DEPARTMENT OF MECHANICAL ENGINEERING
GURU JAMBHESHWAR UNIVERSITY OF SCIENCE & TECHNOLOGY, HISAR

B.Tech. (Mechanical Engineering) Programme

VI- Semester

Sr. No.	Category	Course Code		Course Title	Hours per week			Course Credits		
		Theory	Practical		L	T	P	Theory	Practical	Total
1.	Open Elective Courses	OE (refer to list)##	--	Open Elective-II	3	0	0	3.0	--	3.0
2.	Professional Elective Courses	PEC (refer to list)*	--	Professional Elective -I	3	0	0	3.0	--	3.0
3.	Humanities & Social Sciences including Management Courses	HSMC301-T	--	Economics for Engineers	2	0	0	2.0	--	2.0
4.	Professional Core Courses	PCC-ME305-T	PCC-ME305-P	Dynamics of Machines	3	0	2	3.0	1.0	4.0
5.	Professional Core Courses	PCC-ME306-T	PCC-ME306-P	Automobile Engineering	3	0	2	3.0	1.0	4.0
6.	Professional Core Courses	PCC-ME307-T	PCC-ME307-P	Heat Transfer	3	1	2	4.0	1.0	5.0
7.	Mandatory Courses	MC-ME302-T	--	Entrepreneurship	3	0	0	0.0	--	0.0
					20	1	6			
Total credits										21.0

Note- At the end of the VI-semester each student would undergo 4-6 weeks practical training in an industry/research laboratory.

##Open Elective –II	
Course Code	**Course Name**
OE-PTG392-T	Graphics Design Fundamentals
OE-CSE392-T	Introduction to Soft Computing
OE-ECE392-T	Fundamentals of Communication Systems
OE-FT392-T	Food Safety, Quality and Regulations
OE-CE392-T	Introduction to Fluid Mechanics
OE-EE392-T	Renewable Energy Resources

*Professional Elective -I	
Course Code	**Course Name**
PEC-ME351-T	Operation Research
PEC-ME352-T	Work Study
PEC-ME353-T	Total Quality Control
PEC-ME354-T	Production Management
PEC-ME355-T	Industrial Engineering

6th Semester

DYNAMICS OF MACHINES (THEORY)

General Course Information

Course Code: PCC-ME305-T Course Category: Professional Core Course Course Credits: 3.0 Contact Hours: 3 hours/week (L: 3; T: 0) Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Outcomes

Sr. No.	Course Outcome	RBT Level
CO1	Students will be able to define the various mechanical systems like flywheel, transmission drives, governor, gyroscope, brake, dynamometer and balancing, and state forces and their effect acting on them, and fundamental laws of dynamics.	L1
CO2	Students will be able to describe different mechanical systems and their dynamic behaviour.	L2
CO3	Students will be able to solve different kind of problems related to force analysis in different mechanical systems.	L3
CO4	Students will be able to analyse different mechanical systems dynamically.	L4
CO5	Students will be able to select and design appropriate mechanical system required for a particular application.	L5

Course Contents

UNIT-I

Flywheel: Turning Moment Diagrams, Fluctuation of Energy, Coefficient of Fluctuation of Energy and Speed, Application in Engines and Punching Presses, Problems

Belts, Ropes and Chain Drives: Types of Belt Drives, Velocity Ratio, Slip, Belt Length, Crowning of Pulleys, V-Belts, Condition for Transmission of Maximum Power, Centrifugal Tension, Chain Drive, Types of Chains, Merits and Demerits of Chain Drive over Belt Drive, Problems

UNIT-II

Governors: Governor, Types of Governors, Centrifugal Governors, Watt Governor, Porter Governor, Proell Governor, Hartnell Governor, Hartung Governor, Wilson- Hartnell Governor, Pickering Governor, Sensitiveness of Governors, Stability of Governors, Hunting of Governors, Effort and Power of a Governor, Problems

Gyroscope: Gyroscope, Gyroscopic Couple, Gyroscopic Stabilization of Aeroplane and Ship, Stability of Four Wheel and Two Wheel Vehicles Moving on Curved Path, Problems

UNIT-III

Brakes: Brake, Types of Brakes, Block or Shoe Brake, Band Brake, Differential Band Brake, Band and Block Brake, Internal Expanding Shoe Brake, Braking Effect in a Vehicle, Problems

Dynamometers: Dynamometer, Types of Dynamometers, Prony Brake Dynamometer, Rope Brake Dynamometer, Epicyclic Train Dynamometer, Belt Transmission Dynamometer, Torsion Dynamometer, Problems

UNIT-IV

Balancing of Rotating Parts: Static Balancing, Dynamic Balancing, Balancing of Rotating Masses, Balancing of Several Masses Rotating in Same Plane by Graphical Method, Balancing of Several Masses Rotating in Different Planes by Graphical Method, Problems

Balancing of Reciprocating Parts: Balancing of Reciprocating Masses, Partial Balancing of Locomotives, Effect of Partial Balancing of Reciprocating Parts of Two Cylinder Locomotives, Balancing of Multi Cylinder Inline Engines, Radial Engines and V- Engines, Problems

Text and Reference Books

1. KJ, Waldron and GL, Kinzel, Kinematics, Dynamics and Design of Machinery, Wiley Publishers, Edition, 2016.
2. A, Ghosh and AK, Mallik, Theory of Mechanisms and Machines, East West Press Private Limited Publishers, Edition, 2017.
3. JJ, Uicker (Jr), GR, Pennock and JE, Shigley, Theory of Machines and Mechanisms, Oxford Publishers, 2016.
4. SS, Rattan, Theory of Machines, Tata McGraw Hill Publishers, Edition, 2017.

Course Articulation Matrix (CO to PO/PSO Mapping)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	1	--	--	--	--	--	--	--	3	3	--	--
CO2	3	2	1	1	--	--	--	--	--	2	--	3	3	--	--
CO3	3	3	2	1	1	--	--	--	1	2	--	3	3	--	--
CO4	3	3	2	2	1	--	--	1	2	2	--	3	3	1	1
CO5	3	2	3	2	2	--	--	1	2	2	--	3	3	2	3

1 : (Slight/Low), 2:(Moderate/Medium), 3 :(Substantial/High)

DYNAMICS OF MACHINE (LAB)

General Course Information

Course Code: PCC-ME305-P Course Category: Professional Core Course Course Credits: 1.0 Mode: Practical Contact Hours: 02 hours per week	**Course Assessment Methods (internal: 30; external: 70):** Internal practical evaluation is to be done by the course coordinator. The end semester practical examination will be conducted jointly by external and internal examiners

Course Outcomes

Sr. No.	Course Outcome	RBT Level
CO1	Students will be able to define the various mechanical systems like flywheel, transmission drives, governor, gyroscope, brake, dynamometer, balancing.	L1
CO2	Students will be able to describe different mechanical systems through models and experimental setups.	L2
CO3	Students will be able to solve different kind of problems related to force analysis in different mechanical systems experimentally.	L3
CO4	Students will be able to analyse dynamically and determine the parameters involved in the various mechanical systems experimentally.	L4
CO5	Students will be able to select and design appropriate mechanical system required for a particular application.	L5

Lab Contents

1. To perform experiment on Watt Governor, to Prepare Performance Characteristic Curves, and to find stability and sensitivity.
2. To Perform Experiment on Porter Governor, to Prepare Performance Characteristic Curves, and to Find Stability and Sensitivity.
3. To Perform Experiment on Proell Governor, to Prepare Performance Characteristic Curves, and to Find Stability and Sensitivity.
4. To Perform Experiment on Hartnell Governor, to Prepare Performance Characteristic Curves, and to Find Stability and Sensitivity.
5. To Study Gyroscopic Effects Through Models.
6. To Determine Gyroscopic Couple on Motorized Gyroscope.
7. To Perform the Experiment for Static Balancing on Static Balancing Machine.
8. To Perform the Experiment for Dynamic Balancing on Dynamic Balancing Machine.
9. Determine the Moment of Inertial of Connecting Rod by Compound Pendulum Method and Triflair Suspension Pendulum.
10. To Find BHP of an Engine by Using Rope Brake Dynamometer.

NOTE: *The list is indicative. The teacher can alter/add more number of experiments as per the requirement.*

Course Articulation Matrix (CO to PO/PSO Mapping)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	1	--	--	--	--	--	--	--	3	3	--	--
CO2	3	2	1	1	--	--	--	--	--	2	--	3	3	--	--
CO3	3	3	2	1	1	--	--	--	1	2	--	3	3	--	--
CO4	3	3	2	2	1	--	--	1	2	2	--	3	3	1	1
CO5	3	2	3	2	2	--	--	1	2	2	--	3	3	2	3

1 : (Slight/Low), 2:(Moderate/Medium), 3 :(Substantial/High)

AUTOMOBILE ENGINEERING (THEORY)

General Course Information

Course Code: PCC-ME306-T Course Category: Professional Core Course Course Credits: 3.0 Contact Hours: 3 hours/week (L: 3; T: 0) Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Outcomes

Sr. No.	Course Outcome	RBT Level
CO1	Students will be able to define the basic components of an automobile.	L1
CO2	Students will be able to explain the functions of all the basic components of an automobile.	L2
CO3	Students will be able to demonstrate the working of an automobile.	L3
CO4	Students will be able to examine the conditions of an automobile.	L4
CO5	Students will be able to evaluate the overall vehicle performance of an automobile.	L5

Course Contents

UNIT-I

Introduction to Automobiles : Classification, Components, Requirements of Automobile Body; Vehicle Frame, Separate Body & Frame, Unitized Body, Car Body Styles, Bus Body & Commercial Vehicle Body Types; Front Engine Rear Drive & Front Engine Front Drive Vehicles, Four Wheel Drive Vehicles, Safety considerations; Safety features of latest vehicle; Future trends in automobiles.

Clutches : Requirement of Clutches – Principle of Friction Clutch – Wet Type & Dry Types; Cone Clutch, Single Plate Clutch, Diaphragm Spring Clutch, Multi plate Clutch, Centrifugal Clutches, Electromagnetic Clutch, Over Running Clutch; Clutch Linkages.

UNIT-II

Power Transmission: Requirements of transmission system; General Arrangement of Power Transmission system; Object of the Gear Box; Different types of Gear Boxes; Sliding Mesh, Constant Mesh, Synchro- mesh Gear Boxes; Epi-cyclic Gear Box, Freewheel Unit. Overdrive unit-Principle of Overdrive, Advantage of Overdrive, Transaxle, Transfer cases.

Drive Lines, Universal Joint, Differential and Drive Axles: Effect of driving thrust and torque reactions; Hotchkiss Drive, Torque Tube Drive and radius Rods; Propeller Shaft, Universal Joints, Slip Joint; Constant Velocity Universal Joints; Front Wheel Drive; Principle, Function, Construction & Operation of Differential; Rear Axles, Types of load coming on Rear Axles, Full Floating, Three quarter Floating and Semi Floating Rear Axles.

UNIT-III

Suspension Systems: Need of Suspension System, Types of Suspension; factors influencing ride comfort, Suspension Spring; Constructional details and characteristics of leaf springs.

Steering System : Front Wheel geometry & Wheel alignment viz. Caster, Camber, King pin Inclination, Toe-in/Toe-out; Conditions for true rolling motions of Wheels during steering; Different types of Steering Gear Boxes; Steering linkages and layout; Power steering – Rack & Pinion Power Steering Gear, Electronics steering.

UNIT-IV

Automotive Brakes, Tyres & Wheels : Classification of Brakes; Principle and constructional details of Drum Brakes, Disc Brakes; Brake actuating systems; Mechanical, Hydraulic, Pneumatic Brakes; Factors affecting Brake performance, Power & Power Assisted Brakes; Tyres of Wheels; Types of Tyre & theirconstructional details, Wheel Balancing, Tyre Rotation; Types of Tyre wear & their causes.

Emission Control System & Automotive Electrical : Sources of Atmospheric Pollution from the automobile, Emission Control Systems – Construction and Operation of Positive Crank Case Ventilation (PVC) Systems, Evaporative Emission Control, Heated Air Intake System, Exhaust Gas Recirculation (ECR) Systems, Air Injection System and Catalytic Converters; Purpose construction & operation of lead acid Battery, Capacity Rating & Maintenance of Batteries; Purpose and Operation of Charging Systems, Purpose and Operations of the Starting System; Vehicle Lighting System.

Text and Reference Books

1. Automobile Engineering by Anil Chhikara, Satya Prakashan, New Delhi.
2. Automobile Engineering by Dr. Kirpal Singh, standard Publishers Distributors.
3. Automotive Mechanics – Crouse / Anglin, TMH.
4. Automotive Technology – H.M. Sethi, TMH, New Delhi.
5. Automotive Mechanics – S.Srinivasan, TMH, New Delhi.
6. Automotive Mechanics – Joseph Heitner, EWP.
7. Motor Automotive Technology by Anthony E. Schwaller – Delmer Publishers, Inc.
8. The Motor Vehicle – Newton steeds Garrett, Butter Worths.

Course Articulation Matrix (CO to PO/PSO Mapping)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	--	1	1	1	1	1	1	3	3	3	1
CO2	3	3	3	2	--	1	1	1	1	1	1	3	3	3	1
CO3	3	3	3	2	--	1	2	1	1	1	1	3	3	3	2
CO4	3	3	3	3	--	1	3	2	1	1	1	3	3	3	3
CO5	3	3	3	3	--	1	3	2	1	1	1	3	3	3	3

1 : (Slight/Low), 2:(Moderate/Medium), 3 :(Substantial/High)

AUTOMOBILE ENGINEERING (LAB)

General Course Information

Course Code: PCC-ME306-P Course Category: Professional Core Course Course Credits: 1.0 Mode: Practical Contact Hours: 02 hours per week	**Course Assessment Methods (internal: 30; external: 70):** Internal practical evaluation is to be done by the course coordinator. The end semester practical examination will be conducted jointly by external and internal examiners.

Course Outcomes

Sr. No.	Course Outcome	RBT Level
CO1	Students will be able to list the basic components required for an automobile.	L1
CO2	Students will be able to prepare a report on the constructional details, working principles and operation of different components of an automobile.	L2
CO3	Students will be able to demonstrate the function of basic components used in an automobile.	L3
CO4	Students will be able to differentiate the performance of different components used in an automobile.	L4
CO5	Students will be able to select the most suitable component form the available to improve the performance of an automobile.	L5

Lab Contents

1. To study and prepare report on the constructional details, working principles and operation of the following Automotive Engine Systems & Sub Systems.
    a. Multi-cylinder: Diesel and Petrol Engines.
    b. Engine cooling & lubricating Systems.
    c. Engine starting Systems.
    d. Contact Point & Electronic Ignition Systems.
2. To study and prepare report on the constructional details, working principles and operation of the following Fuels supply systems:
    a. Carburetors
    b. Diesel Fuel Injection Systems
    c. Gasoline Fuel Injection Systems.
3. To study and prepare report on the constructional details, working principles and operation of the following Automotive Clutches.
    a. Coil-Spring Clutch
    b. Diaphragm – Spring Clutch.
    c. Double Disk Clutch.
4. To study and prepare report on the constructional details, working principles and operation of the following Automotive Transmission systems.
    a. Synchromesh – Four speed Range.
    b. Transaxle with Dual Speed Range.
    c. Four Wheel Drive and Transfer Case.
    d. Steering Column and Floor – Shift levers.
5. To study and prepare report on the constructional details, working principles and operation of the following Automotive Drive Lines & Differentials.
    a. Rear Wheel Drive Line.
    b. Front Wheel Drive Line.
    c. Differentials, Drive Axles and Four Wheel Drive Line.
6. To study and prepare report on the constructional details, working principles and operation of the following Automotive Suspension Systems.
    a. Front Suspension System.
    b. Rear Suspension System.

7. To study and prepare report on the constructional details, working principles and operation of the following Automotive Steering Systems.
    a. Manual Steering Systems, e.g. Pitman –arm steering, Rack & Pinion steering.
    b. Power steering Systems, e.g. Rack and Pinion Power Steering System.
    c. Steering Wheels and Columns e.g. Tilt & Telescopic steering Wheels, Collapsible Steering Columns.
8. To study and prepare report on the constructional details, working principles and operation of the following Automotive Tyres & wheels.
    a. Various Types of Bias & Radial Tyres.
    b. Various Types of wheels.
9. To study and prepare report on the constructional details, working principles and operation of the Automotive Brake systems.
    a. Hydraulic & Pneumatic Brake systems.
    b. Drum Brake System.
    c. Disk Brake System.
    d. Antilock Brake System.
    e. System Packing & Other Brakes.
10. To study and prepare report on the constructional details, working principles and operation of Automotive Emission / Pollution control systems.
11. Modeling of any two automotive systems on 3D CAD using educational softwares (eg. 3D modeling package/Pro Engineering/I-Deas/ Solid edge etc.)
12. Crash worthiness of the designed frame using Hypermesh and LS-Dyna solver or other software.

NOTE: *The list is indicative. The teacher can alter/add more number of experiments as per the requirement.*

Course Articulation Matrix (CO to PO/PSO Mapping)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	--	2	2	1	1	1	1	3	3	3	1
CO2	3	3	3	1	--	2	2	1	1	1	1	3	3	3	1
CO3	3	3	3	1	--	2	2	1	1	2	1	3	3	3	1
CO4	3	3	3	1	--	3	3	2	2	2	2	3	3	3	3
CO5	3	3	3	1	--	3	3	2	2	2	2	3	3	3	3

1 : (Slight/Low), 2:(Moderate/Medium), 3 :(Substantial/High)

HEAT TRANSFER (THEORY)

General Course Information

Course Code: PCC-ME307-T Course Category: Professional Core Course Course Credits: 4.0 Contact Hours: 4 hours/week (L: 3; T: 1) Mode: Lectures and Tutorial Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Outcomes

Sr. No.	Course Outcome	RBT Level
CO1	Students will be able to define and relate different modes of heat transfer.	L1
CO2	Students will be able to describe, explain and compare the mechanisms of heat transfer.	L2
CO3	Students will be able to apply the basic principles of heat transfer in daily routine thermal systems and can demonstrate its working.	L3
CO4	Students will be able to examine and compare the operations of various heat transfer devices.	L4
CO5	Students will be able to evaluate the performance of various heat transfer devices.	L5
CO6	Students will be able to design and select a better heat exchanging/transfer device under given conditions.	L6

Course Contents

UNIT-I

Basics and Laws: Definition of Heat Transfer, Reversible and irreversible processes, Modes of heat flow, Combined heat transfer system and law of energy conservation.

Steady State Heat Conduction: Introduction, I-D heat conduction through a plane wall, long hollow cylinder, hollow sphere and Conduction equation in Cartesian, polar and spherical co-ordinate systems, Numericals.

UNIT-II

Steady State Conduction with Heat Generation: Introduction, 1 – D heat conduction with heat sources, Extended surfaces (fins), Fin effectiveness, Numericals.

Transient Heat Conduction: Systems with negligible internal resistance, Transient heat conduction in plane walls, cylinders, spheres with convective boundary conditions, Numericals.

UNIT-III

Convection: Forced convection-Thermal and hydro-dynamic boundary layers, Equation of continuity, Momentum and energy equations, Some results for flow over a flat plate and flow through tube, Fluid friction and heat transfer (Colburn analogy), Free convection from a vertical flat plate, Empirical relations for free convection from vertical and horizontal planes, Numericals.

Thermal Radiation: The Stephen-Boltzmann law, black body radiation, Shape factors and their relationships, Heat exchange between non black bodies, Electrical network for radiative exchange in an enclosure of two or three gray bodies, Radiation shields, Numericals.

UNIT-IV

Heat Exchangers: Classification, Performance variables, Analysis of a parallel/counter flow heat exchanger, Heat exchanger effectiveness, Numericals.

Heat Transfer with Change of Phase: Laminar film condensation on a vertical plate, Drop-wise condensation, Boiling regimes, Free convective, Nucleate and film boiling, Numericals.

Text and reference Books

1. Heat and Mass Transfer: Fundamentals and Application, Yunus A Cengel; Afshin J. Ghajar, Mc Graw Hill
2. Heat Transfer – J.P. Holman, John Wiley & Sons, New York.
3. Fundamentals of Heat & Mass Transfer–Incropera, F.P. & Dewitt, D.P –John Willey New York.
4. Conduction of Heat in Solids – Carslow, H.S. and J.C. Jaeger – Oxford Univ. Press.
5. Conduction Heat Transfer – Arpasi, V.S. – Addison – Wesley.
6. Compact Heat Exchangers – W.M. Keys & A.L. Landon, Mc. Graw Hill.
7. Thermal Radiation Heat Transfer – Cengel, R. and J.R. Howell, Mc. Graw Hill.
8. Heat Transmission – W.M., Mc.Adams , Mc Graw Hill.

Course Articulation Matrix (CO to PO/PSO Mapping)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	--	2	1	1	1	2	1	2	3	3	1
CO2	3	3	2	1	--	2	1	1	1	1	1	2	3	3	1
CO3	3	3	3	2	--	2	1	1	1	2	1	3	3	3	1
CO4	3	3	3	2	--	2	1	1	1	2	1	3	3	3	1
CO5	3	3	3	2	--	2	1	1	2	2	1	3	3	3	2
CO6	3	3	3	3	--	2	2	2	2	2	2	3	3	3	2

1 : (Slight/Low), 2:(Moderate/Medium), 3 :(Substantial/High)

HEAT TRANSFER (LAB)

General Course Information

Course Code: PCC-ME307-P Course Category: Professional Core Course Course Credits: 1.0 Mode: Practical Contact Hours: 02 hours per week	**Course Assessment Methods (internal: 30; external: 70):** Internal practical evaluation is to be done by the course coordinator. The end semester practical examination will be conducted jointly by external and internal examiners.

Course Outcomes

Sr. No.	Course Outcome	RBT Level
CO1	Students will be able to define and relate different modes of heat transfer.	L1
CO2	Students will be able to describe, explain and compare the mechanisms of heat transfer.	L2
CO3	Students will be able to apply the basic principles of heat transfer in daily routine thermal systems and can demonstrate its working.	L3
CO4	Students will be able to examine and compare the operations of various heat transfer devices.	L4
CO5	Students will be able to evaluate the performance of various heat transfer devices.	L5
CO6	Students will be able to design and select a better heat exchanging/transfer device under given conditions.	L6

Lab Contents

1. To determine the thermal conductivity of a metallic rod.
2. To determine the thermal conductivity of an insulating power.
3. To determine the thermal conductivity of a solid by the guarded hot plate method.
4. To find the effectiveness of a pin fin in a rectangular duct natural convective condition and plot temperature distribution along its length.
5. To find the effectiveness of a pin fin in a rectangular duct under forced convective and plot temperature distribution along its length.
6. To determine the surface heat transfer coefficient for a heated vertical tube under natural convection and plot the variation of local heat transfer coefficient along the length of the tube. Also compare the results with those of the correlation.
7. To determine average heat transfer coefficient for externally heated horizontal pipe under forced convection & plot Reynolds and Nusselt numbers along the length of pipe. Also compare the results with those of the correlations.
8. To measure the emissivity of the gray body (plate) at different temperature and plot the variation of emissivity with surface temperature.
9. To find overall heat transfer coefficient and effectiveness of a heat exchange under parallel and counter flow conditions. Also plot the temperature distribution in both the cases along the length of heat of heat exchanger.
10. To verify the Stefen-Boltzmann constant for thermal radiation.
11. To demonstrate the super thermal conducting heat pipe and compare its working with that of the best conductor i.e. copper pipe. Also plot temperature variation along the length with time or three pipes.
12. To study the two phases heat transfer unit.
13. To determine the water side overall heat transfer coefficient on a cross-flow heat exchanger.

NOTE: *The list is indicative. The teacher can alter/add more number of experiments as per the requirement.*

Course Articulation Matrix (CO to PO/PSO Mapping)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	--	2	1	1	1	2	1	3	3	3	1
CO2	3	3	2	1	--	2	1	1	1	2	1	3	3	3	1
CO3	3	3	2	1	--	2	1	1	1	2	1	3	3	3	1
CO4	3	3	3	2	--	2	1	1	2	2	1	3	3	3	1
CO5	3	3	3	2	--	2	1	1	2	2	1	3	3	3	1
CO6	3	3	3	2	--	2	1	1	2	2	2	3	3	3	2

1 : (Slight/Low), 2:(Moderate/Medium), 3 :(Substantial/High)

ENTREPRENEURSHIP (THEORY)

General Course Information

Course Code: MC-ME302-T Course Category: Mandatory Course Course Credits: 0.0 Contact Hours: 3 hours/week (L: 3; T: 0) Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Outcomes

Sr. No.	Course Outcome	RBT Level
CO1	Students will be able to describe the concept of entrepreneurship, the role of entrepreneurship in economic development of the country and the scope for an entrepreneur	L1
CO2	Students will be able to understand small enterprises, problems faced by small enterprises, engineering economics, product planning and development, the contents of a project report and formulation of a project report.	L2
CO3	Students will be able to apply the basic steps in setup a new business.	L3
CO4	Students will be able to examine the development of a startup.	L4

Course Contents

Unit – I

Entrepreneurship: Entrepreneurship, Role of entrepreneur in Indian economy, Characteristics of all entrepreneur, Types of entrepreneurs, some myths and realities about entrepreneurship.

Small scale Industries: Introduction, Role and scope of small scale industries, concept of small scale and ancillary industrial undertaking, How to start a small scale industry, Steps in launching own venture, procedure for registration of small scale industries, various development agencies- their functions and role in industrial and entrepreneurship development, Infrastructure facilities available for entrepreneurship development in India.

Unit – II

Engineering Economics: Definition and concept, Importance of Economics for engineers, present value, Wealth, Goods, Wants, Value and price, capital, money, utility of consumer and producer goods.

Costing: Introduction, Elements of cost, Prime cost, Overhead, Factory cost, Total cost, Selling Price, Nature of cost, Types of Cost.

Unit III

Depreciation: Definition and concept, Causes of Depreciation, Methods of calculating depreciation.

Economic analysis of investment: Introduction, Nature of selection problem, Nature of replacement problem, Replacement of items which deteriorate, Replacement of machines whose operating cost increase with time and the value of money also changes with time

Unit IV

Product planning and Development: Introduction, Requirement of a good product design, product development approaches, Product development process, Elements of concurrent engineering, Various controlling agencies involved their role and formalities for getting clearance before starting individual venture.

Preparation of feasibility Project Report: Tools for evaluation of techno-economic feasibility project report, Preparation of Preliminary Project Reports – Project Appraisal – Sources of Information, SWOT analysis.

Text and reference Books

1. The practice of Entrepreneurship - G.G. Meredikh, R.E. Nelson and P.A. Neck
2. Handbook of Entrepreneurship - Rao and Pareek
3. S.S.Khanka "Entrepreneurial Development" S.Chand & Co. Ltd. Ram Nagar New Delhi, 1999.
4. Kuratko & Hodgetts, "Enterprenuership – Theory, process and practices", Thomson learning 6th edition.
5. Hisrich R D and Peters M P, "Entrepreneurship" 5th Edition Tata McGraw-Hill, 2002
6. Mathew J Manimala," Enterprenuership theory at cross roads: paradigms and praxis" Dream tech 2nd edition 2006.88
7. Rabindra N. Kanungo "Entrepreneurship and innovation", Sage Publications, New Delhi, 1998.

Course Articulation Matrix (CO to PO/PSO Mapping)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	--	--	1	--	--	2	--	--	--	3	3	3	1	2	1
CO2	2	1	1	--	2	2	--	--	2	2	3	3	--	2	2
CO3	--	2	2	2	2	2	1	--	2	2	3	3	--	1	1
CO4	--	--	--	--	1	1	--	--	2	2	3	3	--	1	--

1 : (Slight/Low), 2:(Moderate/Medium), 3 :(Substantial/High)

Professional Elective -I

Course Code	Course Name	L	T	P	Credits
PEC-ME351-T	Operation Research	3	-	-	3.0
PEC-ME352-T	Work Study	3	-	-	3.0
PEC-ME353-T	Total Quality Control	3	-	-	3.0
PEC-ME354-T	Production Management	3	-	-	3.0
PEC-ME355-T	Industrial Engineering	3	-	-	3.0

OPERATION RESEARCH (THEORY)

General Course Information

Course Code: PEC-ME351-T Course Category: Professional Elective Course Course Credits: 3.0 Contact Hours: 3 hours/week (L: 3; T: 0) Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Outcomes

Sr. No.	Course Outcome	RBT Level
CO1	Students will be able to understand the concept of operation research	L1
CO2	Students will be able to learn the principles of linear programming problems and their applications	L2
CO3	Students will be able to apply the principles of transportation problems and assignment problems.	L3
CO4	Students will be able to formulate the OR models for various needs of the society and organization.	L4
CO5	Students will be able to solve the problems of society and organization using OR techniques.	L5

Course Contents

Unit - I

Introduction: Definition, role of operations research in decision-making, applications in industry. Concept on O.R. model building –Types & methods.

Linear Programming (LP): Programming definition, formulation, solution- graphical, simplex Gauss-Jordan reduction process in simplex methods, BIG-M methods computational, problems.

Unit - II

Deterministic Model: Transportation model-balanced & unbalanced, north west rule, Vogel's Method, least cost or matrix minimal, Stepperg stone method, MODI methods, degeneracy, assignment, traveling salesman, problems.

Advanced Topic Of LP: Duality, PRIMAL-DUAL relations-its solution, shadow price, economic interpretation, dual-simplex, post-optimality & sensitivity analysis, problems.

Unit - III

Waiting Line Models: Introduction, queue parameters, M/M/1 queue, performance of queuing systems, applications in industries, problems.

Project Line Models: Network diagram, event, activity, defects in network, PERT & CPM, float in network, variance and probability of completion time, project cost- direct, indirect, total, optimal project cost by crashing of network, resources leveling in project, problems.

Unit - IV

Simulation: Introduction, design of simulation, models & experiments, model validation, process generation, time flow mechanism, Monte Carlo methods- its applications in industries, problems.

Decision Theory: Decision process, SIMON model types of decision making environment- certainty, risk, uncertainty, decision making with utilities, problems.

Text and Reference Books

1. Operation Research – Hira, D.S.
2. Operation Research – TAHA, PHI, New Delhi.
3. Principle of Operations Research – Ackoff, Churchaman, arnoff, Oxford IBH, Delhi.
4. Operation Research- Gupta & Sharma, National Publishers, New Delhi.
5. Quantitative Techniques- Vohra, TMH, New Delhi
6. Principles of operation Research (with Applications to Managerial Decisions) by H.M.Wagher, Prentice Hall of India, New Delhi.
7. Operation Research – Sharma, Gupta, Wiley Eastern, New Delhi.
8. Operation Research – Philips, Revindran, Solgeberg, Wiley ISE.

Course Articulation Matrix (CO to PO/PSO Mapping)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	--	2	1	1	1	2	1	2	3	3	1
CO2	3	3	2	1	--	2	1	1	1	1	1	2	3	3	1
CO3	3	3	3	2	--	2	1	1	1	2	1	3	3	3	1
CO4	3	3	3	2	--	2	1	1	1	2	1	3	3	3	1
CO5	3	3	3	2	--	2	1	1	2	2	1	3	3	3	2

1 : (Slight/Low), 2:(Moderate/Medium), 3 :(Substantial/High)

WORK STUDY (THEORY)

General Course Information

Course Code: PEC-ME352-T Course Category: Professional Elective Course Course Credits: 3.0 Contact Hours: 3 hours/week (L: 3; T: 0) Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Outcomes

Sr. No.	Course Outcome	RBT Level
CO1	Student will be able to understand the concepts of work study and its application area.	L1
CO2	Student will be able to apply different types of engineering work methods with the help of charting and diagrams to eliminate unproductive activities under the different controls in operations and job analysis.	L2
CO3	Student will be able to record the activities of the people, materials and equipment to find alternative methods which minimize waste and to implement the devised method.	L3
CO4	Student will be able to find the standard time of any activity through work measurement techniques with the aim to improve the processes.	L4
CO5	Student will be able to design to the man–machine system ergonomically to improve Human Efficiency and reduce the effort of the workers	L5

Course Contents

Unit – I

Work Study: Definition and Objective of Work Study, Scope of Work Study, Advantages of Work Study, Techniques of Work Study, Work Study and Management, Work Study and Productivity

Unit – II

Method Study: Objectives and Procedure of Method Study, Selection of job, Various recording techniques like outline process charts, flow process charts, man machine charts, two handed process charts, string diagram, flow diagram, multiple activity chart, SIMO chart and micro motion study, cyclographs and chrono-cyclographs, Process Chart Symbols, Therblig

Unit- III

Work Measurement: Definition and Objectives of Work Measurement, Work measurement techniques, basic procedure of work measurement.

Time Study: Definition of Time Study, Difference between Time Study and Motion Study, Basic Procedure for Time Study, Time study equipment, Job evaluation and incentive schemes Various Time Estimates and Production Standard, Level of Performances, Allowances, allowances and standard time determination

Unit – IV

Ergonomics: Concept of Ergonomics, Objectives of Ergonomics, Man Machine System Interface, Anthropometry, Ergonomics and Safety, Fatigue in Workers, Quantitative qualitative representation and alphanumeric displays, control

types, relation between controls and displays, Design of work places, influence of climate on human efficiency. Influence of noise, vibration and light.

Text and Reference Books

1. Work study and Ergonomics by Suresh Dalela and Saurabh, Standard Publishers
2. Motion and Time Study by R. M. Bernes, John-Wiley & Sons, 2001.
3. Ergonomics at work by D.J. Oborne, John Wiley & Sons
4. Human Factors in Engineering and Design by Sanders Mark S and McCormick Ernert J, McGraw-Hill Inc., 1993.
5. International Labour organization, "Work-study", Oxford and IBH publishing company Pvt. Ltd., N.Delhi, 2001

Course Articulation Matrix (CO to PO/PSO Mapping)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	1	2	2	2	1	1	1	3	2	1	3	3
CO2	3	3	2	1	2	1	1	2	2	2	2	2	2	3	3
CO3	3	3	2	1	2	1	1	2	2	2	2	2	2	3	3
CO4	3	3	2	1	2	1	1	2	2	2	2	2	2	3	3
CO5	3	3	2	1	2	1	1	2	2	2	2	2	2	3	3

1 : (Slight/Low), 2:(Moderate/Medium), 3 :(Substantial/High)

TOTAL QUALITY CONTROL (THEORY)

General Course Information

Course Code: PEC-ME353-T Course Category: Professional Elective Course Course Credits: 3.0 Contact Hours: 3 hours/week (L: 3; T: 0) Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Outcomes

Sr. No.	Course Outcome	RBT Level
CO1	Student will be able to understand the philosophy and core values of Total Quality Control	L1
CO2	Student will be able to learn about the statistical quality control in production and apply the knowledge of control charts for monitoring the quality of process/product	L2
CO3	Student will be able to understand the standard sampling plans, learn the rejection process for a product in an industry.	L3
CO4	Student will be able to understand the different quality standards in industry.	L4

Course Contents

UNIT-I

Quality Control: Introduction, objectives, quality of design, quality of production, quality of conformance to design, quality of inspection, process monitoring, quality and productivity, quality cost. Advantages of Statistical Quality Control in Industry.

Fundamentals of Statistics and Probability in Quality Control: Events and probability, laws of probability. Statistical Distributions: Normal, Binomial and Poisson distribution, their importance in SQC. Poisson Probability as approximation to Normal Probability, use of Normal and Poisson distribution tables.

UNIT-II

Control Charts for Variables: Fundamentals of process control, tools of process control, quality characteristic, Design and use of Control Charts for Variables: Trial control limits, control limits for future use, revision of control limits. Cause and effect diagram, inferences on the state of the process from control charts, Type I and Type II errors and methods to reduce them. Use of X (X bar) charts and R- charts, X (X bar) and σ- charts. Efficiency of a control chart. OC curve of a control chart. Computing average run length for X- chart.

Trend Control Charts: Control Charts with Reject Limits and Modified Control Charts. Relationship between Specification Limits and Control Chart Limits, Process capability analysis and its importance in quality of conformance.

UNIT-III

Control Charts for Attributes: Defects and Defectives, control charts for fraction defectives and percent fraction defectives and number of defectives. Control charts for number of defects. Comparison of control charts for variables with the charts for attributes. Computing Average run length for a p-chart.

Product Control and its Tools: Fundamentals of lot-by-lot acceptance sampling by attributes: Notations, OC curve and its importance in acceptance sampling, AQL and LTPD for a sampling plan, Producer and consumer risks, Single and Double sampling plans and constructing OC curves, interpretation of the operating characteristics curve, Effect of change of sample size and acceptance number on OC curve, ATI, ASN, AOQ and AOQL concepts, economics of inspection. Item- by- item sequential sampling plans, OC curve and ASN curve for sequential sampling plan.

UNIT-IV

Standard Sampling Plans: Types of Standard Sampling Plans, Difference between Acceptance Rectification and Acceptance- Rejection Plans, single and double sampling plans based on AOQL and LTPD. Sampling plans based on Mil-Standards 105 E.

Motivation for quality assurance, zero defect program, quality circles, total quality management. Indian Standards on Process and Product Control. ISO-9000 Standards.

Text and Reference Books

1. Quality control Application – By Hansen BL, Ghare PH; Prentice Hall of India.
2. Statistical Quality Control - By E.L. Grant & R.S. Levenworth; T MH.
3. Quality Control – Paranthaman, D.; Tata McGraw Hill, India
4. Quality Planning and Analysis – Juran J.M. and F.M. Gryna, TMH, India
5. Total Quality Control – By Feigenbaum, A.V.; McGraw Hill International.
6. Statistical Quality Control – By Montgomery, D.C.; John Wiley & Sons (Asia)

Course Articulation Matrix (CO to PO/PSO Mapping)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	2	2	1	1	1	3	2	1	3	3
CO2	3	3	2	2	2	2	2	1	1	1	3	2	1	3	3
CO3	3	3	2	2	2	2	2	1	1	1	3	2	1	3	3
CO4	3	3	2	2	2	2	2	1	1	1	3	2	1	3	3

1 : (Slight/Low), 2:(Moderate/Medium), 3 :(Substantial/High)

PRODUCTION MANAGEMENT (THEORY)

General Course Information

Course Code: PEC-ME354-T Course Category: Professional Elective Course Course Credits: 3.0 Contact Hours: 3 hours/week (L: 3; T: 0) Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Outcomes

Sr. No.	Course Outcome	RBT Level
CO1	Student will be able to take the right decisions to optimize resources utilization by improving productivity of the Lands, Buildings, People, Materials, Machines, Money, Methods and Management effectively.	L1
CO2	Student will be able to understand the forecasting and material handling concepts.	L2
CO3	Student will be able to understand material management and learn different purchasing methods.	L3
CO4	Student will be able to understand the role of Production planning & control and implementation of Just in time technique in Production management.	L4
CO5	Student will be able to understand the Quality control and apply the control charts in Production management.	L5

Course Contents

UNIT-I

Introduction to Production Management- Introduction, History of Production Management, Definitions of Production Management, Objectives of Production Management, Scope of Production Management.

Forecasting- Purpose of sale forecasting, Importance of forecasting, Forecasting and Product life cycle, Forecasting methods, Qualitative and Quantitative techniques of forecasting.

UNIT-II

Material handling- Objectives and Principles of material handling, Relation between plant layout and material handling, Material handling equipments and their effective utilisation.

Material Management- Material planning and control, Purchasing methods, Purchasing procedure, inventory control, stores management and coding, inventory control, Material requirement planning (MRP).

UNIT-III

Production planning and control- Objectives and need for Production planning and control, Operations scheduling, Aggregate planning, Master production schedule (MPS).

Quality control- Quality and inspection, Seven tools for Quality control, Control charts, Acceptance sampling, Quality circles.

UNIT-IV

Man power and facilities planning- Man power requirement and planning, Plant Heuristics, Facilities requirement and planning, Role of advanced process planning.

Just in Time (JIT)- Introduction and characteristics of JIT, Benefits of JIT, Implementation of JIT, Processes to eliminate waste, JIT inventory.

Text and Reference Books

1. S.Anil Kumar & N.Suresh, "Production and operations Management", New Age International.
2. Buffa & Sarin, "Modern Production Management", John Wiley Publication
3. M.Mahajan., "Statistical Quality Control", Dhanpat Rai Publication.

Course Articulation Matrix (CO to PO/PSO Mapping)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	1	2	2	2	1	1	1	3	2	1	3	3
CO2	1	1	1	1	2	2	2	1	1	1	3	2	1	3	3
CO3	1	1	1	1	2	2	2	1	1	1	3	2	1	3	3
CO4	1	1	1	1	2	2	2	1	1	1	3	2	1	3	3
CO5	3	3	2	2	2	2	2	1	1	1	3	2	1	3	3

1 : (Slight/Low), 2:(Moderate/Medium), 3 :(Substantial/High)

INDUSTRIAL ENGINEERING (THEORY)

General Course Information

Course Code: PEC-ME355-T Course Category: Professional Elective Course Course Credits: 3.0 Contact Hours: 3 hours/week (L: 3; T: 0) Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Outcomes

Sr. No.	Course Outcome	RBT Level
CO1	Student will be able to take the right decisions to optimize resources utilization by improving productivity of the Lands, Buildings, People, Materials, Machines, Money, Methods and Management effectively.	L1
CO2	Student will be able to apply work study methods with the help of charting and diagrams to eliminate unproductive activities in different operations and job analysis.	L2
CO3	Student will be able to record the activities of the people, materials and equipment to find alternative methods which minimize waste and also to find the Standard Time of any activity through work measurement techniques.	L3
CO4	Student will be able to understand the need of ergonomics in Man–Machine Interface, Human Efficiency and the effort of the workers	L4
CO5	Student will be able to understand the concepts of value engineering and intellectual property rights	L5

Course Contents

UNIT-I

Plant Layout: Objectives of Good Plant Layout, Importance of Plant Layout, Types of Plant Layout, Advantages and Limitations of Different Types of Plant Layouts

Material Handling: Function of Material Handling, Principles of Material Handling, Material Handling Devices, Relation between Plant Layout and Material Handling

UNIT-II

Work Study: Definition and Concept of Work Study, Need of Work Study, Advantages of Work Study, Techniques of Work Study, Work Study and Management, Work Study and Productivity

Method Study: Objectives and Procedure of Method Study, Process Chart Symbols, Flow Diagram, String Diagram, Therblig, Multiactivity Charts

UNIT-III

Work Measurement: Objectives of Work Measurement, Basic Procedure for Time Study, Difference between Time Study and Motion Study, Various Time Estimates and Production Standard, Level of Performances, Allowances, Various Time Recording Techniques in Time Study

Value Engineering: Types of Values, Concept of Value Engineering, Phases of Value Engineering Studies, Application of Value Engineering

UNIT-IV

Ergonomics: Concept of Ergonomics, Objectives of Ergonomics, Man Machine System Interface, Anthropometry, Ergonomics and Safety, Ergonomics and Fatigue

Intellectual Property Rights: Intellectual Property Rights, Patents, Trade Marks, CopyRights, Law of Contract

Text and Reference Books

1. Industrial Engineering and Management by Hicks, Tata McGraw Hill, New Delhi
2. Work study and Ergonomics by Suresh Dalela and Saurabh, Standard Publishers
3. Motion and time study by R. Bernes, John-Wiley & Sons
4. Ergonomics at work by D.J. Oborne, John Wiley & Sons
5. Techniques of Value Analysis and Engineering by Miles, McGraw Hill

Course Articulation Matrix (CO to PO/PSO Mapping)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	1	2	2	2	1	1	1	3	2	1	3	3
CO2	3	3	2	1	2	1	1	2	2	2	2	2	2	3	3
CO3	3	3	2	1	2	1	1	2	2	2	2	2	2	3	3
CO4	1	1	1	1	2	2	2	1	1	1	3	2	1	3	3
CO5	1	1	1	1	2	2	2	1	1	1	3	2	1	3	3

1 : (Slight/Low), 2:(Moderate/Medium), 3 :(Substantial/High)