literature Survey
- Related Theory
- Implementation details

- Project Outcomes
- Conclusion
- References

Assessment criteria for the departmental committee (including project guide) for Continuous Assessment:

Guide will monitor weekly progress and marks allocation will be as per Table 2.

Assessment criteria for the departmental committee (including project guide) for End Semester Exam:

Departmental committee (including project guide) will evaluate project as per Table 3.

Each group shall present/publish a paper based on the semester project in reputed/peer reviewed Conference/Journal/TechFest/Magazine before end of the semester.

Table 1: Log Book Format

Sr	Week (Start Date:End Date)	Work Done	Sign of Guide	Sign of Coordinator
1				
2				

Table 2: Continuous Assessment Table

Sr	Exam Seat No	Name of Student	Student Attendance	Log Book Maintain	Literature Review	Depth of Understanding	Report	Total
			5	5	5	5	5	25

Table 3: Evaluation Table

Sr	Exam Seat No	Name of Student	Project Selection	Design/ Methodology	Fabrication/ Modeling/ Simulation	Result Verification	Presentation	Total
			5	5	5	5	5	25

Employability Skill Development Program-II (HMME5090L)

Practical Scheme
Practical : 02 Hrs./week
Credit : 01

Examination Scheme
Teacher Assessment : 50 Marks
Total : 50 Marks

Prerequisite: Basic Mathematics, Basic knowledge of C programming.

Course Objectives:

1. To enhance the problem solving skills with real life examples.
2. To enable the students to express their thoughts and knowledge on various platforms.
3. Able to describe the basic database management system.
4. Able to implement basic programming project using python.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Analyze and solve the logical problem based on words, venn diagram etc.	L4	Analyze
CO2	Understand and solve the English comprehension, Sentence completion, Sentence Correction problems.	L2 and L4	Understand, Analyze
CO3	Understand and illustrate the concept of Exception Handling, Garbage collection.	L2 and L3	Understand, Apply
CO4	Understand and describe the fundamental of DBMS, NoSql, MongoDB.	L2	Understand

Course Contents

Unit-I

Reasoning : Data sufficiency, Logical Deductions, Logical Sequence of Words, Logical Venn Diagrams, Statement and Arguments, Statement and Assumptions, Statement and Conclusions Syllogism.
English: Reading Comprehension, Para Jumbles, Cloze Test, Tenses/ Voice/ Speech, Prepositions/ SVA/ Articles, Vocab /Verbal Analogy, Sentence completion, Sentence Correction.

Unit-II

Modules: Introduction, Importance of Modularity programming, Import keyword, User defined modules creation, Function based modules, Classes based modules, Connecting modules, from keyword.
Exception Handling: Introduction, The need of exception handling, Getting exceptions, Default exception handler, Handling exception, Try, Except.
Garbage collection: Introduction, Importance of manual GC, Self-referenced objects, gc module, Collect() method, Threshold function.

Unit-III

Collections Framework: Introduction to collection of data types, Importance of Data processing, DS algorithms introduction.
List: Create a list, Adding elements, Deleting elements, Pre-defined functionality of List, Nested List, Immutability and Mutability of List.
Set: The functionality of Set object, Frozen set, Dictionaries, Create a dictionary, Adding elements
Dict: Pre-defined functions of Dict class, Programs using Collection types.

Unit-IV

Tkinter- GUI: Types of Layouts , Create Labels and Display images, Create Buttons, Create Events, StringVar class, Calculator program using GUI
Basic ML AI including Projects Iterators, Nested functions, Generators, Closures, Decorators, Basic ML and AI, PIP, Visualization etc
Project Domain(Per domain 1 or 2 project)

1. ML/AI Based Projects
2. Data Analysis Based projects
3. Test Summarization based projects
4. web scrapping and crawling

Unit-V

DBMS Using Python: Introduction to Mysql, Mysql Python connectivity, Execute DDL.

commands, Execute DRL commands, Execute DML commands, Transaction management examples (rollback and commit), GUI Database connectivity.

NoSql Using Python: Installation and Configuration, MongoDB Advantages, MongoDB Data Modelling, MongoDB Tools, Collection and Documents, CRUD and the MongoDB Shell, Introduction to CRUD, Introduction to the MongoDB API, Creating a Database, Collection and Documents.

Data Modelling and Schema Design: Mo ngoDB Database References Model Tree Structures, MongoDB Analysing Queries, MongoDB Atomic Operations, MongoDB Map Reduce, MongoDB Text Search, MongoDB Regular Expression, MongoDB Capped Collections.

Administration: MongoDB Deployment and Cluster setup, MongoDB GridFS, Trident Spout, Working with Replica Sets, MongoDB Sharding.

Reference Books:

1. Dr. R S Aggarwal, Quantitative Aptitude for Competitive Examinations, S. Chand Publication.
2. M. G. Venkateshmurthy, Programming Techniques through C, Pearson Publication.
3. Behrouz Forouzan, A Computer Science Structure Programming Approaches using C, Cengage Learning.
4. YashwantKanetkar, Let Us C, BPB Publication.

Evaluation Scheme:

Teacher Assessment(TA):

Teachers Assessment (TA) will carry weightage of 50 marks. The distribution of marks for term work shall be as follows:

1. MCQ Test based on Aptitude: 20 Marks
2. MCQ Test based on Programming skills: 20 Marks
3. Mock Interview: 10 Marks

Any other component recommended by BOS and approved by Dean Academics.

Detailed syllabus of Third Year in Mechanical Engineering (Semester VI)

Machine Design I (PCME6010T)

Teaching Scheme

Lectures : 3 Hrs./week

Credit : 3

Examination Scheme

Term Test : 15 Marks

Teacher Assessment : 20 Marks

End Sem Exam : 65 Marks

Total: 100 Marks

Prerequisite:

1. Knowledge of Strength of Materials
2. Knowledge of Material Technology

Course Objectives:

1. To familiarize with use of design data books various design codes of practices
2. To study basic principles of machine design
3. To acquaint with the concepts of design based on strength rigidity

Course Outcomes:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Use design data books in designing various components.	L3	Apply
CO2	Illustrate basic principles of machine design.	L4	Analyze
CO3	Demonstrate understanding of various design considerations, theories of failures, Standards/Codes.	L3	Apply
CO4	Design machine elements for static as well as dynamic loading.	L6	Create
CO5	Design machine elements on the basis of strength/ rigidity concepts.	L6	Create

Course Contents

Unit-I

06 Hrs

Introduction to Machine Design: Mechanical Engineering Design, Design methods, Aesthetic and Ergonomics consideration in design, Material properties and their uses in design, Manufacturing consideration in design, Design consideration of casting and forging

Basic Principle of Machine Design: Modes of failures, Factor of safety, Design stresses, Guidelines for selection of Theories of failures in the process of designing, Standards, I.S. Codes, Preferred Series and Numbers.

Unit-II

16 Hrs

Design against Static Loads: Cotter joint, Knuckle joint, Turn buckle, Bolted and welded joints under eccentric loading;

Curved Beams: Assumptions made in the analysis of curved beams, Design of curved beams: Bending stresses in curved beams such as crane hook, C-frame, etc.

Power Screw C-clamps along with the Frame, Screw Jack

Unit-III

05 Hrs

Design against Fluctuating Loads: Variable stresses - reversed, repeated, fluctuating stresses. Fatigue failure: static and fatigue stress concentration factors, Endurance limit estimation of endurance limit, Design for finite and infinite life, Soderberg and Goodman design criteria, Fatigue design under combined stresses

Unit-IV

08 Hrs

Design of Shaft: power transmitting and power distribution shafts (excluding crank shaft) under static and fatigue loading

Keys: Types of Keys and their selection based on shafting condition

Couplings: Classification of coupling, Design of Flange couplings, Bush pin type flexible couplings

Unit-V

07 Hrs

Design of Springs: Design of helical compression and tension Springs under Static and Variable

loads, design of Leaf springs

Design of Thin Cylindrical and Spherical Shells:

Design of Cylinders, Cylindrical shell with hemi spherical ends and Spheres.

Text Books

1. Mechanical Engineering Design by J.E.Shigley, McGraw Hill
2. Design of Machine Elements - V.B. Banadari, Tata McGraw Hill Publication
3. Design of Machine Elements - Sharma, Purohil. Prentice Hall India Publication McGrawHill

Reference Books

1. Design of Machine Elements by V.M.Faires
2. Design of Machine Elements by Spotts.
3. Machine Design by R.C.Patel, Pandya, Sikh, Vol-I II C. Jamnadas Co
4. Machine Design by Black Adams, McGraw Hill
5. Design Data book by P.S.G. College of Technology, Coimbatore.
6. Design Data Book- Mahadevan.

Evaluation Scheme:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper will be based on the entire syllabus summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Machine Design I Laboratory (PCME6010L)

Practical Scheme

Practical : 2 Hrs./week

Credits : 1

Examination Scheme

Teacher Assessment : 25 Marks

End Sem Exam : 25 Marks

Total: 50 Marks

List of Design exercises /Assignments /Sheets:

Part (A).Following assignments are to be solved in the lab sessions in the form of tutorial or any software based exercises (Minimum six):

1. Design of Curved Beams
2. Design of Cotter Joint
3. Design of Knuckle Joint
4. Design of C-clamp along with frame
5. Design of Screw jack
6. Design of Bolted and welded joints
7. Design under fluctuating loads (finite and infinite life)
8. Design of Shaft
9. Design of Coupling
10. Design of Leaf spring
11. Design of Helical Spring

Part (B) Prepare a layout of following using any CAD software (Minimum two):

1. Layout of Cotter Joint
2. Layout of Knuckle Joint
3. Layout of C-clamp
4. Layout of Screw jack
5. Layout of coupling

6. Layout of Leaf spring

Evaluation Scheme:

Continuous Assessment (A):

Term work shall consist of Part (A) and Part (B).

The distribution of marks shall be as follows:

1. Part (A): 15 Marks
2. Part (B): 10 Marks

The final certification and acceptance of laboratory journal/manual/report will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the teacher assessment.

End Semester Examination (C):

Oral / Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Refrigeration and Air Conditioning

(PCME6020T)

Teaching Scheme	Examination Scheme
Lectures : 3 Hrs./week	Term Test : 15 Marks
Credit : 3	Teacher Assessment : 20 Marks
	End Sem Exam : 65 Marks
	Total: 100 Marks

Prerequisite: Knowledge of thermodynamics, heat transfer and fluid mechanics.

Course Objectives:

1. To apply the thermodynamic principles to refrigeration and air-conditioning systems.
2. To analyse and compare the performance of different refrigeration and air-conditioning systems.
3. To study the controls and applications of refrigeration and air-conditioning systems.

Course Outcomes:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Apply the fundamentals of thermodynamics to refrigeration systems and calculate the coefficient of performance of reversed Carnot cycle, Bell-Coleman cycle and Aircraft refrigeration systems.	L3	Apply
CO2	Analyse the vapour compression refrigeration systems, components and interpret the importance of refrigerant properties and its selection criteria.	L4	Analyze
CO3	Analyse the psychrometric properties, processes, charts and principles of air-conditioning.	L4	Analyze
CO4	Design air-conditioning systems using cooling load calculations and duct design principles.	L6	Design
CO5	Discuss the applications and controls of various refrigeration and air-conditioning systems.	L2	Understand

Course Contents

Unit-I

08 Hrs

Introduction to Refrigeration:

Methods of refrigeration, First and Second Law applied to refrigerating machines, Carnot refrigerator Carnot heat pump. Unit of refrigeration, Co-efficient of Performance, Energy Efficiency Ratio (EER) and BEE star rating.

Air refrigeration systems: Bell Coleman cycle, analysis and applications. Aircraft refrigeration systems: Simple, Bootstrap, Reduced ambient Regenerative aircraft cooling system, Importance of Dry Air Rated Temperature.

Unit-II

12 Hrs

Vapour Compression Refrigeration Systems:

Simple vapour compression cycle, Effect of liquid sub cooling superheating, effect of evaporator and condenser pressures, methods of sub-cooling, Use of P-h charts, Actual VCR cycle, 2 stage VCR systems applications. Types of Compressors, Condensers, Expansion devices and Evaporators.

Cooling tower: Types of cooling towers, tower approach, tower range, tower efficiency, tower losses, tower maintenance.

Refrigerants: Desirable properties of refrigerants, ASHRAE numbering system for refrigerants, Secondary refrigerants, ODP and GWP, Montreal Kyoto protocol and Indias commitment Recent developments in refrigerants.

Non-Conventional Refrigeration Systems:

Ammonia-water Lithium BromideWater vapour absorption refrigeration system, Thermoelectric refrigeration, Thermo-acoustic refrigeration, Vortex tube refrigeration systems Radiant heating and cooling systems.

Unit-III

06 Hrs

Psychrometry:

Need for air conditioning, Principle of psychrometry, Psychrometric properties, chart and processes, Bypass factor, Sensible heat factor, Adiabatic mixing of two air streams, Air washers, Requirements of comfort air conditioning, Summer and Winter Air conditioning.

Unit-IV

12 Hrs

Design of Air Conditioning Systems:

Different Heat sources, Cooling Load estimation, Ventilation and infiltration, Inside and Outside Design condition, RSHF, GSHF, ERSHF, Room apparatus dew point and coil apparatus dew point.

Introduction to Unitary Products: Room/Split and Packaged Air Conditioners, Introduction to recent developments: VRF systems, VAV systems, Inverter Units.

Human Comfort, Thermal exchange of body with environment, Effective temperature, Comfort chart, Comfort zone, Indoor Air Quality, Green Buildings.

Duct Design: Friction chart for circular ducts, Equivalent diameter of a circular duct for rectangular ducts, Methods of duct design, Factors considered in air distribution system, Air distribution systems for cooling and heating.

Unit-V 04 Hrs

Controls and Applications: Controls: LP/HP cut-off, Thermostats, Humidistats, Interlocking control, Electronic Controllers.

Applications: Refrigeration A/C Ice plant food storage plants dairy and food processing plants, Food preservation, Freeze Drying, A/C in textile industry, printing, pharmaceutical industry and Hospitals Deep sea water air-conditioning.

Text Books

1. Refrigeration and air-conditioning C. P. Arora, 3rd Edition, 2017, McGraw Hill
2. Refrigeration and air-conditioning Domkundwar, Arora, 2018, Dhanpat Rai
3. Basic Refrigeration and air-conditioning- P. Ananthanarayana, TMH
4. Refrigeration and air-conditioning R K Rajput, 3rd Edition, 2013, S.K. Kataria Sons
5. Refrigeration and air-conditioning Manohar Prasad, 3rd Edition, 2015, New Age Publisher

Reference Books

1. Principles of refrigeration R J Dossat, Willey Eastern Publication
2. Refrigeration and air-conditioning W F Stoeker and J W Jones, TMH
3. Air Conditioning System Design Roger Legg, Butterworth-Heinemann Publication
4. ASHRAE Handbook of Fundamentals

5. ISHRAE Refrigeration Handbook

6. ISHRAE Air Conditioning Handbook

Evaluation Scheme:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.

2. Total duration allotted for writing each of the paper is 1 hr.

3. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper will be based on the entire syllabus summing up to 65 marks.

2. Total duration allotted for writing the paper is 3 hrs.

Refrigeration and Air Conditioning Laboratory

(PCME6020L)

Practical Scheme	**Examination Scheme**
Practical : 2 Hrs./week	Teacher Assessment : 25 Marks
Credits : 1	End Sem Exam : 25 Marks
	Total: 50 Marks

List of Laboratory Experiments: (Any six)

1. Trial on Refrigeration test rig.
2. Trial on Air conditioning test rig.
3. Study of domestic refrigerator along with wiring diagram.
4. Study of leak detection, evacuation and charging of refrigerant.
5. Report on different protocols to regulate global warming.
6. Simulation of VCR system with an open-source software.
7. Cooling load estimation exercise for an actual scenario.
8. Visit report of a manufacturing unit of refrigerator/air-conditioner or a cold storage plant/ice plant.

Evaluation Scheme:

Continuous Assessment (A):

Term work shall consist of minimum 5 experiments and minimum 2 assignments.

The distribution of marks shall be as follows:

1. Performance in Experiments: 05 Marks
2. Journal Submission: 05 Marks
3. Viva-voce: 05 Marks
4. Subject Specific Lab Assignment/Case Study: 10 Marks

The final certification and acceptance of laboratory journal/manual/report will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the teacher assessment.

End Semester Examination (C):

Oral / Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Mechatronics (PCME6030T)

Teaching Scheme

Lectures : 3 Hrs./week

Credit : 3

Examination Scheme

Term Test : 15 Marks

Teacher Assessment : 20 Marks

End Sem Exam : 65 Marks

Total: 100 Marks

Course Objectives:

1. To study key elements of Mechatronics system and its integration
2. To familiarise concepts of sensors characterization and its interfacing with microcontrollers
3. To study continuous control logics i.e. P, PI, PD and PID
4. To study discrete control logics in PLC systems and its industrial applications.
5. To Design Pneumatic and Hydraulic Circuits.

Course Outcomes:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Represent Mechatronics system with block diagrams.	L3	Apply
CO2	Identify the suitable sensor and actuator for a given mechatronics system.	L1	Remember
CO3	Distinguish and analyse various circuits for signal conditioning and their interfacing with microcontrollers.	L4	Analyze
CO4	Design hydraulic/pneumatic circuits.	L6	Create
CO5	Analyse continuous control logics (P, PI, PD and PID) for standard input conditions.	L4	Analyze
CO6	Develop ladder logic programming.	L6	Create

Course Contents

Unit-I — 06 Hrs

Introduction of Mechatronics and automation

Key elements of mechatronics and automation, Applications of Mechatronics domestic, industrial etc.

Levels of automation

Automation principles and strategies: ten strategies of automation and production system, automation migration strategy

Advanced automation functions: safety, maintenance repair diagnosis, error detection and recovery

Unit-II — 06 Hrs

Sensors and actuators

Sensors: Criteria for selection of sensors based on requirements, principle of measurement, sensing method, performance chart etc. (Displacement, temperature, acceleration, force/pressure) based on static and dynamic characteristics.

Actuators: Selection of actuators based on principle of operation, performance characteristics, maximum loading conditions, safety etc.

Principle and selection of mechano-electrical actuators (1) DC motors (2) Stepper Motors (3) Solenoid Actuators (4) Servo Motors (5) BLDC.

Unit-III — 08 Hrs

Mechanization, Automation and Interfacing: Mechanization and automation, product cycle, hard Vs flexible automation, Capital- intensive Vs low-cost automation Types of systems-mechanical, electrical, hydraulic, pneumatic and hybrid systems Automation using CAMS, Geneva mechanisms, gears etc.

Assembly line Automation: automated assembly systems, transfer systems, vibratory bowl feeders, non-vibratory feeders, part orienting, feed track, part placing part escapement systems Introduction to Material storage/ handling and transport systems, and its automation using AS/RS, AGVS and conveyors etc.

Interfacing: Interfacing of 8051 with Different types of Motors.

Unit-IV — 10 Hrs

Pneumatic and Hydraulic Circuits

Hydraulic and pneumatic devices-Different types of valves, Actuators and auxiliary elements in Pneumatics hydraulics, their applications and use of their ISO symbols Synthesis and design of circuits (up to 3 cylinders)pneumatic, electro pneumatics and hydraulics

Design of Electro-Pneumatic Circuits using single solenoid and double solenoid valves; with and without grouping

Unit-V 12 Hrs

Introduction to Robotics, IoT and Artificial Intelligence: Automation and Robotics, Robot types, anatomy and related attributes, accuracy, repeatability Trajectory planning, Robot control system and end effector, Sensors in robotics, Industrial application and future applications, Introduction to IoT Introduction to Artificial Intelligence.

Reference Books

1. Mechatronics, Kenji Uchino and Jayne R. Giniewicz, publication: Marcel Dekker, Inc
2. Applied Mechatronics- A. Smaili and F. Mrad, OXFORD university press
3. Mechatronics System Design, Shetty and Kolk, Cengage Learning, India Edition
4. Introduction to Mechatronics and Measurement Systems, Alciatore and Histand, Tata McGraw-Hill
5. Mechatronics, Necsulescu, Pearson education
6. Mechatronics - Electromechanics and Control Mechanics, Mill Springer-Verlag
7. Mechatronics - Electronic Control Systems in Mechanical Engineering, Bolton Pearson education
8. Mechatronics - Electronics in products and processes, Bradley, et al. Chapman and Hall
9. Mechatronics - Mechanical System Interfacing, Auslander and Kempf, Prentice Hall
10. Introduction to Mechatronics, AppuKuttan K.K., OXFORD Higher Education
11. Pneumatic Circuits and Low-Cost Automation by Fawcett JR
12. The Art of Electronics, Horowitz and Hill Cambridge, University Press
13. Electromechanical Design Handbook, Walsh, McGraw-Hill
14. Electro-mechanical Engineering - An Integrated Approach, Fraser and Milne

Evaluation Scheme:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper will be based on the entire syllabus summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Mechatronics Laboratory (PCME6030L)

Practical Scheme	**Examination Scheme**
Practical : 2 Hrs./week	Teacher Assessment : 25 Marks
Credits : 1	End Sem Exam : 25 Marks
	Total: 50 Marks

List of Laboratory Experiments:

1. Study Behaviour of Inductive sensors
2. Study Behaviour of Capacitive sensors
3. Writing a PLC ladder Program for give task -1
4. Pneumatic circuit sequencing
5. Electro-pneumatic circuit sequencing
6. Study Manual Direction Control valve
7. Direct control of double acting cylinder

Any other experiment based on syllabus may be included, which would help the learner to understand topic/concept.

Evaluation Scheme:

Continuous Assessment (A):

Term work shall consist of minimum 6 experiments and 5 assignments.

The distribution of marks shall be as follows:

1. Performance in Experiments: 05 Marks
2. Journal Submission: 05 Marks
3. Viva-voce: 05 Marks
4. Subject Specific Lab Assignment/Case Study: 10 Marks

The final certification and acceptance of laboratory journal/manual/report will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the teacher assessment.

End Semester Examination (C):

Oral / Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Power Engineering (PCME6040T)

Teaching Scheme

Lectures : 3 Hrs./week

Credit : 3

Examination Scheme

Term Test : 15 Marks

Teacher Assessment : 20 Marks

End Sem Exam : 65 Marks

Total: 100 Marks

Pre-requisite: Knowledge of Thermodynamics and Fluid Mechanics

Course Objectives:

1. To study boilers, boiler mountings and accessories
2. To study steam turbines, hydraulic turbines and their utilities
3. To study pumps, compressors and their utilities

Course Outcomes:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand working of different types of boilers and analyze steam generator, steam turbine performance.	L2	Understand
CO2	Explain basic concepts in the case of centrifugal compressors and analyze their performance.	L2	Understand
CO3	Describe working of axial flow compressors and analyze their performance.	L2	Understand
CO4	Explain basic difference between impulse and reaction water turbines, determine various parameters and design turbine runners.	L2	Understand
CO5	Describe operating principles of reciprocating and centrifugal pumps and evaluate their performance.	L2	Understand

Course Contents

Unit-I

10 Hrs

Steam Generators

Fire tube and Water tube boiler, Low pressure and high-pressure boilers, once through boiler, examples, and important features of HP boilers, Mountings and accessories, Equivalent evaporation of boilers, Boiler performance, Boiler efficiency.

Steam Nozzle

Flow through steam nozzle-velocity at exit and condition for maximum discharge, nozzle efficiency.

Steam Turbine- Basic of steam turbine, Classification, compounding of turbine, Impulse turbine velocity diagram, Condition for max efficiency, Reaction turbine - velocity diagram, degree of reaction, Parson's turbine, Condition for maximum efficiency.

Unit-II

05 Hrs

Rotary Compressors: vane type compressors, scroll screw compressors etc.

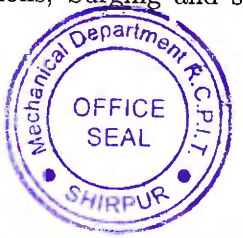
Centrifugal compressors: Work required, polytropic efficiency, pressure rise, slip, effect of blade shape, two-dimensional flow through impeller; Vaned diffuser and volute casing;

Surging and choking of compressors; Compressor performance and characteristic curves.

Unit-III

05 Hrs

Axial flow compressors; Cascade analysis, vortex theory, work required, polytropic efficiency, pressure rise, degree of reaction; Simple design calculations; Surging and stalling of compressors; Compressor performance and characteristic curves.



Unit-IV

10 Hrs

Hydraulic Turbines: Introduction to hydrodynamic thrust of jet on a fixed and moving surface (flat curve), Types of hydro turbines - impulse and reaction, definition of various turbine parameters like gross head, discharge, work done, input power, output power, efficiencies etc., Eulers' equation applied to a turbine, turbine velocities and velocity triangles, expression for work done.

Impulse Turbine: Components of Pelton turbine, definition of design parameters like speed ratio, jet ratio, and estimation of various parameters like head, discharge, and efficiency etc., determination of number of buckets.

Reaction Turbines: Types of reaction turbines - inward and outward flow, Francis turbine, Kaplan turbine; elements of the turbine, estimation of various parameters. Unit quantities in turbines.

Unit-V

12 Hrs

Pumps

Classification of pumps: positive displacement and non - positive displacement

Positive Displacement pumps: Types and applications, general features of rotary pumps, general feature of reciprocating pumps, definition of head, discharge, work done and efficiency, types of reciprocating pumps, indicator diagram, use of air vessel.

Centrifugal Pumps: Types - radial flow, mixed flow and axial flow, priming of pumps, components of the pump, Euler's equation and velocity triangles, correction factors for the head, design constant e.g., head constant, flow constant etc. self-priming pumps, series and parallel operation of pumps, system curve, determination of operating point, Cavitation in pumps, Determination of available and required NPSH, Model testing, Dimensional analysis.

Submersible Pumps: Types and applications, general features of submersible pumps, work done and efficiency

Reference Books

1. Thermal Engineering, R K. Rajput, 10th edition, Laxmi Publication
2. Thermal Engineering, Kothandraman, Domkundwar, Khajuria, Arora, 5th edition, 2002, Dhanpatrai Sons
3. Thermal Engineering, Ballaney P.L., 25th edition, 2015, Khanna Publishers.
4. Steam Gas Turbines and Power Plant Engineering, R. Yadav, 7th edition, 2000, Central Publishing house Allahabad
5. Fluid Mechanics and Fluid Machines, D.S. Kumar, 2013, S.K. Kataria Sons
6. Fluid Mechanics and Machinery, C. S. P. Ojha, P. N. Chandramouli, R. Berndtsson, 2010, Oxford University Press
7. Fluid Mechanics and Hydraulic Machinery, P. N. Modi and S. M. Seth, 17th edition, 2011, Standard Book House.
8. Hydraulic Machines Including Fluidics, Jagdish Lal, 6th edition, 2016, Metropolitan Book Company pvt. Ltd.

9. Theory and Design of Hydraulic Machines Including Basic Fluid Mechanics, Vasandani V.P., Khanna Publishers.

10. Hydraulic Machines, R K Rajput, S.Chand Publication.

11. Fluid Mechanics and Fluid Machines, Bansal R.K, 9th edition, 2015, Laxmi Publications.

12. Turbines, Fans and Compressors; Yahya S.M, 4th edition, 2011, Tata McGraw Hill.

Evaluation Scheme:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper will be based on the entire syllabus summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Power Engineering Laboratory (PCME6040L)

Practical Scheme

Practical : 2 Hrs./week

Credits : 1

Examination Scheme

Teacher Assessment : 25 Marks

Total : 25 Marks

List of Laboratory Experiments:(Any six)

1. Study/Demonstration of Boilers
2. Study/Demonstration of Boiler mountings and accessories
3. Study of Steam Turbine
4. Trial on Impulse turbine (Pelton Wheel)
5. Trial on Reaction water turbine (Francis / Kaplan turbine)
6. Study of Rotary compressors
7. Trial on Positive displacement pump
8. Trial on Single stage centrifugal pump
9. Trial on Multistage centrifugal pump
10. Demonstration of different components of Centrifugal pump by dismantling the pump system.

Evaluation Scheme:

Continuous Assessment (A):

Term work shall consist of minimum 06 experiments, minimum 05 assignments covering numerical.

The distribution of marks shall be as follows:

1. Performance in Experiments: 05 Marks
2. Journal Submission: 05 Marks
3. Viva-voce: 05 Marks
4. Subject Specific Lab Assignment/Case Study: 10 Marks

The final certification and acceptance of laboratory journal/manual/report will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the teacher assessment.

Smart Materials (PEME6051T)

Teaching Scheme	Examination Scheme
Lectures : 3 Hrs./week	Term Test : 15 Marks
Credit : 3	Teacher Assessment : 20 Marks
	End Sem Exam : 65 Marks
	Total: 100 Marks

Pre-requisite: Knowledge of Material Technology

Course Objectives:

1. To study the working principles of various smart materials.
2. To identify applicability of various smart materials as actuator and sensor.
3. To study advances in smart materials

Course Outcomes:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand working of smart materials and their application as actuator and sensor.	L2	Understand
CO2	Select an appropriate smart material for a given application.	L1	Remember
CO3	Identify applicability of smart materials for new prospective smart structures.	L1	Remember

Course Contents

Unit-I

08 Hrs

Introduction to Smart Materials: Overview of the different types of Smart Materials, Smart materials used in structures, smart material for sensors, actuators controls, memory and energy storage and their inter-relationships, concept of High bandwidth- low strain generating materials (HBLS), and Low Bandwidth High Strain Generating Materials (LBHS)

Unit-II

09 Hrs

Overview of the following materials with focus on synthesis, constitutive/governing relationships, strengths and weaknesses, and applications (both sensing and actuation etc) 1. Peizoelectric Materials 2. Magnetostrictive Materials 3. Shape Memory Alloys 4. Electroactive Polymers

Unit-III

09 Hrs

Overview of the following materials with focus on synthesis, strengths and weaknesses, and applications 1. Ferrofluids and Magneto rheological Fluids and applications in dampers 2. Soft Matter and its applications as smart skins, smart textiles etc 3. Carbon Nanotubes and Carbon nano-structures and its applications 4. Thermoelectric Materials and Peltier devices

Unit-IV

08 Hrs

Smart Materials for Energy Applications: Materials used for energy storage, Hydrogen Storage Materials, Energy harvesting, Energy scavenging from vibrations

Unit-V

08 Hrs

Composite Materials: Introduction to Composite Materials, Nano Composite Materials, Soft conducting and magnetic solids, active fiber composites, Smart polymer matrix composites

Reference Books

1. Shape Memory Alloys; D.C. Lagoudas; 2008; Springer Science.

2. Self-healing Materials: Fundamentals, Design Strategies and Applications; S.K. Ghosh; 2009;

Wiley- VCH Verlag GmbH and Co.

3. Energy Harvesting Technologies; S Priya and D J Inman; 2008; Springer-Verlag.
4. Optical Materials and Applications; Moriaki Wakaki; 2012; CRC Press.
5. Polymer Nano-composites and their Applications; S.S. Ray, M Bousmina; 2008; American Scientific Publishers.
6. Smart Materials and Structures; M.V. Gandhi and B.S. Thompson; 1992; Chapman Hall, London; New York.
7. Encyclopedia of Smart Materials Vol. I and II; Mel Scwartz; 2002; John Wiley Sons.
8. Smart Structures: Analysis and Design; A.V. Srinivasan; 2001; Cambridge University Press, Cambridge; New York.
9. Piezoelectric Sensorics: Force, Strain, Pressure, Acceleration and Acoustic Emission Sensors, Materials and Amplifiers; G. Gautschi; 2002; Springer, Berlin; New York.
10. Piezoelectric Actuators and Ultrasonic Motors; K. Uchino; 1997; Kluwer Academic Publishers, Boston.
11. Handbook of Giant Magnetostrictive Materials; G. Engdahl; 2000; Academic Press, San Diego, Calif.;London.
12. Shape Memory Materials; K. Otsuka and C.M. Wayman; 1998; Cambridge University Press, Cambridge; New York.
13. Fiber Optic Sensors: An Introduction for Engineers and Scientists; Eric Udd; 1991; John Wiley Sons, New York.
14. Electroactive Polymers for Robotic Applications: Artificial Muscles and Sensors; Kwang J KIm and Satoshi Tadokore; 2007; Springer-Verlag, London.

Evaluation Scheme:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.
2. Total duration allotted for writing each of the paper is 1 hr.

3. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper will be based on the entire syllabus summing up to 65 marks.

2. Total duration allotted for writing the paper is 3 hrs.

Design of Heat Exchanger Equipment

(PEME60512T)

Teaching Scheme

Lectures : 3 Hrs./week

Credit : 3

Examination Scheme

Term Test : 15 Marks

Teacher Assessment : 20 Marks

End Sem Exam : 65 Marks

Total: 100 Marks

Pre-requisite: Knowledge of Heat Exchangers and Heat Transfer.

Course Objectives:

1. To understand the factors influencing the design of Heat Exchanger
2. To design the various parts of a Heat Exchanger

Course Outcomes:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Classify different HX and understand the methodologies for its design.	L4	Analyze
CO2	Design double pipe HX.	L6	Create
CO3	Design SHTX.	L6	Create
CO4	Design Compact HX.	L6	Create
CO5	Understand the heat transfer enhancement techniques and performance evaluation.	L2	Understand

Course Contents

Unit-I — 10 Hrs

Different classification and basic design methodologies for heat exchanger:

Classification of heat exchanger, selection of heat exchanger, overall heat transfer coefficient, LMTD method for heat exchanger analysis for parallel, counter, multi-pass and cross flow heat exchanger, e-NTU method for heat exchanger analysis, fouling, cleanliness factor, percent over surface, techniques to control fouling, additives, rating and sizing problems, heat exchanger design methodology)

Unit-II — 08 Hrs

Design of double pipe heat exchangers:

Thermal and hydraulic design of inner tube and annulus, hairpin heat exchanger with bare and finned inner tube, total pressure drop

Unit-III — 10 Hrs

Design of Shell tube heat exchangers:

Basic components, basic design procedure of heat exchanger, TEMA code, J-factors, conventional design methods, Bell-Delaware method.

Unit-IV — 05 Hrs

Design of compact heat exchangers:

Heat transfer enhancement, plate fin heat exchanger, tube fin heat exchanger, heat transfer and pressure drop

Unit-V — 06 Hrs

Heat Transfer Enhancement and Performance Evaluation:

Enhancement of heat transfer, Performance evaluation of Heat Transfer Enhancement technique. Introduction to pinch analysis.

Reference Books

1. Heat Exchangers; Sadik Kaka, Hongtan Liu, Anchasa Pramuanjaroenkij; 4th Edition; 2020;

CRC Press

2. Compact Heat Exchangers; Kays, V.A. and London, A.L; Third Edition; 1998; Mc Graw Hill.

3. Fundamentals of Heat Exchanger Design; Ramesh K Shah, Dusan P. Sekulic;2003; Wiley Publication

4. Process Heat transfer; D Q Kern; 2nd Edition; 2019; Tata Mc Graw Hill

Evaluation Scheme:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper will be based on the entire syllabus summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Reliability Engineering (PEME6053 T)

Teaching Scheme	Examination Scheme
Lectures : 3 Hrs./week	Term Test : 15 Marks
Credit : 3	Teacher Assessment : 20 Marks
	End Sem Exam : 65 Marks
	Total: 100 Marks

Pre-requisite: Knowledge of Probability.

Course Objectives:

1. To familiarize the students with various aspects of probability theory.
2. To acquaint the students with reliability and its concepts.
3. To introduce the students to methods of estimating the system reliability of simple and complex systems.
4. To understand the various aspects of Maintainability, Availability and FMEA procedure.

Course Outcomes:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Apply the laws of Probability to engineering problems.	L3	Apply
CO2	Analyze failure data and apply various reliability concepts to calculate different reliability parameters.	L4	Analyze
CO3	Evaluate the system reliability of simple and complex systems.	L5	Evaluate
CO4	Apply redundancy techniques to improve the system Reliability.	L3	Apply
CO5	Apply a Failure Mode Effect and Criticality Analysis, Fault tree analysis and Event tree analysis to analyze complex systems.	L3	Apply

Course Contents

Unit-I — 09 Hrs

Probability theory: Probability: Standard definitions and concepts; Conditional Probability, Bayes Theorem.

Probability Distributions: Binomial, Normal, Poisson, Weibull, Exponential, relations between them and their significance.

Measures of Central tendency and Dispersion: Mean, Median, Mode, Range, Mean Deviation, Standard Deviation, Variance, Skewness and Kurtosis.

Unit-II — 09 Hrs

Reliability Concepts: Reliability definitions, Importance of Reliability, Quality Assurance and Reliability, Bath Tub Curve.

Failure Data Analysis: Hazard rate, failure density, Failure Rate, Mean Time To Failure (MTTF), MTBF, Reliability Functions.

Reliability Hazard Models: Constant Failure Rate, Linearly increasing and decreasing Failure rate, Time Dependent Failure Rate, Weibull Model. Distribution functions and reliability analysis.

Unit-III — 06 Hrs

System Reliability: System Configurations: Series, parallel, mixed configuration, k out of n structure, Complex systems.

Unit-IV — 10 Hrs

Reliability Improvement: Redundancy Techniques: Element redundancy, Unit redundancy, Standby redundancies. Markov analysis.

System Reliability Analysis Enumeration method, Cut-set method, Success Path method, Decomposition method.

Unit-V — 08 Hrs

Maintainability and Availability: System downtime, Design for Maintainability: Maintenance requirements, Design methods: Fault Isolation and self-diagnostics, Parts standardization and Inter-

changeability, Modularization and Accessibility, Repair Vs Replacement.

Availability qualitative aspects.

Failure Mode, Effects and Criticality Analysis: Failure mode effects analysis, severity/criticality analysis, FMECA examples. Fault tree construction, basic symbols, development of functional reliability block diagram, Fault tree analysis and Event tree Analysis.

Case studies on Fault tree/event tree analysis.

Text Books

1. Reliability Engineering; L.S. Srinath; 4th edition; 2008; Affiliated East-West Press (P) Ltd.
2. Reliability Engineering; E Balagurusamy; 2017; Tata McGraw-Hill.

Reference Books

1. Engineering Reliability; B.S. Dhillion, C. Singh; 1981; John Wiley Sons.
2. Reliability and Maintainability Engineering; Charles E. Ebeling; 2007; Tata McGraw Hill.
3. Practical Reliability Engineering; P.D.T. Connor, A Kleyner; 5th edition; 2012; John Wiley Sons.
4. Reliability in Engineering Design; K.C. Kapur, L.R. Lamberson; 2009; John Wiley Sons.
5. Probability and Statistics; Murray R. Spiegel; 3rd edition; 2010; Tata McGraw-Hill.

Evaluation Scheme:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper will be based on the entire syllabus summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Database Management System (PCME6060L)

Practical Scheme

Practical : 2 Hrs./week

Credits : 1

Examination Scheme

Teacher Assessment : 25 Marks

End Sem Exam : 25 Marks

Total: 50 Marks

Course Objectives:

1. Learn and practice data modeling using the entity-relationship (ER) and developing database designs.
2. Understand the use of Structured Query Language (SQL) and learn SQL syntax.
3. Understand the need of database processing and learn techniques for controlling the consequences of concurrent data access.

Course Outcomes:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand the fundamentals of a database system and design an optimized database.	L2	Understand
CO2	Design and draw ER and EER diagram for the real-life problem.	L3	Apply
CO3	Create and populate a Relational Database and retrieve any type of information from the database by formulating SQL queries.	L3	Apply
CO4	Analyze and apply concepts of normalization to relational database design.	L4	Analyze
CO5	Understand the concept of transaction, concurrency and recovery.	L2	Understand

Unit-I — 03 Hrs

Introduction Database Concepts: Introduction, characteristics of database, database system applications, file system v/s database system, View of data, data independence, data models, database languages, database design, DBMS system architecture, database users and DBA.

Unit-II — 05 Hrs

EntityRelationship Data Model: Introduction, The Entity-Relationship (ER) Model: Entity types, Entity sets, types of attributes, keys, and relationships, Relationship constraints: cardinality and participation, Entity-Relationship (ER) diagram.

Unit-III — 12 Hrs

Structured Query Language (SQL): Introduction, SQL data definition, basic structure of SQL and basic operations, aggregate functions: group by having nested and complex queries, modification of the database, Views in SQL, Joins, Integrity constraints, Functions, Stored Procedures, Triggers, and Cursors.

Unit-IV — 05 Hrs

Relational Database Design: Pitfalls in Relational-Database design, Concept of Normalization, Function Dependencies, First Normal Form, 2nd NF, 3rd NF, BCNF and 4th NF.

Unit-V — 03 Hrs

Transaction Management and Concurrency: Transaction concept, Transaction model, ACID properties, transaction atomicity and durability, concurrent executions.

List of Experiments: (However Instructor is free to design his/her own experiments)

1. To draw an ER diagram for a problem statement and design a relational schema for the same
2. To implement DDL SQL queries / commands
3. To implement DML SQL queries / commands
4. To implement aggregate functions

5. To implement Integrity Constraints
6. To implement Joins and Views
7. To implement nested queries and sub-queries
8. To implement triggers.
9. To implement procedures, functions and cursors.

Text Books

1. Korth, Slberchatz, Sudarshan, Database System Concepts, 6th edition, McGraw Hill
2. Elmasri and Navathe, Fundamentals of Database Systems, Pearson education.
3. G. K. Gupta; Database Management Systems, 5th edition, McGraw Hill.

Reference Books

1. Peter Rob and Carlos Coronel, Database Systems Design, Implementation and Management, 5th edition, Thomson Learning.
2. P.S. Deshpande, SQL and PL/SQL for Oracle 10g, Black Book, 2009, Dreamtech Press.
3. Mark L. Gillenson, Paul raj Ponniah, Introduction to Database Management, Wiley
4. Oracle for Professional, Sharaman Shah, SPD.
5. Raghu Ramkrishnan and Johannes Gehrke, Database Management Systems, TMH.

Evaluation Scheme:

Continuous Assessment (A): Term work shall consist of minimum 8 experiments and two assignments.

The distribution of marks shall be as follows:

1. Performance in Experiments: 05 Marks
2. Journal Submission: 05 Marks
3. Viva-voce: 05 Marks
4. Subject Specific Lab Assignment/Case Study: 10 Marks

The final certification and acceptance of laboratory journal/manual/report will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the teacher assessment.

End Semester Examination (C):

Oral / Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Project Stage-I (PJME6070L)

Practical Scheme
Practical : 02 Hrs./week
Credit : 01

Examination Scheme
Teacher Assessment : 25 Marks
End Sem Exam : 25 Marks
Total : 50 Marks

Course Objectives:

- To implement the solution as per the problem statement.
- To develop the team building, writing, logical reasoning and management skills.
- To provide the connections between the designs and concepts across different disciplinary boundaries.
- To encourage students to become independent personnel, critical thinkers and lifelong learners.

Course Outcomes:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Apply engineering knowledge to produce solution of a problem considering cultural, social, environmental, and economic factors using appropriate tool and method. .	L4	Analyze
CO2	Demonstrate project based learning that allows students to transfer existing ideas into new applications.	L2	Understand
CO3	Develop an ability to work in teams and manage the conduct of the research study.	L3	Apply
CO4	Integrate different perspectives from relevant disciplines which help them to get internships, jobs and admission for higher studies.	L3	Apply
CO5	Present the research in the form of technical writing, understand what constitutes to plagiarism and how to use proper referencing styles.	L2	Understand

Syllabus:

Domain knowledge (any beyond) needed from the areas of Mechanical Engineering for the effective implementation of the project.

The areas can be updated based on the technological innovations and development needed for specific project.

Each student shall work on project approved by departmental committee approved by the Head of Department, a group of 03 to 05 students (max allowed: 5 students in extraordinary cases, subject to the approval of the department committee and the Head of the department) shall be allotted for each Semester Project. Each group shall submit at least 3 topics for the Semester Project. The departmental committee shall finalize one topic for every group. Semester Project Title or Theme should be based on knowledge acquired during semester. The project work shall involve sufficient work so that students get acquainted with different aspects of knowledge acquired from semester subjects.

Guidlines: The main purpose of this activity is to improve the students technical skills, communication skills by integrating writing, presentation and teamwork opportunities.

- Each group will be reviewed twice in a semester and marks will be allotted based on the various points mentioned in the evaluation scheme.
- In the first review of this semester, each group is expected to complete 30 percent of project.
- In the second review of this semester, each group is expected to complete 50 percent of project.
- Interaction with alumni mentor will also be appreciated for the improvement of project.

Student is expected to:

- Select appropriate project title based on acquired knowledge from current semester subjects.
- Maintain Log Book of weekly work done(Log Book Format will be as per Table 4).
- Report weekly to the project guide along with log book.

Assessment Criteria:

- At the end of the semester, after confirmation by the project guide, each project group will submit project completion report in prescribed format for assessment to the departmental committee (including project guide).
- Assessment of the project stage I (at the end of the semester) will be done by the departmental committee (including project guide).
- Oral examination should be conducted by Internal and External examiners. Students have to give presentation and demonstration based on their project.

Prescribed project report guidelines:

Size of report shall be of minimum 25 pages. Project Report should include appropriate content for:

- Introduction
- Literature Survey
- Related Theory
- Implementation details
- Project Stage I Outcomes
- Conclusion
- References

Assessment criteria for the departmental committee (including project guide) for Continuous Assessment:

Guide will monitor weekly progress and marks allocation will be as per Table 5.

Assessment criteria for the departmental committee (including project guide) for End Semester Exam:

Each group will be reviewed twice in a semester by faculty guide and faculty coordinator based on the following criteria:

- Project progress
- Documentation/Technical paper writing
- Key findings
- Validation of results

Each review consists of 25 marks. Average of the marks scored in both the two reviews will be considered for final grading. The final certification and acceptance of TA ensures the satisfactory performance on the above aspects.

Departmental committee (including project guide) will evaluate project as per Table 6.

Table 4: Log Book Format

Sr	Week (Start Date:End Date)	Work Done	Sign of Guide	Sign of Coordinator
1				
2				

Table 5: Continuous Assessment Table

Sr	Exam Seat No	Name of Student	Student Attendance	Log Book Maintain	Literature Review	Depth of Understanding	Report	Total
			5	5	5	5	5	25

Table 6: Evaluation Table

Sr	Exam Seat No	Name of Student	Project Selection	Design/ Methodology	Fabrication/ Modeling/ Simulation	Result Verification	Presentation	Total
			5	5	5	5	5	25

Environmental Studies (MCME6080T)

Teaching Scheme

Lectures : 1 Hr./week

Examination Scheme

Pre-requisite: Interest in Environment and its impact on Human.

Course Objectives:

1. Understand environmental issues such as depleting resources, pollution, ecological problems and the renewable energy scenario.
2. Familiarise environment related legislation
3. Understand and compare solar energy

Course Outcomes:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand how human activities affect environment.	L2	Understand
CO2	Understand the various technology options that can make a difference.	L2	Understand
CO3	Identify the advantages of solar energy over other forms of energy.	L1	Remember

Unit-I 04 Hrs

Social issues and Environment

Ecological footprint and Carrying Capacity Depleting nature of Environmental resources such as soil, water minerals and forests Carbon emissions and Global Warming.

Unit-II 04 Hrs

Technological growth for Sustainable Development

Social, Economical and Environmental aspects of Sustainable Development Renewable Energy Harvesting Concept of Carbon credit, Green Building Power and functions of Central Pollution Control Board and State Pollution Control Board

Unit-III 05 Hrs

Solar Energy

Basic concept of Solar Radiation Study of Solar panels Comparative study of Solar energy with other energy sources

Text Books:

1. Environmental Studies From Crisis to Cure, R. Rajagopalan, 2012
2. Textbook of Environmental Studies For Undergraduate Courses, Erach Bharucha
3. Solar Engineering, Sukhatme