Gondwana University, Gadchiroli

Four Year Degree Course in Engineering and Technology

Course and Examination Scheme with Model AICTE Curriculum of Bachelor of Engineering

Fifth (V) Semester of Mechanical Engineering

S.N.	Course Category	Corse Code	Subject	Teaching Scheme				Examination Scheme									
				Hours/ week			No of Credits	Theory						Practical			
				L	T	P		Duration of paper (Hrs)	Max Marks	Max Marks Sessional		Total	Min Passing	Max Marks	Max Marks	Total	Min Passing Marks
									ESE	MSE	IE			TW	POE		
1	Professional Core Courses	PCC-ME-301	Heat Transfer	3	1	0	4	3	80	10	10	100	40	-	-	-	-
2	Professional Core Courses	PCC-ME-302	Design of Machine Elements	3	1	0	4	4	80	10	10	100	40	-	-	-	-
3	Professional Core Courses	PCC-ME-303	Manufacturing Processes	3	0	0	3	3	80	10	10	100	40	-	-	-	-
4	Professional Core Courses	PCC-ME-304	Kinematics of Machines	3	1	0	4	3	80	10	10	100	40	-	-	-	-
5	Humanities & social sciences including management course	HSMC-301 (3011-3012)	Open Elective -I (OEL-I)	3	0	0	3	3	80	10	10	100	40	-	-	-	-
6	Professional Core Courses	PCC-ME-3051	Heat Transfer	0	0	2	1	-	-	-	-	-	-	25	25	50	25
		PCC-ME-3052	Manufacturing Processes	0	0	2	1	-	-	-	-	-	-	25	25	50	25
7	Mandatory Course	MC-III	Essence of Indian Traditional Knowledge	0	0	0	0	-	-	-	-	-	-	-	-	-	-
8	Project (Summer Internship)	PROJ-ME-306	Project -I	0	0	2	1	-	-	-	-	-	-	50	-	50	25
Total				**15**	**3**	**6**	**21**		**400**	**50**	**50**	**500**		**100**	**50**	**150**	**-**
Semester Total				**24**			**21**	**650**									

Open Elective-I:- HSMC-3011- Industrial Economics and Entrepreneurship Development
HSMC-3012- Production Technology

Gondwana University, Gadchiroli

Four Year Degree Course in Engineering and Technology

Course and Examination Scheme with Model AICTE Curriculum of Bachelor of Engineering

Sixth (VI) Semester of Mechanical Engineering

S.N.	Course Category	Corse Code	Subject	Teaching Scheme				Examination Scheme									
				Hrs/week			No of Credits	Theory						Practical			
				L	T	P		Duration of paper (Hrs)	Max Marks	Max Marks Sessional		Total	Min Passing	Max Marks	Max Marks	Total	Min Passing Marks
									ESE	MSE	IE			TW	POE		
1	Professional Core Courses	PCC-ME-307	Manufacturing Technology	4	0	0	4	3	80	10	10	100	40	-	-	-	-
2	Professional Core Courses	PCC-ME-308	Dynamics of Machines	3	1	0	4	3	80	10	10	100	40	-	-	-	-
3	Professional Elective Courses	PEC-MEL-321-323	Elective -I	3	0	0	3	3	80	10	10	100	40	-	-	-	-
4	Professional Elective Courses	PEC-MEL-324-326	Elective -II	3	0	0	3	3	80	10	10	100	40	-	-	-	-
5	Humanities & social sciences including management	OEC-302 (3021-3023)	Open Elective - II (Humanities)	3	0	0	3	3	80	10	10	100	40	-	-	-	-
6	Professional Core Courses	PCC-ME-3091	Manufacturing Technology	0	0	2	1	-	-	-	-	-	-	25	25	50	25
		PCC-ME-3092	Dynamics of Machines	0	0	2	1	-	-	-	-	-	-	25	25	50	25
7	Project (Or Summer Internship)	Proj-ME 310	Project II	0	0	6	3	-	-	-	-	-	-	75	-	75	40
			Total	**16**	**1**	**10**	**22**	-	**400**	**50**	**50**	**500**	**-**	**125**	**50**	**175**	**-**
			Semester Total	**27**			**22**	**675**									

Elective-I:-

PEC-MEL-321. Power Plant Engineering
PEC-MEL-322. Composite Material
PEC-MEL-323. Industrial Robotics

Elective-II:-

PEC-MEL-324. Internal Combustion Engine and Gas Turbine
PEC-MEL-325. Product Life Cycle Management
PEC-MEL-326. Product Design and development

Open Elective-II

OEC-3021. Operations Research Techniques
OEC-3022. Industrial Engineering
OEC-3023. Computational Methods

PCC-ME-301	Heat Transfer (Theory)	3L :1T :0P	4 Credits

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs/week	Duration of Uni. Examination : 3 Hrs
Tutorial: 1 hr/week	University Assessment: 80 Marks
	College Assessment: 20 Marks

Syllabus

UNIT – I **[08 Hrs.]**

Introduction to three modes of heat transfer, Derivation of heat balance equation- Steady one dimensional solution for conduction heat transfer in Cartesian, cylindrical and spherical geometry, Thermal conductivity and diffusivity. One dimensional steady state conduction equation for the plane wall, cylinder and sphere. Thermal resistance of composite structures, thermal contact resistance, and overall heat transfer coefficient, critical thickness of insulation.

UNIT – II **[08 Hrs.]**

Introduction to conduction with internal heat generation for plane wall, cylinder and sphere, Concept of Dielectric Heating (Analytical treatment limited to plane wall with internal heat generation only).

Extended surfaces, Heat flow through Fins of uniform cross sectional area, Fin efficiency and effectiveness, Error in temperature measurement (Thermometer Well) .

Transient/Unsteady state Conduction, Lumped parameter analysis, Heisler charts.

UNIT – III **[08 Hrs.]**

Forced convection, Physical significance of non-dimensional parameters. Concept of velocity & thermal boundary layer thickness, Local and average heat transfer coefficients. Empirical co-relations for external, internal flow, laminar & turbulent flow through conduits.

Free or natural convection, Grashoff number, Rayleigh number, Horizontal and vertical plate, Empirical co-relations for cylinders and spheres.

Heat transfer with phase change, pool boiling curve & regimes of pool boiling. Film & Drop wise condensation, Laminar film condensation on vertical surface, Film condensation on horizontal tubes, Introduction to heat pipe.

UNIT – IV **[08 Hrs.]**

Thermal Radiation, Surface emission Properties, Absorptivity, Transmissivity, Reflectivity, Opaque body, White body, Gray body. Black body radiation, laws of radiation– Kirchhoff's, Planck's, Wien's displacement, Stefan Boltzmann, radiation intensity and Lamberts Co-sine law. Radiation exchange between surfaces, concept of shape factor, reciprocity theorem, Radiation shields

UNIT – V **[08 Hrs.]**

Heat Exchanger:- Classification, Overall heat transfer coefficient, Fouling factor, LMTD method of heat exchange analysis for parallel, counter & cross flow arrangement.

Effectiveness NTU method, heat exchanger analysis by NTU method, design aspects of heat exchangers.Introduction to compact heat exchanger.

Introduction mass transfer, Similarity between heat and mass transfer

Total number of hours (40 lectures + 12 tutorials)

Text Books:

1. Fundamentals of heat and mass transfer – F. P. Incropera& Dewitt J. Wiley

2. Elements of Heat Transfer – M. N. Ozisik
3. J.P.Holman, Heat Transfer, Eighth Edition, McGraw Hill
4. Yunus A Cengel, Heat Transfer : A Practical Approach, McGraw Hill,
5. Heat Transfer – S. P. Sukhatme
6. Heat and mass transfer – R. K. Rajput
7. Heat Transfer – Dr. D. S. Kumar

PCC-ME-302	DESIGN OF MACHINE ELEMENTS (Theory)	3L :1T :0P	4 Credits

Teaching Scheme	Examination Scheme
Lectures: 3 Hours/Week	Duration of Paper: 04 Hours
Tutorial: 1 Hour/Week	University Assessment: 80 Marks
	College Assessment: 20 Marks

Syllabus

UNIT – I **[10 Hrs.]**

Definition of design, types of design, design process, (i.e., various phases in design) feasibility, preliminary design alternatives, General consideration in Machine Design. Manufacturing considerations in design. Mechanical properties, Applications and designations as per ISI and their equivalence with other standards of engineering materials, selection of material. Factor of safety, Statistical methods in determining factor of safety. Theories of failure, modes of failure, compound stresses, eccentric axial loading, variable stresses in machine parts, stress concentration & stress raisers, notch sensitivity, stress concentration factor, methods for reducing stress concentration factor. Goodman's criteria, Soderberg criteria, Gerber`s criteria, fatigue design for finite & infinite life of the parts subjected to variable loads. Design of Cotter Joint & Knuckle Joint.

UNIT – II **[10 Hrs.]**

Design of Riveted joint for Boiler shell, Design of Lozenge joint (Uniform Straight joint), eccentrically loaded riveted joint.

Welded Joint: Design of single transverse, double transverse, parallel fillet, combination fillet, butt joint, eccentrically loaded welded joints.

Bolted joint: Design of bolted fasteners, bolts of uniform strength, bolted joints under eccentric loading.

UNIT – III **[10 Hrs.]**

Design of power screw:

Derivation of Expression for deflection and shear stress in helical spring, design of helical spring, design of leaf spring. Design of lever: Hand lever, Foot lever, and Bell crank lever

UNIT – IV **[10 Hrs.]**

Classification of thin & thick cylindrical pressure vessels, Stresses in thin & thick cylindrical pressure vessels when it is subjected to internal pressure, expression for circumferential & longitudinal stresses, design of pressure vessel, heads & cover plate.

Design of transmission shafts on the basis of strength, rigidity & critical speed. ASME code for shaft design. Design of Stepped shaft, Axle, Splined shaft, Keys.

Design of Shrink & Press Fit Joints

Text Books

1. Design of Machine Element, V. B. Bhandari
2. Mechanical Engineering Design, Shigley, J.E. and Mischke, C.R.,FifthEdition, McGraw-Hill International; 1989.
3. Design Data for Machine Elements, B. D. Shiwalkar
4. Machine Design Theory and PracticeMacmillan.1992. Deutschman, D., Michels, W.J. and Wilson, C.E.,
5. Fundamentals of Machine Component Design, 1994., Juvinal, R.C., , John Wiley,

6. Design of Machine elements Prentice-Hall India, 1994. Spottes, M.F. R. L. Norton
7. Mechanical Design – An Integrated Approach, Prentice Hall, 1998
8. Machine Design, Sharma and Agrawal

PCC-ME 303	Manufacturing Processes (Theory)	3L : 0T : 0P	3 Credits

Teaching Scheme	Examination Scheme
Lectures: 3 Hours/Week	Duration of Paper: 03 Hours University Assessment: 80 Marks College Assessment: 20 Marks

Syllabus

Unit-I:- **[08 Hrs]**

Theory of metal cutting: Single and multi-point cutting; Orthogonal and oblique cutting, various force components, Merchant circle force diagram Mechanics of chip formation, Cutting tool nomenclature, Types of chips, Tool wear and tool life, Surface finish and integrity, Machinability, Cutting tool materials, Cutting fluids, Introduction to CNC machining.

Unit-II :- **[08 Hrs]**

Casting and moulding: Introduction to pattern making, Pattern material, Pattern making tools and allowances, Types of pattern, Core prints, Core boxes, Colour coding for patterns, Moulding sand and its types, Properties of moulding sand, Meting furnaces for ferrous metals, Cupola, Ladles, Cleaning in casting, Defects in casting, Modernization and mechanization of foundry, Gating design, Aspiration effect, Gating ratio, Cooling and solidification, shrinkage, riser design, casting defects and residual stresses, Introduction to powder metallurgy

Unit-III:- **[08 Hrs]**

Mechanical and sheet working of metals: Introduction, Principle of hot working processes, Hot rolling, Principle of rolling, Rolling parameters, Types of rolling mills, Hot forging, Hot spinning, Direct and indirect extrusion, Theoretical basis of metal forming, Stress-strain curve. Cold working, Swaging or cold heading, Rotary swaging, Cold hobbing, Cold extrusion, Embossing, Roll bending, Comparison of cold working with hot working. Metals used in sheet metal work, Hand-tools, Development of surface, Sheet metal operation like measuring, marking, cutting etc, Nibbling, Piercing and blanking, Folded sheet metal joints, Sheet metal working machines,

Unit-IV :- **[08 Hrs]**

Welding and additive manufacturing: Joining/fastening processes, Welding and riveting, Classification of welding processes, AC and DC welding, Electrode classification and coding, Physics of welding, brazing and soldering, Design considerations in welding, Solid and liquid state joining processes, Adhesive bonding, Introduction to additive manufacturing, Methods

Unit-V:- **[08 Hrs]**

Unconventional Machining Processes: Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, Ultrasonic Machining, principles and process parameters ,Electrical Discharge Machining, Principle and processes parameters, MRR, surface finish, Tool wear, Dielectric, Power and control circuits, wire EDM; Electro-chemical machining (ECM), etchant, process parameters, MRR and surface finish, Laser Beam Machining (LBM), Plasma Arc Machining (PAM) and Electron Beam Machining

Text Books:-

1. Hajra Choudhury Elements of workshop technology –Media Promoters and Publishers Pvt. Ltd.
2. B.S. Raghuwanshi-A course in Workshop Technology-Vol-1,Dhanpat Rai and Company
3. P.C. Sharma – Production Engineering, S. Chand

4. Ghosh Mallik – Manufacturing Science –East- West Press
5. Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)- Pearson India, 2014
6. Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems
7. Degarmo, Black &Kohser, Materials and Processes in Manufacturing

PCC ME-304	Kinematics of Machines (Theory)	3L: 1T :0P	4 Credits

Teaching Scheme	Examination Scheme
Lectures: 3 Hours/Week	Duration of Paper: 03 Hours
Tutorial : 1 Hour/Week	University Assessment: 80 Marks
	College Assessment: 20 Marks

Syllabus

UNIT 1:- **[08 Hrs]**

Classification of mechanisms-Basic kinematic concepts and definitions-Degree of freedom, mobility- Grashof's law, Kinematic inversions of four bar chain and slider crank chains-Limit positions-Mechanical advantage-Transmission angle-Description of some common mechanisms-Quick return mechanism, straight line generators-Universal Joint-Rocker mechanisms.

UNIT 2:- **[08 Hrs]**

Displacement, velocity and acceleration analysis of simple mechanisms, graphical velocity analysis using instantaneous centers, velocity and acceleration analysis using loop closure equations kinematic analysis of simple mechanisms- slider crank mechanism dynamics-Coincident points- Coriolis component of acceleration- introduction to linkage synthesis- three position graphical synthesis for motion and path generation

UNIT 3:- **[08 Hrs]**

Classification of cams and followers-Terminology and definitions-Displacement diagrams-Uniform velocity, parabolic, simple harmonic and cycloidal motions- derivatives of follower motions specified contour cams- circular and tangent cams- pressure angle and undercutting, sizing of cams, graphical and analytical disc cam profile synthesis for roller and flat face followers

UNIT 4:- **[08 Hrs]**

Involute and cycloidal gear profiles, gear parameters, fundamental law of gearing and conjugate action, spur gear contact ratio and interference/undercutting- helical, bevel, worm, rack & pinion gears, epicyclic and regular gear train kinematics

UNIT 5:- **[08 Hrs]**

Surface contacts- sliding and rolling friction- friction drives- bearings and lubrication- friction clutches- belt and rope drives- friction in brakes

(Total: 40 lectures + 12 tutorials)

Text Books:

1. Thomas Bevan, Theory of Machines, 3rd edition, CBS Publishers & Distributors, 2005.
2. S. S. Rattan, Theory of Machinces, 3rd edition, Tata McGraw Hill Education Private Limited, 2009.
3. R.S. Khurmi & J.K. Gupta, Theory of Machines, S. Chand.
4. CleghornW.L. , Mechanisms of Machines, Oxford University Press, 2005.
5. Robert L. Norton, Kinematics and Dynamics of Machinery, Tata Mc Graw Hill, 2009.
6. Ghosh A. and Mallick A.K., Theory of Mechanisms and Machines, Affiliated East-West Pvt.Ltd, New Delhi, 1988.

HSMC-3011	INDUSTRIAL ECONOMICS & ENTREPRENEURSHIP DEVELOPMENT (Theory)	3L : 0T : 0P	3 Credits

Teaching Scheme	Examination Scheme
Lectures: 3 Hours/Week	Duration of Paper: 03 Hours University Assessment: 80 Marks College Assessment: 20 Marks

Syllabus

UNIT – I **[08 Hrs.]**

Industrial Economics: Basic concepts, demand analysis, types of demand, methods of demand forecasting ,Types of Business structures, top and bottom line of the organization, economics of operations.

UNIT – II **[08 Hrs.]**

Factors of production, production function, firm and industry, laws of return, cost concepts, fix variable, average, marginal and total cost, break even analysis, depreciation cost, taxationsystem, types of taxes.

UNIT – III **[08 Hrs.]**

Optimum size of unit, optimum firm, industrial combinations, causes for the growth ofcombinations, forms of combinations in India, Various competitive situations, perfect,monopoly, monopolistic, oligopoly. Price determination under these situations, Impact of Globalization on Indian economy.

UNIT – IV **[08 Hrs.]**

Concept of entrepreneurship, definition, competencies of entrepreneurs, entrepreneurial functions, achievement, motivation, types of enterprises. Procedure to set up small scale industrial unit, advantages and limitation of SSI. Market survey and factors governing product selection. Project formulation, financial & marketing analysis of project.

UNIT – V **[08 Hrs.]**

Factors governing the selection of site, plant and machinery. Role of consultancyorganizations, role of District Industries Centre, State Industrial Development Corporations, Banks and Financial Institutions, latest SSI intensive schemes (To be confirmed from DIC Time to time). Determination of working capital requirement.

Text Books

1. Industrial Economics. By, Ranjana Seth, Ane Book Pvt Ltd.
2. Modern Economic Theory By, K.K. Dewett. S.Chand.
3. Industrial Economics. By, JagdishSheth, Pearson Publication.
4. “Entrepreneurial Development” By, S.S.KhankaS.Chand& Co. Ltd. Ram Nagar New Delhi, 1999.
5. Hisrich R D and Peters M P, “Entrepreneurship” 5th Edition Tata McGraw-Hill, 2002.
6. Management of Entrepreneurship. By, N.V.R. Naidu, I.K. International Pvt Ltd.
7. Entrepreneurial Development. By, S.Anil Kumar. New Age International.
8. Dynamics of Entrepreneurial – Vasant Desai
9. . Indian Industrial Economy – K. V. Sivaya, V. B. M. Das
10. Managerial Economics – V. N. Gupta.
11. Managerial Economics – G. S. Gupta.

Reference Books

1. Business Economics. By, K.Rajgopalchar. Atalantic Publishers.
2. Microeconomics. By, Robert Pindyk
3. Business Economics. By, H.L. Ahuja,H. L. Ahuja,Louis Prof. De Broglie. S. Chand.
4. Rabindra N. Kanungo "Entrepreneurship and innovation", Sage Publications, New Delhi, 1998.
5. Financing Small Scale Industries in India, By, K.C.Reddy. Himalaya Publication.

HSMC-3012	PRODUCTION TECHNOLOGY (Theory)	3L : 0T : 0P	3 Credits

Teaching Scheme	Examination Scheme
Lectures: 3 Hours/Week	Duration of Paper: 03 Hours University Assessment: 80 Marks College Assessment: 20 Marks

Syllabus

UNIT -I **[08 Hrs.]**

Analysis of Metal forming processes: Theoretical basis of metal forming, Classification of metal forming processes, Cold forming, Hot working, Effect of variables on metal forming processes, Methods of analysis of metal forming process, Rolling, Drawing, Extrusion

UNIT-II **[08 Hrs.]**

Thermal Aspects in Machining: Sources of heat generation in machining and its effects, Temperature Measurement techniques in machining, types of cutting fluids, Functions of cutting fluid, Characteristics of cutting fluid, Application of cutting fluids, Economics of Metal Cutting Operations.

UNIT-III **[08 Hrs.]**

Gear and Thread Manufacturing: Different types of Threads, Manufacturing methods and tools involved, Different gear forming and generating methods with their special features, Gears finishing processes.

UNIT -IV **[08 Hrs.]**

Production planning and control : Principle and objective, Advantages, Types of production, Sales forecasting and types, Regression analysis, Averaging models, Forecasting demand of new products, Types of forecast, Averaging models, Economical batch quantity, Routing and routing documents, Scheduling and master schedule, Machine loading, Dispatching, Progress reporting and follow up, Inventory control

UNIT -V **[08 Hrs.]**

Economics of tooling : Machine tool replacement, Mathematical analysis for economical equipment selection, Return on investment, Economics of tool selection, Breakeven point analysis, Economic lot size, Minimum cost analysis, Economic batch quantity and break-even quantity

Text Books:

1. Metal Cutting principles, by M C Shaw, Oxford University press
2. Fundamentals of machining and machine tools, by Boothroyd - CRC publication
3. A textbook of Production Engineering – P.C.Sharma, S Chand
4. Production Technology - H.M.T. By HMT
5. Workshop Technology Vol. II by Raghuvanshi, Dhanpatrai Pub
6. Production Technology by R.K. Jain, Khanna Pub.

PCC-ME - 3051	Heat Transfer Laboratory	0L - 0T- 2P	1 Credit

Practical Scheme:	Examination Scheme:
Practical: 2 Hrs	University Assessment: 25 Marks College Assessment: 25 Marks

List of Practical

Minimum eight practical should be performed from the following :

1. Determination of thermal conductivity of metal bar
2. Determination of conductivity of a composite slab.
3. Determination of thermal conductivity of insulating material in the powder form.
4. Determination of thermal conductivity of liquids.
5. Determination of temperature distribution and heat transfer plate from a fin under (A) Free convection & (B) Forced convection condition.
6. Determination of forced convection heat transfer coefficient for fluid flow through a closed conduit.
7. Determination of forced convection heat transfer coefficient for air fluid flow over a vertical surface.
8. Determination of critical heat flux in saturated pool boiling.
9. Determination of condensation heat transfer in film wise & drop wise modes.
10. Study of various types of heat exchangers and Performance of Double pipe Heat Exchanger/Shell and Tube Heat Exchanger.
11. Determination of emissivity of non black surfaces.
12. Determination of Stefan-Boltzmann constant.
13. Study of heat pipes.

A Journal/Report on practical conducted shall be submitted by each student.

University Practical examination shall be on viva-voce of 10 marks and practical performance or objective test of 15 marks.

PCC- ME - 3052	Manufacturing Processes Laboratory	0L - 0T - 2P	1 Credit

Practical Scheme:	Examination Scheme:
Practical: 2 Hrs	University Assessment: 25 Marks College Assessment: 25 Marks

List of Practical

Minimum 6 practical's should be performed from the following :

1. Perform a job using Lathe,
2. Perform a job using Milling
3. Perform a job using Shaper
4. Demonstration job on casting
5. Perform a job on pattern making
6. Perform a job using welding machine (Gas /Arc)
7. Study and identification of various defects like blowholes, porosity etc in a weld joint
8. Study and comparison of single point and multipoint cutting tool
9. Study and demonstration of single point cutting tool nomenclature
10. Study and demonstration of Multi-axle milling machine
11. Study and demonstration of Vertical milling machine

A Journal/Report on practical conducted shall be submitted by each student.

University Practical examination shall be on viva-voce of 10 marks and practical performance or objective test of 15 marks.

MC-III	Essence of Indian traditional Knowledge	0L – 0T – 0P	0 Credit

Syllabus

UNIT-I

Society ,State and polity in India:

State in Ancient India: Evolutionary Theory, Force Theory, Mystical Theory ,Contract Theory, Stages of State Formation in Ancient India, Kingship , Council of Ministers, Administration Purusārtha, Varnāshrama System, Āshrama or the Stages of Life

UNIT-II

Indian Literature, Culture, Tradition, and Practices:

Evolution of script and languages in India: Harappan Script and Brahmi Script. The Vedas, the Upanishads, the Ramayana and the Mahabharata, Puranas, , Kautilya'sArthashastra

UNIT-III

Indian Religion, Philosophy, and Practices:

Pre-Vedic and Vedic Religion, Buddhism, Jainism, Six System Indian Philosophy, Shankaracharya, Various Philosophical Doctrines ,

UNIT-IV

Science, Management and Indian Knowledge System:

Astronomy in India, Chemistry in India, Mathematics in India, Physics in India, Agriculture in India, Medicine in India ,Metallurgy in India, Water Management in India,

UNIT-V

Cultural Heritage and Performing Arts:

Indian Architect, Engineering and Architecture in Ancient India, Dance, Music, Theatre, drama, Painting, Martial Arts Traditions, Fairs and Festivals, Current developments in Arts and Cultural, Indian's Cultural Contribution to the World

Based on above curriculum, students are expected to perform at least two activities from the following:-

1. A case study of local cultural, religious and social ecosystem existing in adjacent area
2. Visit to some religious/historic monuments and its detailed study regarding its origin, significance, history and place in society with report submission
3. A detailed case study of some tribal /local residents regarding their origin, culture, literature etc. and report submission
4. A detailed study of evolution of science/technology and related area from ancient period and its ultimate inculcation in present technological field
5. A detailed history of great mathematicians, scientists, spiritual leaders, technocrats from ancient, medieval or modern period and report submission.

Text Books :

1. Romila Thapar : The Penguin History of Early India: From the Origins to AD 1300,Penguin books India
2. R.S Sharma : India's ancient past, Oxford
3. D.N. Jha : Ancient India - An Introductory Outline, Peoples Publishing house
4. Romila Thapar : Ashoka& Decline of the Maurya, Oxford
5. Romila Thapar : History of India, Vol. I, Penguin
6. Bridget and Raymond Allchin : The rise of civilization of India and Pakistan, Cambridge University
7. L. Mukherjee : Ancient India, Surjeet Publications

8. R.C. Majumda, H.C. Raychaudhurai, - Kalikinkar Datta : An Advanced History of India, Laxmi Publication
9. A.L. Basham : The Wonder That was India, Sidguik and Jackson

Grade Scheme

S.N.	Number of activities performed by student	Grade
1.	All five activities	A
2.	Any four activities	B
3.	Any three activities	C
4.	Any two activities	D
5.	Less than two activities/No activity	F

PROJ-ME - 306	Project I {Summer Internship} (30 hours)	0L – 0T – 2P	1 Credit

Students are expected to fulfil any one of the following (A or B or C)

(A) Students are expected to undergo the training (before commencement of semester or during the semester as per schedule) at CIIIT centers in the Institute, Industry or organization for minimum two weeks duration in total.

(B) Students are expected to carry a Minor project (Training centers of CIIIT, Departmental laboratories/workshop in the Institute or recognized training Institutes/centers) under the guidance of concerned resource person for a period of 30 hrs in a semester

(C) Students are expected to Participate in any National or International technical event/ competition organized by reputed institutes or organizations to demonstrate an innovative machine or product

Student should submit training report with certificate from concerned industry/organization and deliver presentation based on the training/ project undertaken.

Contents of Industrial Training Report: -

i. Details of Industry/Organisation (Name of Industry, Address, Ownership, Organisation structure etc.)

ii. Descriptions about Layout, Departments/Sections, Operations and Processes used in the plant

Contents of Minor Project Report: -

i. Details of laboratory/Training Centre

ii. Descriptions about Layout, Departments/Sections,

iii. Brief description of the equipments / softwares handled

iv. Brief description about hands on project undertaken

v. Steps followed to fabricate mechanism / model

vi. Display and submission of physical/virtual prototype/model

Evaluation Guidelines for A, B and C are as follows:

Industrial Training / Project Report	- 25 Marks (Maximum).
Presentation	- 15 Marks (Maximum).
Viva – Voce	- 10 Marks (Maximum).

PCC-ME- 307	Manufacturing Technology (Theory)	4L : 0T : 0P	4 Credits

Teaching Scheme	Examination Scheme
Lectures: 4 Hours/Week	Duration of Paper: 03 Hours University Assessment: 80 Marks College Assessment: 20 Marks

Syllabus

Unit-I:- **[08 Hrs]**

Forging die design: Forging equipment ,Forging machine, Design of forging, Design factors, Die design for drop forging and press forging, General forging operations, Material for die blocks, Die block dimensions, Position of impression in dies, Die-maintenance, Die design for machine forging, Determination of stock size, Selection of forging equipment,

Unit-II:- **[08 Hrs]**

Press tool design : Press operations, Press working equipment, Rating of press, Requirement of press tool design, Press tool components, Press selection, Press working terminology, Types of dies, Types of press operations, Method of operation, Principle of metal cutting, Cutting forces, Design principles cutting actions in dies, clearance, cutting forces, Methods of reducing cutting forces, Minimum Diameter of Piercing ,Center of Pressure, Blanking, Piercing, Drawing, Bending and Progressive Die design, scrap reduction, strip layout.

Unit-III:- **[08 Hrs]**

Jigs and fixtures : Locating and clamping, Principle of location, Locating devices, Design principles for location, Clamping and clamping devices, Design principles common to jig and fixture, Drilling jigs, Drilling bushes, Drill bush material, Design principles for milling fixtures, Lathe fixtures, Grinding fixtures, Broaching fixtures, Indexing and indexing devices, Fundamentals of jigs and fixture design

Unit-IV:- **[08 Hrs]**

Metrology and tolerance analysis: Standards of measurements, simple gauging instruments for linear and angular measurement, comparators – Mechanical, Electrical, Pneumatic, Optical, Measurement of straightness and flatness. Measurement of thread, Measurement of gear tooth profile, Tolerance analysis of limit & fits. Types of fits, Shaft basis system, Hole basis system, Selective assembly, Allowances, IS specifications, Design of Limit gauges.

Unit-V:- **[08 Hrs]**

Quality control: Definition, function, objectives, characteristics. Quality, Quality of design, quality of conformance, process control charts and process capability. Statistical quality control, Acceptance sampling techniques, O. C. Curves, sampling plans, Inspection, Types and objectives Introduction to ISO 9000, BIS 14000 series, TQM concepts, Quality assurance, Quality audit, Quality circles.

Text Books:

1. Kalpak jian and Schmid, Manufacturing processes for engineering materials (5th Edition)- Pearson India, 2014.
2. Taha H. A., Operations Research, 6th Edition, Prentice Hall of India, 2003.
3. P C Sharma – Production Engineering. S. Chand
4. Metrology – R K Jain-Khanna

PCC-ME 308	DYNAMICS OF MACHINES (Theory)	3L :1T :0P	4 Credits

Teaching Scheme	Examination Scheme
Lectures: 3 Hours/Week	Duration of Paper: 03 Hours
Tutorials: 1 Hour/Week	University Assessment: 80 Marks
	College Assessment: 20 Marks

Syllabus

Unit I:- **[08 Hrs]**

Static Force Analysis:

Constraint and applied forces, Static Equilibrium, Equilibrium of two and three force members, Member with two forces and torque, Force conventions, free body diagrams, Superposition, Principle of virtual work, Friction in Mechanisms

Dynamic Force Analysis:

D'Alembert's Principle, Equivalent offset inertia force, Dynamic analysis of slider crank and four link mechanism, Velocity & Acceleration of piston, Engine Force Analysis, Turning Moment on Crank shaft, Dynamically Equivalent System, Inertia of connecting Rod, Inertia Forces in Reciprocating Engines(Graphical Method)

Unit II:- **[08 Hrs]**

Turning Moment Diagrams & Engine Flywheel:

Turning moment diagrams for Single Cylinder Four Stroke Engine, Multi Cylinder Engine,

Function of Flywheel, Maximum Fluctuation of Energy, Coefficient of Fluctuation of Energy, Dimensions of Flywheel Rim.

Gyroscope:

Angular Velocity, Angular Acceleration, Gyroscopic Couple (Torque), Gyroscopic Effect on Aero planes, Naval Ships, Stability of Two Wheel Vehicle.

Governors:

Types of Governor, Watt Governor, Porter Governor, Proell Governor, Hartnell Governor, Centrifugal & Inertia Governors, Hunting, Isochronism in Governors. **(No Numerical Treatment in Governors)**

Unit III:- **[08 Hrs]**

Vibrations

Longitudinal Vibrations:

Free Longitudinal Vibrations, Damped Vibrations, Logarithmic Decrement, Forced Vibrations, Magnification Factor, Vibration Isolation & Transmissibility.

Transverse Vibrations:

Natural Vibrations of Shaft and beams under different types of load conditions, Frequency of Natural Transverse Vibrations for Point Load, Uniformly Distributed Load, Frequency of Natural Transverse Vibrations for a shaft or beam carrying several point loads, Dunkerlay's Method, Energy Method, Critical speed or Whirling Speed of Shaft.

Unit IV:- **[08 Hrs]**

Torsional Vibrations:

Free Torsional Vibrations for Single Rotor System, Two Rotor System, Three Rotor System, Torsionally Equivalent Shaft. Free Torsional Vibrations of a Geared System.

Unit V:- **[08 Hrs]**

Balancing:

Static and Dynamic Balancing, Balancing of Rotating Masses, Balancing of several Rotating masses in different planes, Balancing of Reciprocating Masses, Hammer Blow, Variation of Tractive Force, Swaying Couple, Secondary Balancing, Balancing of Locomotives, Balancing of In line Engines, Balancing of Radial Engines.

Text Books:

1. Theory of machines & Mechanisms - Shigley
2. Theory of Machines & Mechanisms – Ghosh & Mallik
3. Theory of Mechanisms - S. S. Rattan
4. Mechanism and Machine Theory – Rao & Dukipatti
5. Theory of Vibrations - W. T. Thomson

Reference Books:

1. Theory of Machine - Thomas Bevan
2. Theory of Machines – Sandor & Erdman
3. Mechanical Vibrations - Grover

PEC-MEL-321	Power Plant Engineering (Theory)	3L :0T :0P	3 Credits

Teaching Scheme	Examination Scheme
Lectures: 3 Hours/Week	Duration of Paper: 03 Hours University Assessment: 80 Marks College Assessment: 20 Marks

Syllabus

Unit I:- **[08 Hrs]**

Steam Power Plant - Layout, Coal Handling, Ash handling, feed water, cooling water, Pulverized fuel firing; dust collection, draught system, Fuel Burners. Steam generator (Boilers), Types, High pressure boiler, Super critical boilers, Steam turbines; types and governing of steam turbines, Condensers (Numerical); cooling towers

Unit II:- **[08 Hrs]**

Nuclear Power Plants - Nuclear reactor material; Breeder reactor; CANDU; PWR (Pressurised Water Reactor); Liquid metal cooled reactor; Radiation shielding; waste disposal of Nuclear reactor; economics of Nuclear Power Plant

Unit III:- **[08 Hrs]**

Hydroelectric Power plants - Runoff; Hydrograph and flow duration curve; Mass curve; Selection of site; Types of hydro electric power plant such as storage plant, runoff river plant, Pumped storage power plant; Water turbines & its types; Draft tube; Surge tank; Governing of turbine , Combine operation of hydro electric power plant with steam, nuclear, diesel & turbine power plant (working)

Unit IV:- **[08 Hrs]**

Gas turbine and Un-conventional power generation - Gas turbine and combined cycle power plants, Brayton cycle analysis and optimization, Components of gas turbine power plants, Principles of wind, tidal, solar PV and solar thermal, Geothermal, biogas and fuel cell power systems

Unit V:- **[08 Hrs]**

Economics of Power Plant - Cost analysis, load curves; tariffs, economics of combine power plant, economic loading of power plant, capacity scheduling and energy problems, depreciation and various methods of calculation

Text Books:

1. Nag P.K., Power Plant Engineering, 3rd ed., Tata McGraw Hill, 2008.

2. El Wakil M.M., Power Plant Technology, Tata McGraw Hill, 2010.

3. A text book of power plant Engineering – Arora Domkundwar- Dhanpat Rai Publishers

4. Power plant Engineering – G R Nagpal – Khanna Publishers

PEC-MEL-322	COMPOSITE MATERIALS (Theory)	3L : 0T : 0P	3 Credits

Teaching Scheme	Examination Scheme
Lectures: 3 Hours/Week	Duration of Paper: 03 Hours University Assessment: 80 Marks College Assessment: 20 Marks

Syllabus

Unit-I:- **[08 Hrs]**

Introduction to Composites Material

Definition, Types of composite materials, general classification and characteristics of composite materials, Rule of mixture, laminated composites-terminology, applications of composite materials.

Constituents of Composite Material

Reinforcement and fillers*:* glass fibers, carbon fibers, organic fibers, boron fibers, natural fibers, ceramic fibers

Matrix: Thermoset matrix and thermoplastic matrix, metal matrix materials, ceramic matrix materials

Unit-II:- **[08 Hrs]**

Manufacturing of Composites

Manufacturing of composites, Layup and curing - open and closed mould processing, hand layup techniques, bag-molding, compression molding, pultrusion, filament winding, liquid composite molding, metal matrix composite manufacturing, ceramic matrix composite manufacturing, Injection moulding, selection of manufacturing method.

Unit-III:- **[08 Hrs]**

Mechanical Characterization of Fiber Reinforced Composite Materials

Static mechanical properties, fatigue properties, impact properties, wear properties, methods of characterization of fiber-matrix interphase, quality inspection methods and different ASTM standards, Types of defects, NDT methods.

Unit-IV:- **[08 Hrs]**

Mechanics of Fiber Reinforced Composite Materials

Fiber matrix interaction, micromechanics of composite materials, Laminate Analysis, Failure theories for composite materials

Fracture and Fatigue of Fiber Reinforced Composite Materials

Failure of composites, delamination in composites, modes of fracture, composite damage mechanics, S-N diagram for composite materials.

Unit-V:- **[08 Hrs]**

Polymeric Nano-composite Materials and Testing

Introduction to nanomaterials, nanoplatelete / nanoparticles / nanofibers reinforced composites, CNT / Graphene reinforced composites, challenges in processing of nanocomposites, prediction of properties of nanocomposites, applications of nanocomposites

Text Books

1. P.K. Mallick, Fiber-Reinforced Composites: Materials, Manufacturing, and Design, Third Edition, CRC Press, 2007
2. K. K. Chawla, Composite Materials: Science and Engineering, Springer, 2012
3. Composite Materials handbook, Mein Schwartz McGraw Hill Book Company, 1984.
4. Mechanics of composite materials, Autar K. Kaw CRC Press New York.

Recommended Reading

1. Bryan Harris, Engineering Composite Materials, The Institute of Materials, Landon
2. Hussain, Farzana, et al., Review article: polymer-matrix nanocomposites, processing, manufacturing, and application: an overview. Journal of composite materials 40.17, 2006: 1511-1575
3. M. Ashby, Material Selection in Mechanical Design, 4th Edition, Elsevier, 2010
4. Fundamentals of Polymer Engineering, Anil Kumar, Rakesh K. Gupta, CRC Press, 2003.
5. Mechanics of Composite Materials, Rober M. Jones, McGraw Hill Kogakusha Ltd. 1975
6. Stress analysis of fibre Reinforced Composite Materials, Michael W, Hyer MGH International.

PEC-MEL-323	INDUSTRIAL ROBOTICS (Theory)	3L :0T :0P	3 Credits

Teaching Scheme	Examination Scheme
Lectures: 3 Hours/Week	Duration of Paper: 03 Hours University Assessment: 80 Marks College Assessment: 20 Marks

Syllabus

Unit-I:- **[08 Hrs]**

Automation and Robotics, Robot anatomy, configuration of robots, joint notation schemes, work volume, introduction to manipulator kinematics, position representation, forward and reverse transformations of a 2- DOF arm, a 3- DOF arm in two dimension , a 4 – DOF arm in three dimension, homogeneous transformations in robot kinematics, D-H notations, solving kinematics equations, introduction to robot arm dynamics.

Unit-II:- **[08 Hrs]**

Basic control system models, slew motion, joint –interpolated motion and straight line motion, controllers like on/off, proportional, integral, proportional plus integral, proportional plus derivative, proportional plus integral plus derivative.

Unit-III:- **[08 Hrs]**

Robot actuation and feedback components position and velocity sensors, actuators and power transmission devices, mechanical grippers , vacuum cups, magnetic grippers, pneumatic, electric , hydraulic and mechanical methods of power and control signals to end effectors.

Unit-IV:- **[08 Hrs]**

General considerations in robot material handling, material transfer applications, pick and place operations, palletizing and related operations, machine loading and unloading, die casting, plastic molding, forging, machining operations, stamping press operations using robots. Application of robot in spot welding continuous are welding, spray coatings, Robots in Assembly Operations.

Unit-V:- **[08 Hrs]**

Robot cell layouts, multiple robots and machine interface, other considerations in work cell design, work cell control, interlocks, error detection and recovery, work cell controller, robot cycle time analysis.

Text Books

1. Industrial Robotics, -- M. P. Groover, M. Weiss , R.N. Nagel, N.G. Odrey, McGraw Hill International, Koren Robotics, 1986
2. Robotic Technology & -- S.R.Deb, McGraw Hill International, 994 Flexible Automation,

Reference S Books:

1. Robotics Engineering - An Integrated Approach , Richard D. Klafter, Thomas A.Chmielewski,M. Negin, PHI Publication
2. Robotics, K .S.Fu , R. C. Gonzales , C.S.G.Lee, Tata McGraw Hills, International Edition, 1987
3. Introduction to Robotics – Analysis, System, Application, Saeed B. Niku, Pearson Education.

PEC-MEL-324	I.C. Engines & Gas Turbines (Theory)	3L :0T :0P	3 Credits

Teaching Scheme	Examination Scheme
Lectures: 3 Hours/Week	Duration of Paper: 03 Hours University Assessment: 80 Marks College Assessment: 20 Marks

Syllabus

Unit I:- **[08 Hrs]**

Basic Introduction to Internal Combustion Engines:

Introduction to Engine components, Working of Two stroke and Four Stoke Engines, Classification of I.C. Engines, Comparison between S.I. & C.I. Engines, Valve Timing Diagrams.

Conventional & Alternate fuels in I. C. Engine :

Petrol, diesel, with their Octane & Cetane rating, Alternate Fuels for I.C. Engines like L.P.G, C.N.G, Ethanol & Other Bio-diesels, Bio Diesel Preparation.

Fuel supply systems in S.I. Engines:

Carburetors, MPFI, Port fuel Injection.

Fuel supply systems in C.I. Engines:

Direct Injection, Common Rail Direct Injection Systems, Distributor system, Individual pump system, Fuel Pump, Fuel Injectors.

Lubrication Systems & Cooling Systems used in I. C. Engines

Unit II:- **[08 Hrs]**

Combustion in S. I. Engines:

Normal Combustion in S.I. Engines, Combustion stages, Factors affecting normal combustion, Combustion chamber design criterion, Types of Combustion Chambers, Ignition fundamentals, Conventional Ignition systems in I.C. Engines.

Abnormal combustion, Pre-Ignition, Flame propagation, Detonation & knocking fundamentals, Factors affecting knocking.

Turbulence, swirls, Squish and Tumble.

Combustion in C. I. Engines:

Combustion Phenomenon, Combustion in direct and indirect injection system, fuel spray behavior, combustion in C.I. Engines, Three Stages in C.I. Engine Combustion,

Factors affecting combustion in C.I. Engines, Ignition delay, auto ignition, factors affecting delay.

Abnormal combustion and Diesel Knocking, Ignition Lag or Delay Period, Supercharging & Turbo Charging & Scavenging in I.C. Engines.

Unit III:- **[08 Hrs]**

Performance Testing in I.C. Engines:

Importance of I.C. Engine Testing, Measurement of various parameters like Indicated Power, Brake Power, Frictional Power, Speed, Fuel Consumption, Air Consumption,

Morse Test for measurement of I.P., Willan's line method and Motoring Test for measurement of Frictional Power.

Calculations of Indicated and Brake Thermal Efficiency, Volumetric Efficiency, Mechanical efficiency,

Preparation of Heat Balance Sheet, Numericals on Heat Balance Sheet, Engine Performance Characteristics Curves.

Engine Emission and Control:

Introduction to Emission from I.C. Engines, S.I. Engine Emissions, HC, CO, & NOx, S.I. Engine Emission Control

C. I. engines emissions HC, CO, NOx, smog, particulate, C. I. engines emissions control methods, Comparison of S.I. & C.I. Engine Emissions.

Standard Pollution norms like Euro Standards and Bharat Stage.

Effects of engine emissions on human health.

Unit IV:- **[08 Hrs]**

Reciprocating Compressors:- Construction and working, Types, Multistage conditions for minimum work, Inter-cooling, efficiency and control of air compressors.

Rotary Compressors:- Principle, operation, parts, indicator diagram, work done, Roots efficiency, Vanes efficiency (No analytical treatment expected)

Centrifugal Compressor: - Principle, Operation, parts, velocity diagram, static & total head quantities, work done by impeller, isentropic efficiency of compressor, slip factor, pressure coefficient, power input factor.

Axial Flow Compressor :- Principle, operation, parts, velocity diagram, work done, degree of reaction, stage efficiency, compressor characteristics, surging & chocking, Polytropic efficiency.

Unit V:- **[08 Hrs]**

Gas Turbine :- Ideal cycles, isentropic & small stage efficiency, application of gas turbine, pressure losses, effect of inter-cooling, reheat & regeneration, Fuel-air ratio, combustion efficiency, performance calculation, open cycle & closed cycle gas turbine plants, cogenerations & combined power cycles.

Jet Propulsion: - Principles & working of turbojet, turboprop, Ramjet & pulse jet, simple turbojet cycle. Thrust power, propulsive power. Thermal efficiency, propulsive efficiency, overall efficiency

Text Books:

1. "Internal Combustion Engines", V. Ganesan, Tata McGraw-Hill Publishing Company Ltd, Fourth Edition, 2013
2. "A Course in Internal Combustion Engines", M. L. Mathur and R. P. Sharma, DhanpatRai Publications Pvt. Ltd, First Edition, Re-print 2003
3. "Internal Combustion Engines", Rajput R. K., Laxmi Publications Pvt. Ltd, First Edition, Re-print 2014

Reference Books:

1. "Internal Combustion Engines and Air Pollution", R. Yadav, Central Publishing House, Allahabad, Second Edition, 2004
2. "Internal Combustion Engine Fundamentals", John B. Heywood, Tata McGraw-Hill. Publishing Company Ltd, First Edition, 2011
3. "Automotive Engines",Srinivasan, Tata McGraw-Hill Publishing Company Ltd., First Edition, 2001
4. "Internal Combustion Engines", Domkundwar and Domkundwar,DhanpatRai Publications Pvt. Ltd. First Edition,

5. Obert E. F, “Internal Combustion Engines and Air Pollution”, Harper and Row Publication Inc. NY, 1973.
6. Heisler H, “Advanced Engine Technology”, Edward Arnold, 1995.
7. Heldt P. M, “High Speed Combustion Engines”, Oxford & IBH publishing Co. India, 1985.
8. Stockel M W, Stockel T S and Johanson C, “Auto Fundamentals”, The Goodheart, Wilcox Co. Inc., Illinois, 1996.

PEC-MEL-325	PRODUCT LIFE CYCLE MANAGEMENT (PLM) (Theory)	3L :0T :0P	3 Credits

Teaching Scheme	Examination Scheme
Lectures: 3 Hours/Week	Duration of Paper: 03 Hours University Assessment: 80 Marks College Assessment: 20 Marks

Syllabus

Unit-I:- **[08 Hrs]**

Concepts of Product Life cycle

Concepts of Product Lifecycle: Introduction to PLM, PLM products, Concepts; PLM in Product development process and PLM benefits; Define PLM, Scope and benefits; PLM prospects, future, Goals and PLM footprints

Unit-II:- **[08 Hrs]**

Elements and Functional modules in PDM/PLM

PLM / PDM Elements: Concept of PDM -Product Data Management; Functional modules in PDM and PLM Integration; PDM Integration: CAD Integration and ERP Integration

Unit-III:- **[08 Hrs]**

PLM Architecture

PLM Architecture: Need of Architecture; Logical and Physical Architecture and TIER Architecture; Different PLM Architectures: Web centric Architecture; Client and Application Architecture; Database Architecture; Tier-1,2,3 Architecture

Unit-IV:- **[08 Hrs]**

Communication of PLM Architectures:

Communication between PLM Architectures: Communication between Tiers; Working of Architecture and Final Architecture, Final Architecture Layout and Load Balancing

Introduction to User Interface for PLM systems like: Windchill and Enovia

Unit-V:- **[08 Hrs]**

PDM systems Tools and Features in similar systems:

PLM systems features: Windchill tools and features; Enovia Tools, features. PLM-Product lifecycle management: Product Lifecycle Management vis-à-vis PDM; PLM software and basic Functions; Product Lifecycle Management processes and work flow; PLM& PDM Case studies (Using PLM Software) , Product structure, workflow, Terminologies in workflow, The Link between Product Data and Product Workflow, PLM applications, PDM applications.

Text Books

1. Grieves, Michael, Product Life cycle Management, McGraw-Hill, 2006. ISBN 0071452303
2. Antti Saaksvuori, Anselmi Immonen, “Product Life Cycle Management” - Springer, 1st Edition (Nov.5, 2003)
3. Stark, John. Product Lifecycle Management: Paradigm for 21st Century Product Realization, Springer Verlag, 2004. ISBN 1852338105

PEC-MEL-326	**PRODUCT DESIGN & DEVELOPMENT** (Theory)	3L :0T :0P	3 Credits

Teaching Scheme	**Examination Scheme**
Lectures: 3 Hours/Week	Duration of Paper: 03 Hours University Assessment: 80 Marks College Assessment: 20 Marks

Syllabus

UNIT – I **[08 Hrs.]**

Overview of Product Design and Development Process, Purpose of product, Market Research, Market Segment, Competitive Strategy, Demand Pattern for the product and Current trends, Customer Needs Requirements, Product life-cycle, Product policy of an organization .

UNIT – II **[08 Hrs.]**

Collection of ideas and - Selection criteria - screening new products (Inventions &Innovation), Creativity and problem solving, Creativity Methods, Creative Idea Evaluation , Conceptual Decomposition, Concept Design, Concept Selection, Concept Testing.

UNIT – III **[08 Hrs.]**

Value engineering in product design; Advantages, Applications in product design, Problem identification and selection, Analysis of functions, Anatomy of function. Primary versus secondary versus tertiary/unnecessary functions,

Functional analysis: Functional Analysis System Technique (FAST), Case studies.

UNIT – IV **[08 Hrs.]**

Quality Function Deployment, Define Product Specifications, Product attributes: Target setting, Success Criteria, Monitoring tools and Techniques, Product Architecture , Develop a Cost Model of the Product, Refine the Specifications. Ergonomics in product design

UNIT – V **[08 Hrs.]**

Computer Aided Design, Robust design, DFX, DFM, DFA,DFMA guidelines, Product design for manual assembly, Design guidelines for metallic and non-metallic products to be manufactured by different processes such as casting, machining, injection molding etc., Rapid prototyping, needs, advantages.

Text Books

1. Product Design for Manufacture and Assembly by Geoffrey Boothroyd , Peter Dewhurst , Winston A. Knight ,CRC Press
2. Design for Manufacturability, by David M. Anderson, CRC Press,Taylor & Fransis Group.
3. Design for Manufacturability Handbook (McGraw-Hill Handbooks) by James Bralla .
4. Product Design and Development by Karl Ulrich & Steven Eppinger (McGraw-Hill Education)
5. Introduction to Product Design and Development for Engineers by Dr Ali Jamnia, CRC Press

Reference Books:

1. Product Design and Development (ISE HED IRWIN MARKETING),by Ulrich, Karl, Eppinger, Steven and Yang, Maria C. (McGraw-Hill Publication)
2. Product Design by OTTO & Kristen Wood (Pearson Education India)

OEC-3021	Operations Research Techniques (Theory)	3L: 0T :0P	3 Credits

Teaching Scheme	Examination Scheme
Lectures: 3 Hours/Week	Duration of Paper: 03 Hours University Assessment: 80 Marks College Assessment: 20 Marks

Syllabus

Unit I:- **[08 Hrs]**

Introduction to O.R., Definitions, Characteristics, Limitations, Phases of O.R. and applications. Types of Mathematical Models. Linear programming, Formulation of problem, Graphical Method, Simplex Method., Duality theory and its use in economic interpretation and decision making.

Unit II:- **[08 Hrs]**

Assignment Model: Introduction, Problem on minimization and maximization. Travelling salesman problem by Branch and Bound Method. Transportation Model; Introduction, Methods of finding initial solution, Test of optimality, Transportation problem,

Unit III:- **[08 Hrs]**

Network Models: Introduction to PERT/CPM and its importance in project management. Concept and construction of network diagrams. Probability of completion of project, Cost analysis of project.

Unit IV:- **[08 Hrs]**

Inventory Control Models: Introduction, Meaning of Inventory control, Advantages of Inventory control.

Deterministic Inventory control Models, economic lot size with instantaneous replenishment with and without storage costs, economic lot size with finite replenishment with and without shortage. Selective Inventory Management Technique.

Unit V:- **[08 Hrs]**

Sequencing: Sequencing of n jobs and 2 and 3 machines, 2 jobs and n machines

Decision Theory: Pay off and regret tables, Decision rules, Decision under certainty and risk, Decision tree.

Text Books and References:

1. PremKumar Gupta & D.S. Hira, Operations Research, S. Chand, 2007.
2. H.A. Taha, Operations Research, An Introduction, PHI, 2008
3. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

OEC-3022	INDUSTRIAL ENGINEERING (Theory)	3L: 0T :0P	3 Credits

Teaching Scheme	Examination Scheme
Lectures: 3 Hours/Week	Duration of Paper: 03 Hours University Assessment: 80 Marks College Assessment: 20 Marks

Syllabus

Unit-I:- **[08 Hrs.]**

Production Planning and Control: - Definition, objectives of PPC, functions of PPC, types of production. Value analysis and value Engineering. Introduction, steps involved in value analysis. Applications in Manufacturing.

Forecasting :- Need for forecasting, classification of forecasting methods, like judgmental technique, time series analysis, least square method, moving average method, exponential smoothing method.

Unit-II:- **[08 Hrs.]**

Work Study: -Productivity - Concept & objectives of productivity, Types of productivity, factors affecting productivity. Tools & techniques to improve productivity, Measurement of productivity.

Work study & Method study :- Definitions, objectives, steps in method study, process charts, string diagram, motion study, micro motion study, SIMO chart.

Unit-III:- **[08 Hrs.]**

Work Measurement: - Objectives, definition, stop watch study, work sampling, PMTs, MTM & work factor method.

Ergonomics: Objectives, Human factors in Engg., Man machine system, Display design, design controls. Principles of motion economy, work place design.

Unit-IV:- **[08 Hrs.]**

Plant Layout :- Objectives, principle, Types of plant layout, Material handling, objectives, principles and selection of material handling Equipments, Unit load concept, material flow pattern.

Unit-V:- **[08 Hrs.]**

Maintenance: - Objectives, Types of maintenance, preventive, predictive, break down maintenance.

Reliability and maintainability analysis. Failure data analysis, reliability, MTBT, MTTR, Batch tubs Curve, series, parallel and stand by system.

Text Books:-

1. Work Study - By ILO

2. Motion & Time Study - By Bames

3. Ergonomics - By Murell

4. Production Planning & Control - By Jain & Agrawal

5. Industrial Engineering & - By Martand & Telsang Project Management

6. Reliability Engineering ` - By Balguruswami

7. Plant Layout & Material Handling - By James Apple.

OEC-3023	COMPUTATIONAL METHODS (Theory)	3L: 0T :0P	3 Credits

Teaching Scheme	Examination Scheme
Lectures: 3 Hours/Week	Duration of Paper: 03 Hours University Assessment: 80 Marks College Assessment: 20 Marks

Syllabus

Unit-I:- **[08 Hrs]**

Introduction

- Linear algebra
- Basics of Probability & Statistics
- Basics of Excel + Pivots, Excel solver, ANOVA, CORR.
- Overview of optimization techniques and Design of experiments (DoE)
- Brief history about DoE
- Basic Principles of DoE and types and purposes of DoE methods
- Overview of basic statistical concepts

a) Some techniques of Descriptive statistics (Conditional, Bayes' theorem)
b) Scatter Plot, Box Plot
c) Introduction to basic concepts of Confidence interval and Hypothesis testing, CLT.
d) CORR. ANOVA, REGRESSION, LOGISTICS REGRESSION.

- Introduction to decision making in the manufacturing Environment

Unit-II:- **[08 Hrs]**

Full Factorial Design

Fundamentals of "full factorials", ANOVA, Factorial effects and plots, and Model evaluation.

Fractional Factorial Design: The one-half fraction and one-quarter of the 2^k design, The general 2^{k-p} fractional factorial design and Resolution III, IV and V designs

The Robust Design: The basics of robust designs, Taguchi designs and Robust design example.
Introduction to Response Surface Methodology

Unit-III:- **[08 Hrs]**

Multi-criteria decision making (MCDM)

Introduction to multi criterion optimization.
Simple Additive Weighting (SAW) Method,
Weighted Product Method (WPM),
Analytic Network Process (ANP),
Analytic Hierarchy Process (AHP) Method,
TOPSIS Method,
PROMETHEE

Unit-IV:- **[08 Hrs]**

Multi-objective Decision making (MODM)

Introduction to Multi objective optimization Traditional Techniques such as quadratic programming,

Goal programming

Dynamic programming.

Glimpses of Non-traditional optimization Techniques

a) - Greedy Algorithm (TSP),
b) - Genetic algorithms (with examples),
c) - Simulated Annealing (with examples)
d) - Neural network & Fuzziness, Data envelopment analysis

Unit-V:- **[08 Hrs]**

Introduction to various computational tools

MINITAB and Analysis

MATLAB

Design Expert

ANSYS

Text Books

1. Douglas C. Montgomery, Introduction to Statistical Quality Control, Sixth Edition, Wiley, 2020
2. Sheldon M. Ross, Introduction to Probability and Statistics for Engineers and Scientists, Academic Press, 2014
3. Larry J. Stephens, Schaum's Outline of Beginning Statistics. McGraw-Hill Education, 1998
4. Andre Francis, Business Mathematics and Statistics, Sixth Edition, Cengage Learning EMEA 2004
5. Douglas C. Montgomery, Design and Analysis of Experiments, Fifth Edition, John Wiley and Sons, 2001
6. Anderson Sweeney Willioms, Statistics for Business and Economics, CENGAGE Learning Custom, 2014
7. Kathleen McLaughlin, Introduction to Data Analysis Using Minitab for Windows, Third Edition, Pearson, 2005
8. OttmarBeucher, Michael Weeks, Introduction to MATLAB & Simulink: A Project Approach, Infinity Science Press LLC, 2006
9. Manos Paraskevas Design of Experiments (DOE) using Design Expert v.10: A Practical Guide for Process Optimization, 2017

PCC-ME-3091	Manufacturing Technology (Laboratory)	0L: 0T :2P	1 Credits

Teaching Scheme	Examination Scheme
Practical**:** 2 Hours/Week	University Assessment: 25 Marks College Assessment: 25 Marks

List of Practical:-

Minimum Eight shall be performed from the following:

1) Study of press and its components
2) Study and demonstration of drilling jigs and milling fixtures
3) Study and demonstration of slip gauges
4) Determination of effective diameter of screw thread with three wire method
5) Study and demonstration of any mechanical comparator
6) Study of various press operations
7) Design of Go-No Go Gauge
8) Measurement of surface roughness using RMS method
9) Study and performance on Profile projector
10) Study of location principle in jigs and fixtures
11) Study and demonstration of Laser engraving machine
12) Study and demonstration of Pipe bending machine
13) Study and demonstration of Hydraulic Press

A Journal/Report on practical conducted shall be submitted by each student.

University Practical examination shall be on viva-voce of 10 marks and practical performance or objective test of 15 marks.

PCC-ME-3092	Dynamics of Machine (Laboratory)	0L: 0T :2P	1 Credits

Teaching Scheme	Examination Scheme
Practical**:** 2 Hours/Week	University Assessment: 25 Marks College Assessment: 25 Marks

List of Practical:-

Minimum Eight shall be performed from the following:

1. Static force analysis of slider crank and four bar chain mechanism (Graphical Method)
2. Dynamic force analysis of slider crank and four bar chain mechanism (Graphical Method)
3. Performance characteristics of Gyroscope.
4. Performance characteristics of Governor
5. Determination of critical speed of shaft
6. Determination of natural frequency of single rotor system
7. Determination of natural frequency of double rotor system.
8. Determination of natural frequency of un-damped system
9. Determination of natural frequency of damped system
10. Determination of Jump-off speed of cam follower system
11. Dynamic balancing of rotor
12. Graphical balancing analysis of rotary masses rotating in different planes
13. Balancing of Reciprocating mechanism
14. Natural frequency determination of cantilever beam

A Journal/Report on practical conducted shall be submitted by each student.

University Practical examination shall be on viva-voce of 10 marks and practical performance or objective test of 15 marks.

PROJ -ME 310	Project II	(90 hours)	3 Credits

Teaching Scheme	Examination Scheme
Practical**:** 6 Hours/Week	College Assessment: 75 Marks

Students are expected to fulfill any one of the following (A or B).

A. Students have to undergo 4 weeks training programme at CIIIT centres in the Institute/ Industry/Organisation during the summer vacation after V semester examination.

It is expected that students should understand the organizational structure, various sections and their functions, products/services, testing facilities, safety and environmental protection measures etc. Also, students should take up a small case study and propose the possible solution(s).

B. Students have to undertake a project at Institute facilities/CIIIT centres in the Institute / any authorised training centres related to discipline during the summer vacation after V semester examination.

It is expected that students should understand functioning of equipments / machines /software tools available in the laboratory/centers and should be able to operate the machine and develop a product or use the software for problem analysis

Students have to submit certificate and detailed report about the training program / Case study / project work to the department and deliver a presentation.

Contents of Industrial Training Report (A): -

i. Details of Industry/Organisation (Name of Industry, Address, Ownership, Organisation structure etc.)
ii. Descriptions about Layout, Departments/Sections, Operations and Processes used in the plant
iii. Description of problem/issue faced by the industry/Organisation,
iv. Suggestions to overcome the above discussed problem
v. Expected improvement in the operations or process after implementation of the solution

Contents of Project Report (B) : -

i. Details of laboratory/Training Centre

ii. Descriptions about Layout, Departments/Sections,

iii. Brief description of the equipments / software's handled

iv. Brief description about hands on project undertaken

v. Steps followed to fabricate mechanism / model

vi. Display and submission of physical/virtual prototype/model

Evaluation Guidelines for A and B are as follows:

Industrial Training / Project Report - 35 Marks (Maximum).

Presentation - 25 Marks (Maximum).

Viva – Voce - 15 Marks (Maximum).