GURU GHASIDAS VISHWAVIDYALAYA (A CENTRAL UNIVERSITY), BILASPUR, CG
SCHOOL OF STUDIES IN ENGINEERING AND TECHNOLOGY
Department of Industrial & Production Engineering
Choice based credit system (CBCS)–New, Scheme of Teaching& Examination
W.E.F. Session: 2023–24
B. TECH SECOND YEAR, III SEMESTER

SN	Course No.	Subject	Teaching Hours/ Week/ Periods			Evaluation Scheme			Credits
			Theory Lectures	Tutorials	Practical	Continuous Internal Assessment	Semester Examination Assessment	Total Marks	
			L	T	P	CIA	SEA		
1	AMUCTE1	Mathematics-III	3	–	–	40	60	100	3
2	IPUCTT1	Manufacturing Processes– I	3	–	–	40	60	100	3
3	IPUCTT2	Fluid Mechanics	3	–	–	40	60	100	3
4	IPUCTT3	Materials Science	3	–	–	40	60	100	3
5	IPUCTO1	*Open Elective*	3	–	–	40	60	100	3
6	IPUCTK_	*1. Program Elective-1* *2. Program Elective-2*	3	–	–	40	60	100	3
Total			**18**	–	–	**240**	**360**	**600**	**18**
PRACTICALS									
1	IPUCLE1	Programming in C & MATLAB	–	–	3	25	25	50	1.5
2	IPUCLT1	Fluid Mechanics Lab	–	–	3	25	25	50	1.5
Total			**–**	**–**	**6**	**50**	**50**	**100**	**3**
GRAND TOTAL			**18**	**-**	**6**	**290**	**410**	**700**	**21**

List of Department/ Program Elective		
SN	Course No.	Subject
1.	IPUCTK1	Industrial Engineering
2.	IPUCTK2	Work Study and Ergonomics

List of Institute Core/ Open Elective			
SN	Course No.	Subject	Offering Department
1.	CHUCTO1	Engineering Materials	Chemical
2.	MEUCTO1	Introduction to Thermodynamics	Mechanical
3.	ECUCTO1	Data Communication	ECE
4.	CEUCTO1	Green Buildings	Civil
5.	ITUCTO1	Computer Organization & Architecture	IT
6.	CSUCTO1	Data Structure with C++	CSE
7.	IPUCTO1	I. C. Engine	IPE

Internal Assessment: – Two class tests of 15 marks each will be conducted. Moreover, 5 marks will be for attendance and 5 marks are allocated for the Assignments, surprise test, quiz test etc.

Approved in BOS meeting held on 06.10.2023

Semester	Course No.	Subject	Teaching Hours/ Week/ Periods			Evaluation Scheme						Credits
			Theory Lectures	Tutorials	Practical	Continuous Internal Assessment				Semester Examination Assessment	Total Marks	
						CIA						
			L	T	P	CT–1	CT–2	Assignments, surprise test, quiz test etc	Attendance	SEA		
B. Tech III Sem.	AMUCTE1	Mathematics-III	3	-	-	15	15	5	5	60	100	3

COURSE LEARNING OBJECTIVES:

The objective of this course is to:

- Provide the information related to existence and uniqueness criteria applied to numerical methods.
- Providing the knowledge of convergences criteria and awareness of reasons behind the failure of numerical methods.
- Find numerical approximations to the roots of equation by various method.
- Find numerical solution to a system of linear equations by Gaussian elimination and Gauss–Siedel iterative etc.
- Learn the numerical solution for ordinary differential equation.

COURSE CONTENT:

Module – I

Laplace Transforms: Linearity, Existence, Laplace Transforms of derivatives and integrals, Shifting theorem. Inverse Laplace Transforms: Linearity property of inverse transform, convolution theorem.

Complex Variables: Analytic functions, Cauchy's integral theorem, Taylor series.

Module –II

Numerical solution of algebraic and transcendental equations: Secant method, Regula–falsi method, Newton Raphson method. Solution of a system of simultaneous linear algebraic equations direct method: Gauss elimination method, Iterative methods, Gauss Seidel iterative method.

Module –III

Calculus of finite differences: Finite differences, difference formula, operators and relation between operators, inverse operator. Interpolation with equal intervals: Newton's forward and backward interpolation formula. Interpolation with unequal intervals: Lagrange's interpolation.

Module –IV

Numerical differentiation and integration: Numerical differentiation, maxima and minima of a tabulated function. Numerical integration: Trapezoidal rule, Simpson's $(1/3)^{rd}$ and $(3/8)^{th}$ rule, Boole's rule, Weddle rule.

Module–V

Numerical solution of ordinary differential equation: Taylor series method, Euler's method, modified Euler method, Runge's method, Runge Kutta method.

TEXT & REFERENCE BOOKS:

1. Numerical methods for scientific and engineering computations–Jain &Iyngar, New Age International Publications.
2. Numerical analysis – G.S. RAO, New Age International Publications.
3. Numerical methods in engineering and science– B.S.Grewal, Khanna Publishers.
4. Advance engineering methods – H. K. Das, S. Chand Publications.
5. Computer oriented numerical methods V.Rajaraman, PHI Learning Publications.

COURSE OUTCOMES:

At the end of the course the students will be able to:

CO1. Apply knowledge of numerical analysis for understanding, formulating and solving engineering problems.

CO2. Identify, analysis, and solve mechanical engineering problems useful to the society.

CO3. Work effectively with engineering and science teams as well as with multidisciplinary analysis.

Mapping of Course Outcomes (COs) onto Program Outcomes (POs) and Program Specific Outcomes (PSOs):

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

Weightage: 1-Sightly, 2-Moderately, 3-Strongly

Semester	Course No.	Subject	Teaching Hours/ Week/ Periods			Evaluation Scheme						Credits
			Theory Lectures	Tutorials	Practical	Continuous Internal Assessment				Semester Examination Assessment	Total Marks	
						CIA						
			L	T	P	CT–1	CT–2	Assignments, surprise test, quiz test etc	Attendance	SEA		
B. Tech III Sem.	IPUCTT1	Manufacturing Processes– I	3	-	-	15	15	5	5	60	100	3

COURSELEARNINGOBJECTIVES:

The objective of this course is to:

- Understand the principle, concept, thermal and metallurgical aspects during solidification of metal.
- Demonstrate about principles/ methods of casting with detail design of gating/ riser system needed for casting, defects in cast objects and requirements for achieving sound casting.
- Evaluate foundry practices like pattern making, mould making, core making and inspection of defects.
- Build knowledge about principles and criteria of yielding during forming of metals, analysis of different bulk metal forming processes following different analysis approach.
- Understand the application of Powder metallurgy.
- Analyze various metal forming processes and plastic deformation during forming processes.

COURSE CONTENT:

Module –I

Foundry: Moulding method and materials, sand-clay-water system, additives, pattern making and types, pattern allowances & design considerations, types of moulding sand & their properties, testing, cores and sand core boxes, core making, moulding machine.

Gating system: Elements & design of gating system, design of riser, solidification of casting.

Module –II

Melting furnaces and practices: Melting cast iron, steel and non-ferrous material, cupola, charge calculation, open furnaces, converter and crucible furnaces, electric, direct arc furnace, inductive furnace.

Module –III

Special casting processes: Centrifugal and investment casting, shell, types and principle of die casting, squeeze casting, gravity and pressure die casting, die casting consideration, continuous casting, centrifugal casting, slush casting, casting defects.

Module –IV

Metal forming:

Metal forming: Need and classification, elastic and plastic deformation, yield criteria, fundamentals of hot and cold working processes. Introduction, classification and analysis of Bulk deformation process (Rolling, Forging, wire drawing, and Extrusion) and Sheet metal forming process (bending, deep drawing, punching & blanking, coining,

Module –V

Powder metallurgy:

Introduction: scope of powder metallurgy, characterization of metal powders, physical properties size and shape determination, technological properties-apparent density, tap density, green density, sintered density, flow rate, post-processing operations etc.

TEXT & REFERENCE BOOKS:

1. Manufacturing processes for engineering materials - Kalpakjian and Schmid, Pearson India.
2. Manufacturing Science- A. Ghosh and A. K. Mallik, East-West Press Pvt. Ltd. New Delhi.
3. Manufacturing Technology (Foundry, Forming and Welding) – P. N. Rao, Tata McGraw Hill Publishing Company.
4. Materials and Processes in Manufacturing - E. P. DeGarmo, J. T Black, R. A. Kohser, Prentice Hall of India, New Delhi.
5. Production Engineering Sciences - P. C. Pandey and C. K. Singh, Standard Publishers Ltd.
6. R.M. German, Powder Metallurgy Science, Metal Powder Industries Federation, Princeton, New Jersey

COURSE OUTCOMES:

At the end of the course the students will be able to:

CO1. Decide yield of a material according to different yield theory for a given state of stress.
CO2. Analyze the different bulk metal forming process mechanics using different analysis approach and calculate the force, power requirements etc.
CO3. Evaluate the effect of process parameters on the process mechanics during bulk metal forming.
CO4. Select appropriate design of gating systems and manufacturing processes in order to design products.
CO5. Identify the various metal forming techniques and the theory of plasticity and its application for analyzing various metal forming Processes.
CO6. To have an idea about powder metallurgy products used in the industry.

Mapping of Course Outcomes (COs) onto Program Outcomes (POs) and Program Specific Outcomes (PSOs):

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

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

Semester	Course No.	Subject	Teaching Hours/ Week/ Periods			Evaluation Scheme						Credits
			Theory Lectures	Tutorials	Practical	Continuous Internal Assessment				Semester Examination Assessment	Total Marks	
						CIA						
			L	T	P	CT–1	CT–2	Assignments, surprise test, quiz test etc	Attendance	SEA		
B. Tech III Sem.	IPUCTT2	Fluid Mechanics	3	-	-	15	15	5	5	60	100	3

COURSE LEARNING OBJECTIVES:

The objective of this course is to:

- Explain fundamentals of fluid mechanics, which is used in the applications of aerodynamics, hydraulics, marine engineering, gas dynamics etc.
- Develop an understanding about hydrostatic law, principles of buoyancy and stability of a floating body and its application on mass, momentum and energy equation in fluid flow.
- Explain basic laws and equations used for analysis of static and dynamic fluids.
- Inculcate the importance of fluid flow measurement and its applications in industries.
- Determine the losses in a flow system, flow through pipes and flow past immersed bodies.

COURSE CONTENT:

Module – I

Introduction of Fluid: Introduction, continuum, density, specific weight, specific gravity, kinematic and dynamic viscosity, variation of viscosity with temperature, Newton law of viscosity, vapour pressure, boiling point, cavitation, surface tension, capillarity, Bulk modulus of elasticity, compressibility.

Fluid Statics: Fluid Pressure, pressure at a point, Pascals law, pressure variation with temperature, density and altitude. Hydrostatic pressure and force: horizontal, vertical and inclined surfaces. Buoyancy and stability of floating bodies.

Pressure measurement devices: Piezometer, U–tube manometer, single column manometer, U–tube differential manometer, micro–manometers, pressure gauges.

Module –II

Fluid Kinematics: Classification of fluid flow: steady and unsteady flow, uniform and non–uniform flow, laminar and turbulent flow, rotational and irrotational flow, compressible and incompressible flow, ideal and real fluid flow, one, two and three dimensional flows. Stream line, path line, streak line and stream tube, stream function, velocity potential function. One, two and three – dimensional continuity equations in Cartesian coordinates.

Module –III

Fluid Dynamics: Surface and body forces, equations of motion, Euler's equation, Bernoulli's equation, derivation, energy principle, practical applications of Bernoulli's equation, Venturimeter, Orifice meter and Pitot tube, momentum principle, forces exerted by fluid flow on pipe bend, vortex flow: free and forced.

Module –IV

Dimensional analysis and dynamic similitude: Definitions of Reynolds number, Froude number, Mach number, Weber number and Euler number, Rayleigh's method, Buckingham's π–theorem. Model studies: similitude, dimensionless number and its significance.

Module –V

Laminar Flow: Reynold's experiment, flow of viscous fluids in circular pipe, shear stress and pressure gradient relationship, velocity distribution, Hagen-Poiseuille equation, flow of viscous fluids between two parallel plates (Counter flow), shear stress and pressure gradient relationship, velocity distribution, drop of pressure head.

Turbulent Flow: Effect of turbulence, expression for loss of head due to friction in pipes (Darcy-Weisbach equation) and expression force-efficient of friction in terms of shear stress.

Flow through pipe: Loss of energy in pipes, Hydraulic gradient and total energy line, pipe in series and parallel, equivalent pipepower transmission through pipe, water hammer in pipes.

COURSE OUTCOMES:

At the end of the course the students will be able to:

CO1-Develop the concept and Solve problems based on mass, momentum and energy conservation and fluid properties.
CO2- Relate different fluid properties with flow characteristics.
CO3-Knowledge of dimensional analysis and physical significance of dimensionless numbers as well as the concept of drag and lift in viscous fluid flow and losses due to viscous flow in pipes
CO4-Apply the similitude concept and set up the relation between a model and a prototype.
CO5- Develop the analytical skills in designing the pipe line and losses in pipes.

TEXT & REFERENCE BOOKS:

1. Fluid Mechanics and Machinery–C.S.P. Ojha, R. Berndtsson and P. N. Chadramouli, Oxford University Press, 2010.
2. Hydraulics and Fluid Mechanics–P. M. Modi and S. M. Seth, Standard Book House.
3. Theory and Applications of Fluid Mechanics–K. Subramanya, Tata McGraw Hill.

4. Fluid Mechanics with Engineering Applications–R.L. Daugherty, J.B. Franzini and E.J. Finnemore, International Student Edition, McGraw Hill.

Mapping of Course Outcomes (COs) onto Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSOs1	PSOs2	PSOs3
CO1	3	3	2	3	-	-	1	-	-	-	-	1	3	2	2
CO2	3	3	3	2	-	-	-	-	-	-	-	1	3	2	2
CO3	3	3	2	2	-	-	-	-	-	-	-	-	3	1	2
CO4	3	3	2	2	-	-	-	-	-	-	-	-	3	2	-
CO5	3	3	2	2	-	-	-	-	-	-	-	-	2	2	1

Weightage1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Semester	Course No.	Subject	Teaching Hours/ Week/ Periods			Evaluation Scheme						Credits
			Theory Lectures	Tutorials	Practical	Continuous Internal Assessment				Semester Examination Assessment	Total Marks	
			L	T	P	CIA				SEA		
						CT–1	CT–2	Assignments, surprise test, quiz test etc	Attendance			
B. Tech III Sem.	IPUCTT3	Materials Science	3	-	-	15	15	5	5	60	100	3

COURSE LEARNING OBJECTIVES:

The objective of this course is to:

- To classify the material and select the material for different application.
- Understanding of the correlation between the internal structure of materials, their mechanical properties and various methods to quantify their mechanical integrity and failure criteria.
- To apply different theory of failure and predict the failure in material.
- To know different phases and heat treatment methods to tailor the properties of Fe–C alloys.

COURSE CONTENT:

Module – I

Crystal Structure: Unit cells, metallic crystal structures, ceramics. Imperfection in solids: point, line, interfacial and volume defects, dislocation strengthening mechanisms and slip systems, critically resolved shear.

Module – II

Mechanical property measurement: Tensile, compression and torsion tests, Young's modulus, relations between true and engineering stress–strain curves, generalized Hooke's law, yielding and yield strength, ductility, resilience, toughness and elastic recovery.

Hardness: Rockwell, Brinell and Vickers and their relation to strength.

Module – III

Static failure theories: Ductile and brittle failure mechanisms, Tresca, Von–mises, maximum normal stress, Mohr–Coulomb and modified Mohr–Coulomb.

Fracture mechanics: Introduction to stress intensity factor approach and Griffith criterion.

Fatigue failure: High cycle fatigue, stress–life approach, SN curve, endurance and fatigue limits, effects of mean stress using the modified Goodman diagram, fracture with fatigue.

Module – IV

Introduction to non–destructive testing (NDT) alloys, substitutional and interstitial solid solutions. Phase diagrams: interpretation of binary phase diagrams and microstructure development, eutectic, peritectic, peritectoid and monotectic reactions. Iron, iron–carbide phase diagram and microstructural aspects of ledeburite, austenite, ferrite and cementite, cast iron.

Module – V

Heat treatment of Steel: Annealing, tempering, normalising and spheroidising, isothermal transformation diagrams for Fe–C alloys and microstructure development. Continuous cooling curves and interpretation of final microstructures and properties: austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo–nitriding, flame and induction hardening, vacuum and plasma hardening alloying of steel.

Properties of stainless steel and tool steels, maraging steels, cast irons, grey, white, malleable and spheroidal cast irons, copper and copper alloys, brass, bronze and cupro–nickel, aluminium and Al–Cu– Mg alloys, nickel based super alloys and titanium alloys.

TEXT & REFERENCE BOOKS:

1. Materials Science and Engineering: An Introduction – W. D. Callister.
2. Engineering Materials – Kenneth G. Budinski and Michael K. Budinski.
3. Material Science and Engineering – V. Raghavan.
4. Engineering Materials and Metallurgy – U. C. Jindal.

COURSE OUTCOMES:

At the end of the course the students will be able to:

- Explain and analyse the effect of crystal structure on the properties of material.
- Apply the knowledge of material science for selection of best material in various application of engineering.
- Compare the material properties of ferrous and non-ferrous material.
- Analyse the heat treatment process and relate cooling rate on the properties of material.

Mapping of Course Outcomes (COs) onto Program Outcomes (POs) and Program Specific Outcomes (PSOs):

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

Weightage: 1-Sightly, 2-Moderately, 3-Strongly

Semester	Course No.	Subject	Teaching Hours/ Week/ Periods			Evaluation Scheme						Credits
			Theory Lectures	Tutorials	Practical	Continuous Internal Assessment				Semester Examination Assessment	Total Marks	
						CIA						
			L	T	P	CT–1	CT–2	Assignments, surprise test, quiz test etc	Attendance	SEA		
B. Tech III Sem.	IPUCTO1	I. C. Engine	3	-	-	15	15	5	5	60	100	3

COURSE OBJECTIVES:

1. To study classifications of internal combustion engine.
2. To understand how and why actual cycles deviate from air standard cycle and fuel-air cycle.
3. To understand combustion in spark ignition engine and diesel engines.
4. To impart knowledge about carburetion, gasoline injection and diesel injection.
5. To impart knowledge about ignition, cooling, lubrication and governing systems.
6. To impart knowledge about various engine performance characteristics and its testing.

COURSE CONTENT:

Module-I

Introduction of internal combustion engines, classification of I.C. engines, engines components, basic engine nomenclature, four stroke S.I. and C.I. engine, two stroke engines, comparison of two stroke and four stroke engines, comparison of S.I. and C.I. engines.

Module -II

Air Standard Cycle: Otto cycle, Diesel cycle, Dual cycle, comparison between Otto, diesel and dual cycles, fuel-air cycles and actual-cycles.

SI Engines: Combustion phenomenon in S.I. Engines,Flame development and its propagation, ignition lag, knocking in S.I. engines, Carburetor,Theory of carburetion.

Module -III

CI Engine: Combustion phenomenon in CI engines, p-v diagram and their study for various stage of combustion, delay period, detonation in C.I. engines, Fuel injection in CI engines

Module -IV

Engine Friction and Lubrication: Total engine friction, blow by losses, pumping losses, factors effecting engine friction, mechanism of lubrication, lubrication system.

Module - V

Cooling system: Piston and cylinder temperature distribution, principles and various methods of cooling.Measurement of performanceParameters.

TEXT BOOKS:

1. A Course in IC Engines - M.L. Mathur and R.P. Sharma, Laxmi Publication.
2. Internal Combustion Engines –V. Ganesan, TMGH Publication.
3. Internal Combustion Engines: Theory and Practice - G.F. Taylor.
4. Introduction to IC Engine -Stone, Richard.
5. Fundamentals of I.C. Engine- Gupta, PHI.

COURSE OUTCOME:

The after completion of the course the student will be able to

CO1: Demonstrate the components & combustion phenomenon of SI and CI engines.

CO2: Perform a thermodynamic analysis of Otto, Diesel, and Dual cycle models

CO3: Demonstrate the combustion phenomenon of SI engine and CI engine

CO4: Understand cooling, friction & lubrication systems in engines

CO5: Evaluate the performance parameters of IC engines.

Mapping of Course Outcomes (COs) onto Program Outcomes (POs) and Program Specific Outcomes (PSOs):

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

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

Semester	Course No.	Subject	Teaching Hours/ Week/ Periods			Evaluation Scheme						Credits
			Theory Lectures	Tutorials	Practical	Continuous Internal Assessment				Semester Examination Assessment	Total Marks	
						CIA						
			L	T	P	CT–1	CT–2	Assignments, surprise test, quiz test etc	Attendance	SEA		
B. Tech III Sem.	IPUCTK1	Industrial Engineering	3	-	-	15	15	5	5	60	100	3

COURSE OBJECTIVES:

1. To impart capability of successfully planning, controlling, and implementing projects.
2. To apply the principles of engineering science, maths, technology and human engineering, involving industry-relevant problems.
3. To contribute to the profitable growth of industrial economic sectors by using IE analytical tools, effective computational approaches and systems thinking methodologies.
4. To recognize the tools of efficiency, effectiveness and productivity for the resources of the plant and facility.
5. To implement the policy of wage administrations for making the labour more and higher productive in their work.

COURSE CONTENT:

Module-I

Introduction: History & development of industrial engineering. Productivity, means of increasing productivity, work study, productivity and work study, human factor in the fabrication, work of F. W. Taylor, Frank and Lillian Gilberth and their contribution.

Module-II

Method study: Definition & basic procedure, selection of jobs. Recording technique: micro motion study, Therbligs, cyclograph,chronocyclo graph, principle of motion economy, design of work place layout, analysts in the form of chart, operation chart, flow process chart, flow diagram, string diagram, man machine chart, two hand chart, Simo chart.

Module-III

Work measurement: Definition, objectives, application, number of cycles to be timed, time study equipment, performance rating, allowance, lumber of cycle to be studied, determination of standard time, predetermined motion time system, conducting work sampling study & establishing standard time.

Module-IV

Wages & incentives: Characteristics of a good wage or incentive system, method of wage payment, concept of wage & incentive schemes, financial and non-financial: Taylor's differential piece rate, Halsey premium plane, Merric's multiple piece rate system, group incentive scheme.

Ergonomics: Work space dimension, design of work place, environmental stresses & impacts on human work.

Module-V

Value engineering: Introduction, concept of value, value analysis approaches, job plan, value tests.

Industrial safety: Analysis of cost of accident, hazards in various fields like fire, electrical shocks, chemical; organization for safety, plant safety, govt. legislation for safety, safety rules.

TEXT BOOKS:

1. Introduction to work study–I.L.O., Oxford Press.
2. Motion and time study – Mundel, Prentices Hall India.
3. Motion and Time Study– Ralph M Barnes, John Wiley and sons.
4. Industrial Engineering – M. I. Khan, New Age International Publication.

COURSE OUTCOMES:

After completion of the course, student will be able to

CO1: Ability to apply mathematics and science in Industrial engineering.

CO2: Ability to design and conduct experiments, as well as to analyse and interpret data.

CO3: Ability to identify, formulate and solve engineering problems.

CO4: Ability to use the techniques, skills, and modern engineering tools necessary for industrial engineering practice.

Mapping of Course Outcomes (COs) onto Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs**												**PSOs**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSOs1	PSOs2	PSOs3
CO1	3	3	2	2	2	2	-	2	2	2	2	2	3	2	3
CO2	3	2	2	2	2	2	-	2	-	-	2	1	3	2	2
CO3	3	3	2	2	2	-	-	3	-	-	2	2	2	3	-
CO4	3	3	2	3	3	1	1	2	1	-	2	1	3	2	-
CO5	3	3	2	2	2	-	-	2	2	-	1	2	2	2	2

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

Semester	Course No.	Subject	Teaching Hours/ Week/ Periods			Evaluation Scheme						Credits
			Theory Lectures	Tutorials	Practical	Continuous Internal Assessment				Semester Examination Assessment	Total Marks	
			L	T	P	CIA				SEA		
						CT–1	CT–2	Assignments, surprise test, quiz test etc	Attendance			
B. Tech III Sem.	IPUCTK2	Work Study and Ergonomics	3	-	-	15	15	5	5	60	100	3

COURSE OBJECTIVES:

1. To provide the knowledge of interaction of man, machine and integration of their tools.
2. To apply the principles of math, science, technology and engineering, involving industry-relevant problems.
3. To provide the comfort ability in working environment of all the employee, labour.
4. To apply the concept in the examination of human and work in all their contexts.

Module - I

Introduction to man machine systems and ergonomics, human factors in design and engineering, needs of ergonomics and aesthetic design, physiological aspects of work.

Module - II

Work measurement through physiological tests, work physiology, paced and unpaced work performance, data logging, data collection, data reduction and analysis techniques, gross human anatomy, anthropometry, bio mechanics, muscle strength and exertion potential of different limbs.

Module - III

Work capacity, environmental effects, exercises for evaluation of pastoral form and work spaces, environmental conditions including temperature, illumination, noise and vibration.

Module - IV

Perception and information processing, design of displays, hand control, typography, and readability, layout and composition.

Module - V

Exercises in evaluation of human response to product interface, product safety and product liability, design consideration for appearance, colour, texture and form.

TEXT BOOKS:

1. Applied Ergonomics– D. C. Alexander, Taylor & Francis.
2. Ergonomics for Beginners– Jan Dul, Taylor & Francis.
3. The Nature & Aesthetics of Design–David Pye, Cambium Press.

COURSE OUTCOMES:

After completion of the course, student will be able to

CO1: Ability to design and conduct experiments, as well as to analyse and interpret data.

CO2: Ability to identify, formulate and solve engineering problems.

CO3: Ability to use the techniques, skills, and modern engineering tools necessary for work study practice.

CO4: Assess the effect of physical environment factors on comfort and performance.

CO5: Explain the influence of ergonomic principles on work organisation and culture.

Mapping of Course Outcomes (COs) onto Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSOs1	PSOs2	PSOs3
CO1	3	2	3	2	-	3	2	-	-	-	-	2	3	2	2
CO2	2	3	3	2	-	2	2	-	-	-	2	2	3	2	2
CO3	3	2	2	2	-	2	3	-	-	-	2	2	2	3	2
CO4	3	2	2	2	-	2	2	-	-	-	1	2	3	2	2
CO5	3	2	2	2	-	2	2	3	-	-	-	2	2	2	3

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

Semester	Course No.	Subject	Teaching Hours/ Week/ Periods			Evaluation Scheme			Credits
			Theory Lectures	Tutorials	Practical	Continuous Internal Assessment	Semester Examination Assessment	Total Marks	
			L	T	P				
B. Tech III Sem.	IPUCLE1	Programming in C & MATLAB	-	-	3	25	25	50	1.5

COURSE LEARNING OBJECTIVES:

The objective of this course is to:

- Familiarize the student in introducing and exploring MATLAB & C software's.
- Enable the student on how to approach for solving engineering problems using simulation tools.
- Prepare the students to use MATLAB/C in their project works.
- Provide a foundation in use of this software's for real time applications

LIST OF EXPERIMENT (Minimum 10 experiments to be performed):

1. Write a program in 'C' to find simple interest'
2. Write a program in 'C' to calculate sum of three numbers.
3. Write a program in 'C' to calculate number of months and days.
4. Write a program in 'C' to find whether a year is leap or not.
5. Write a program in 'C' to convert the given temperature in Fahrenheit to Celsius.
6. Write a program in 'C' to find whether a number is odd or even.
7. Write a program in 'C' to calculate factorial of a given number.
8. Write a program in 'C' to find the real roots of a quadratic equation.
9. Write a program in 'C' for secant method.
10. Write a program in 'C' for Newton Raphson method.
11. Write a program in 'C' for Regula Falsi method.
12. Write a program in 'C' for Gause elimination and Gause Seidel methods.
13. Write a program in 'C' for Lagrange's interpolation.
14. Write a program in 'C' for Simpson Rule.
15. Write a program in 'C' for Euler method and Runge- Kutta Method.
16. A programme to show conversion from string to integer and vice versa.
17. To know the history and features of MATLAB & the local environment of MATLAB.

18. Find the roots of equations find the values at different points and plot the graph.
19. Find the derivative of an equation in MATLAB.
20. Find the area enclosed between the curves in MATLAB.
21. Find the addition, subtraction, multiplication, transpose and inverse of matrices.
22. Find the rank: Eigen values and Eigen vector of matrices.
23. Write a program to find the roots of an equation using Bi–section method, Regula–falsi method and Newton Raphson method.
24. Plot the surface for an equation using MATLAB.

COURSE OUTCOMES:

At the end of the course the students will be able to:

CO1. Perform the programming & simulation for engineering problems.

CO2. Learn importance of this software for lab experimentation.

CO3. Articulate importance of software's in research by simulation work.

CO4. In-depth knowledge of providing virtual instruments on C language environment.

CO5. Ability to write basic mathematical, numerical method problems in MATLAB.

Mapping of Course Outcomes (COs) onto Program Outcomes (POs) and Program Specific Outcomes (PSOs):

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

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

Semester	Course No.	Subject	Teaching Hours/ Week/ Periods			Evaluation Scheme			Credits
			Theory Lectures	Tutorials	Practical	Continuous Internal Assessment	Semester Examination Assessment	Total Marks	
			L	T	P				
B. Tech III Sem.	IPUCLT1	Fluid Mechanics Lab	-	-	3	25	25	50	1.5

COURSE LEARNING OBJECTIVES:

The objective of this course is to:

- Provide practical knowledge in verification of principles of fluid flow.
- Demonstrate the classical experiments in fluid mechanics.
- Correlate various flow measuring devices such as Venturimeter, orifice meter and notches etc.
- Impart knowledge in measuring pressure, discharge and velocity of fluid flow
- Explain practically the major and minor losses.

LIST OF EXPERIMENT:

1. Measurement of viscosity.
2. Study of pressure measuring devices.
3. To determine the stability of floating body.
4. To determine hydrostatics force on flat surfaces/curved surfaces.
5. To verify the Bernoulli's theorem.
6. To determine flow rate using Venturimeter.
7. To determine flow rate using Orifice meter.
8. Velocity distribution in pipes.
9. To study Laminar flow in a pipeline.

COURSE OUTCOMES:

At the end of the course the students will be able to:

- Present experimental results in the form of written report.
- Measure pressure, velocity and flow rate.
- Conduct experiments (in teams) in pipe flows and open-channel flows and interpreting data from model studies to prototype cases, as well as documenting them in engineering reports.
- Analyze practical problems related to peer industries such as power plants, chemical industries etc.
- Analyze a variety of practical fluid-flow devices and utilize fluid mechanics principles in design.

Course Outcomes and their mapping with Programme Outcomes:

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

Weightage: 1-Sightly, 2-Moderately, 3-Strongly

GURU GHASIDAS VISHWAVIDYALAYA (A CENTRAL UNIVERSITY), BILASPUR, CG
SCHOOL OF STUDIES IN ENGINEERING AND TECHNOLOGY
Department of Industrial & Production Engineering
Choice based credit system (CBCS)–New, Scheme of Teaching& Examination
W.E.F. Session: 2023–24
B. TECH SECOND YEAR, IV SEMESTER

			Teaching Hours/ Week/ Periods			Evaluation Scheme			Credits
			Theory Lectures	Tutorials	Practical	Continuous Internal Assessment	Semester Examination Assessment	Total Marks	
SN	**Course No.**	**Subject**	**L**	**T**	**P**	**CIA**	**SEA**	**L**	
1	AMUDTT1	Statistical Methods	3	–	–	40	60	100	3
2	IPUDTT1	Theory of Machines	3	–	–	40	60	100	3
3	IPUDTT2	Strength of Materials	3	–	–	40	60	100	3
4	IPUDTO1	*Open Elective*	3	–	–	40	60	100	3
5	IPUDTK_	*1. Program Elective-1* *2. Program Elective-2*	3	–	–	40	60	100	3
Total			**15**	–	–	**200**	**300**	**500**	**15**
PRACTICALS									
1	IPUDLT1	Material Testing Lab	–	–	3	25	25	50	1.5
2	IPUDLT2	Theory of Machines Lab	–	–	3	25	25	50	1.5
3	IPUDPV1	Mini Project	–	–	4	50	50	100	2
Total			**–**	**–**	**10**	**100**	**100**	**200**	**5**
GRAND TOTAL			**15**	–	**10**	**300**	**400**	**700**	**20**

List of Department/ Program Elective		
SN	Course No.	Subject
1.	IPUDTK1	Engineering Thermodynamics
2.	IPUDTK2	Plant Layout& Material Handling

List of Institute Core/ Open Elective			
SN	Course No.	Subject	Offering Department
1.	CSUDTO1	Introduction to Information Science	CSE
2.	IPUDTO1	Automobile Engineering	IPE
3.	ECUDTO1	Introduction to Electronics Devices and Circuits	ECE
4.	CEUDTO1	Remote Sensing & GIS	Civil
5.	ITUDTO1	Computer Network	IT
	ITUDTO2	Fundamentals of Python Programming	
6.	CHUDTO1	Fluidization Engineering	Chemical
7.	MEUDTO1	Introduction to Fluid Mechanics	Mechanical
8.	ESUDTO1	Effective Technical Communication	English

Internal Assessment: – Two class tests of 15 marks each will be conducted. Moreover, 5 marks will be for attendance and 5 marks are allocated for the Assignments, surprise test, quiz test etc.

Approved in BOS meeting held on 06.10.2023

Semester	Course No.	Subject	Teaching Hours/ Week/ Periods			Evaluation Scheme						Credits
			Theory Lectures	Tutorials	Practical	Continuous Internal Assessment				Semester Examination Assessment	Total Marks	
			L	T	P	CIA				SEA		
						CT–1	CT–2	Assignments, surprise test, quiz test etc	Attendance			
B. Tech IV Sem.	AMUDTT1	Statistical Methods	3	-	-	15	15	5	5	60	100	3

COURSE LEARNING OBJECTIVES:

The objective of this course is to:

- Demonstrate knowledge of probability and the standard statistical distributions.
- Demonstrate understanding of how to design experiments and surveys for efficiency.
- Demonstrate the ability to perform complex data management and analysis.
- To enable the students to deal with uncertainty problems.
- To enable the students to establish the relation among the statistical data.

COURSE CONTENT:

Module – I

Introduction to statistics, mathematical statistics, variable, frequency distribution, type of series, measure of central tendency various types of averages, mean median mode for grouped and ungrouped data, measure of dispersion.

Module – II

Curve fittings by method of least square, straight line parabola correlation, Karl Pearson's coefficient of correlation, limits for correlation coefficient, rank correction, regression linear regression, equation to the line of regression, regression coefficient, angle between two lines of regression.

Module – III

Theory of probability: Mathematical and statistical definition of probability sample space, finite sample space sample point, events theorem of total probability, sample and compound event, conditional probability, theorem of compound probability, Baye's theorem.

Module – IV

Theoretical distribution: Binominal distribution mean, standard deviation, Poisson distribution, mean, and standard deviation, normal distribution: mean and standard deviation.

Module – V

Random and simple sampling: Mean standard deviation in simple sampling of attribute, test of significant for large sample test of significance based on Chi square, T, F and Z distribution degree of freedom, condition for applying Chi-square test.

TEXT & REFERENCE BOOKS:

1. Mathematical Statistics– M. Roy, Ram Prasad Publications, Agra.
2. Probability & Statistics –P.C. Biswal, PHI Learning.
3. Statistics Analysis– A.A. Afti, Orioited Approach Academic Press.
4. Fundamental of Mathematical Statistics– S. C. Gupta and Kapoor, Sultan Chand and Sons, 1980.

COURSE OUTCOMES:

At the end of the course the students will be able to:

- Analyse and apply measures of location and measures of dispersion grouped and ungrouped series.
- Apply discrete and continuous probability distributions to various business problems.
- Perform test of hypothesis as well as calculate confidence interval for a population parameter for single sample and two sample cases and learn the concept of p–values.
- Learn non–parametric test such as the Chi–square test for independence as well as goodness of fit.
- To enable the students to analyze data and draw appropriate statistical conclusions.

Mapping of Course Outcomes (COs) onto Program Outcomes (POs) and Program Specific Outcomes (PSOs):

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

Weightage: 1-Sightly, 2-Moderately, 3-Strongly

Semester	Course No.	Subject	Teaching Hours/ Week/ Periods			Evaluation Scheme						Credits
			Theory Lectures	Tutorials	Practical	Continuous Internal Assessment				Semester Examination Assessment	Total Marks	
						CIA						
			L	T	P	CT–1	CT–2	Assignments, surprise test, quiz test etc	Attendance	SEA		
B. Tech IV Sem	IPUDTT1	Theory of Machines	3	-	-	15	15	5	5	60	100	3

COURSELEARNINGOBJECTIVES:

The objective of this course is to:

- Impart knowledge of various types of links, mechanisms and machines and kinematics inversions.
- Familiarize the kinematics of mechanisms by drawing the velocity and the accelerations diagrams.
- Solving practical problems related to design of linkage mechanisms and cam and follower systems to generate specified output motions.
- Learn the importance of kinematics behind gear, gear trains and fundamental principles of flywheel.
- Explain the types of mechanical governors and to analyze its performance parameters.

COURSE CONTENT:

Module – I

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.

Module –II

Displacement, velocity and acceleration analysis of simple mechanisms, graphical velocity analysis using instantaneous centre, 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.

Module –III

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.

Module –IV

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, compound, reverted and epicyclic gear trains, velocity ratio of epicyclic gear trains.

Module –V

Turning moment of Flywheel: Function of a flywheel, crank effort diagrams, fluctuation of speed and energy, effect of centrifugal tension of flywheel, inertia torque and its effects on crank effort diagrams.

Governors: Characteristics of centrifugal governors, Gravity controlled governors, Porter and Proell. Spring controlled centrifugal governor: Hartung and Hartnell governor, performance parameter: sensitivity, stability, isochronisms, governor effort and power.

TEXT & REFERENCE BOOKS:

1. Theory of Machines– Thomas Bevan,CBS Publishers.
2. Mechanisms of Machines– W.L. Cleghorn, Oxford University Press, 2015.
3. Kinematics and Dynamics of Machinery– L. Norton Robert, McGraw-Hill.
4. Theory of Mechanisms and Machines – A. Ghosh, A. K. Mallik – EWP Press.
5. Theory of Machines and Mechanisms - J.Uicker, Gordon R Penstock & J.E. Shigley – Oxford International Edition.
6. Theory of Machines- by R S Khurmi, S Chand & Co Ltd.
7. Theory of Machines- by Rattan S S, McGraw Hill Education India Private Limited.

COURSE OUTCOMES:

At the end of the course the students will be able to:

CO1: Apply knowledge of Kinematics of machine for understanding, formulating and solving engineering problems.

CO2: Analyse the position, velocity and acceleration of mechanisms.

CO3: Construct cam profiles and analysis of their velocity and acceleration.

CO4: Understand the different types of gears, gear terminology, important gear trains and their practical applications.

CO5: Understand the various types of governors and its applications.

Mapping of Course Outcomes (COs) onto Program Outcomes (POs) and Program Specific Outcomes (PSOs):

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

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

Semester	Course No.	Subject	Teaching Hours/ Week/ Periods			Evaluation Scheme						Credits
			Theory Lectures	Tutorials	Practical	Continuous Internal Assessment				Semester Examination Assessment	Total Marks	
			L	T	P	CIA				SEA		
						CT–1	CT–2	Assignments, surprise test, quiz test etc	Attendance			
B. Tech IV Sem	IPUDTT2	Strength of Materials	3	-	-	15	15	5	5	60	100	3

COURSELEARNINGOBJECTIVES:

The objective of this course is to:

- Use different material properties and characteristics for various mechanical and structural applications.
- Categorize the stress and strain on the basis of different conditions/type of loading/nature of loading.
- Determine the various parameters such as stress, strain and deflection for various specimens.
- Compare the result using theoretical, graphical and experimental approach.
- Draw stress strain curve to show mechanical properties of material.
- Propose technique/methods to solve problems that match the one's strength.

COURSE CONTENT:

Module – I

Simple stresses and strains: Concept of stress and strain, St. Venant's principle, stress and strain diagram, elasticity and plasticity, types of stresses and strains, Hooke's law, stress–strain diagram for mild steel, working stress, factor of safety, lateral strain, Poisson's ratio, volumetric strain. Elastic moduli and relationship between them, bars of varying section, composite bars, temperature stresses. Strain energy, resilience, gradual, sudden, impact and shock loadings, simple applications.

Module –II

Compound stresses and strains: Two-dimensional system, stress at a point on a plane, principal stresses and principal planes, Mohr circle of stress, ellipse of stress and their applications. Two-dimensional stress–strain system, principal strains and principal axis of strain, circle of strain and ellipse of strain.

Module –III

Bending moment and Shear force diagrams: Bending moment (BM) and shear force (SF) diagrams.BM and SF diagrams for cantilevers simply supported and fixed beams with or without overhangs. Calculation of maximum BM and SF and the point of contra flexure under concentrated loads, uniformly distributed loads over the whole span or part of span, combination of concentrated loads (two or three) and uniformly distributed loads, uniformly varying loads, application of moments.

Module –IV

Bending stress: Flexural stresses, theory of simple bending, assumptions, derivation of bending equation: M/I = f/y = E/R, neutral axis, determination of bending stresses, section modulus of rectangular and circular sections (solid and hollow), I,T, angle and channel sections, design of simple beam sections.

Shear stresses: Derivation of formula, shear stress distribution across various beam sections like rectangular, circular, triangular, I, T angle sections.

Slope and deflection: Relationship between moment, slope and deflection, moment area method, Macaulay's method. Use of these methods to calculate slope and deflection for determinant beams.

Module–V

Torsion: Derivation of torsion equation and its assumptions. Applications of the equation of the hollow and solid circular shafts, torsional rigidity, combined torsion and bending of circular shafts, principal stress and maximum shear stresses under combined loading of bending and torsion. Analysis of close coiled helical springs.

Thin cylinders and spheres: Derivation of formulae and calculations of hoop stress, longitudinal stress in a cylinder and sphere subjected to internal pressures.

COURSE OUTCOMES:

At the end of the course the students will be able to:

CO1. Propose material properties for different mechanical and structural applications.
CO2. Formulate the fundamental concepts of stress/strain.
CO3. Examine various techniques to solve structural/mechanical members subjected to combined loading.
CO4. Apply various failure criteria for general stress states at points.
CO5. Use method of solution that matches one's capability.

TEXT & REFERENCE BOOKS:

1. Elements of Strength of Materials–S.Timoshenko and D. H. Young, Affiliated East-West Press.
2. Solid Mechanics –S. M. A Kazmi,McGraw-Hill.
3. Mechanics of Materials–R.C.Hibbeler, Pearson.
4. An Introduction to the Mechanics of Solids–S. H. Crandall, N. C. Dahl and T. J. Lardner,Tata McGraw Hill Education Private Limited (2012).
5. Laboratory Manual of Testing Materials – William Kendrick Hall, Prentice Hall of India.
6. Mechanics of Materials – Ferdinand P. Beer, E. RusselJhonston Jr., John T. D E Wolf, McGraw Hill.
7. Strength of Materials– R. Subramanian, Oxford University Press.

Mapping of Course Outcomes (COs) onto Program Outcomes (POs) and Program Specific Outcomes (PSOs):

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

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

Semester	Course No.	Subject	Teaching Hours/ Week/ Periods			Evaluation Scheme						Credits
			Theory Lectures	Tutorials	Practical	Continuous Internal Assessment				Semester Examination Assessment	Total Marks	
			L	T	P	CIA				SEA		
						CT–1	CT–2	Assignments, surprise test, quiz test etc	Attendance			
B. Tech IV Sem.	IPUDTO1	Automobile Engineering	3	-	-	15	15	5	5	60	100	3

COURSE OBJECTIVES:

1. To provide the knowledge of basic structure of an automobile.
2. To provide the knowledge of transmission system and its various elements.
3. To provide the knowledge of clutches and suspension system
4. To provide the knowledge of braking system.
5. To provide the knowledge of steering system and engine emissions.

COURSE CONTENT:

Module - I

Introduction of an automobile: Component and basis structure of automobile, classification, difference between automobile and automotive, the chassis construction & classification, defect in frames, frameless construction & specifications. Wheel and tyres: Types of wheel, wheel dimension, desirable tyres properties, types of tyres, tyre material, tyre dimension, factors affecting tyre life.

Module - II

Transmission system: Function of transmission types, sliding mesh gear box, constant mesh gear box, synchro mesh gear box, torque converter, propeller shaft, universal joint, hook joint, final drive, differential, performance of gear box.

Module - III

Clutches: Requirement, function & type of clutch, dry friction clutch, wet friction clutch, clutch plate, single plate & multiple plate clutch, centrifugal clutch and fluid fly wheel.

Suspension system function and requirement, leaf spring, torsion bar, telescopic shock absorber.

Module - IV

Brakes: Function and requirement, brake efficiency, wheel skidding, types of brake, electrical, mechanical and hydraulic & pneumatic brakes, master cylinder, wheel cylinder, self-actualizing brakes, brake drum, brake liners, brake shoe, trouble shooting.

Module - V

Front axle and suspension wheel alignment purpose: Factor of front wheel alignment, steering geometry, correct steering angle, steering mechanism, under steer and over steer, steering gear, power steering, reversibility of steering gears, steering gear ratio, calculation of turning radius.

Engine emission: Emission standard of vehicle in India, Euro norms, emission, testing. Principle of multipoint fuel injection (MPFI), component of MPFI, different sensors of MPFI system, vehicle air conditioning.

TEXT & REFERENCE BOOKS:

1. Automobile Engineering - Kripal Singh Vol. I, II.
2. Automobile Mechanics - Joseph Heitner.
3. Automobile Engineering - N.K Giri
4. Automobile Engineering - Shrinivasan T.M.H.
5. Automobile Engineering - K.K. Jain, R.B. Asthana T.M.H.
6. Automobile Engineering - R.B. Gupta Tech India Publication Series.

COURSE OUTCOMES:

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

CO1: Graduates will gain a strong foundation in core automobile engineering, both in theoretical and applied concepts.

CO2: Acquire knowledge and hands-on competence in the design and development of automobile.

CO3: Graduates will develop an ability to identify and solve automobile engineering maintenance problems.

Mapping of Course Outcomes (COs) onto Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSOs1	PSOs2	PSOs3
CO1	3	1	1	1	-	-	-	-	-	-	-	1	3	1	1
CO2	3	3	3	3	2	1	-	-	-	-	-	2	3	1	1
CO3	3	3	2	1	-	-	-	-	-	-	-	1	3	1	2

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

Semester	Course No.	Subject	Teaching Hours/ Week/ Periods			Evaluation Scheme						Credits
			Theory Lectures	Tutorials	Practical	Continuous Internal Assessment				Semester Examination Assessment	Total Marks	
						CIA						
			L	T	P	CT–1	CT–2	Assignments, surprise test, quiz test etc	Attendance	SEA		
B. Tech IV Sem	IPUDTK1	Engineering Thermodynamics	3	-	-	15	15	5	5	60	100	3

COURSELEARNINGOBJECTIVES:

The objective of this course is to:

1. Learn the fundamentals principles of classical thermodynamics and prepare them to apply basic conversion principles of mass and energy to closed and open systems.
2. Applications of laws of thermodynamic while solving engineering problems.
3. Understand second law of thermodynamics and apply it to various systems, note the significance of the results and to know about entropy and second law.
4. Importance of pure substances and analyse the performance of thermodynamic air and of vapour power cycles.

COURSE CONTENT:

Module –I

Basic concepts:

Microscopic & macroscopic point of view, Thermodynamic system and control volume, Thermodynamic properties, processes and cycles, equilibrium, Quasi-static process, reversible and irreversible process, concept of temperature, Zeroth law of thermodynamics, Heat and Work transfer, pure substance**.**

First law of thermodynamics: Concepts of internal energy, specific heat capacities, enthalpy, energy balance for closed and open systems, energy balance for steady and unsteady flow processes, and its applications.

Module –II

Second law of thermodynamics: Thermal energy reservoirs, Limitations of first law of thermodynamics, Kelvin-Planck and Clausius statements and their equivalence, Perpetual motion machine of the second kind, Carnot cycle, Heat Engine,reversed Carnot cycle, refrigerator and heat pump.

Entropy: Clausius theorem, Concept of entropy, Clausius inequality,entropy change in an open system, reversible and irreversible process, principle of increase of entropy, Third law of thermodynamics, Entropy and disorder, concept of exergy.

Module –III

Properties of pure substances: Thermodynamic properties of pure substances in solid, liquid and vapour phases. Phase rule, p–V, p–T, T–v, T–s, h–S diagrams, pvT surfaces, thermodynamic properties of steam, calculations of work done and heat transfer in non– flow and flow processes.

Module –IV

Vapour power cycles: Carnot cycle,Rankine cycle,reheatcycle, Regenerative cycle, Binary vapour cycle,thermal efficiency and work ratios, factors affecting efficiency and work output.

Module – V

Heat Transfer: Various modes of heat transfer, Fourier's, Newton's and Stefan Boltzmann's law, combined modes of heat transfer, thermal diffusivity, overall heat transfer coefficient. Basic concept of convection and its application, Thermal Radiation: black and non-black bodies, Kirchhoff's law, intensity of radiation, radiation exchange between black surface, geometric configuration factors.

TEXT & REFERENCE BOOKS:

1. Engineering Thermodynamics – P.K. Nag, Tata McGraw Hill Education.
2. Thermodynamics – An Engineering Approach – Cengel, McGraw Hill Education.
3. Fundamentals of thermodynamics – Sonntag & G. J. V. Wylen, John Wiley and Sons.
4. Fundamentals of Engineering Thermodynamics – M. J. Moran, H. N. Shapiro, D. D. Boettner& M. Bailey, John Wiley & Sons.
5. Engineering thermodynamics – J. B. Jones & R. E. Dugan, Prentice Hall.
6. Outline of Thermodynamics for Engineers – M. C. Potter& C. W. Schaum's Somerton, McGraw-Hill Education.

COURSE OUTCOMES:

At the end of the course the students will be able to:

CO1. Describe the basic concepts of thermodynamics such as conservation of mass and energy, work interaction, heat transfer, Zerothand first law of thermodynamics.

CO2. Explain the second law of thermodynamics, and concept of entropy.

CO3. Assess thermodynamic applications using second law of thermodynamics.

CO4. Demonstrate the importance of phase change diagrams of various pure substances.

CO5. Analyze the performance of vapor power cycles and identify methods to improve thermodynamic performance.

CO6.Explain the basics of heat transfer and different modes of heat transfer.

Mapping of Course Outcomes (COs) onto Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs**												**PSOs**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSOs1	PSOs2	PSOs3
CO1	3	3	2	3	-	-	1	-	-	-	-	1	2	2	-
CO2	3	3	3	2	-	-	-	-	-	-	-	1	2	2	
CO3	3	3	2	2	-	-	-	-	-	-	-	-	2	1	-
CO4	3	3	2	2	-	-	-	-	-	-	-	-	2	2	-
CO5	3	3	2	2	-	-	-	-	-	-	-	-	2	-	-
CO6	3	2	2	2	-	-	-	-	-	-	-	-	2	2	-

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

Semester	Course No.	Subject	Teaching Hours/ Week/ Periods			Evaluation Scheme						Credits
			Theory Lectures	Tutorials	Practical	Continuous Internal Assessment				Semester Examination Assessment	Total Marks	
			L	T	P	CIA				SEA		
						CT–1	CT–2	Assignments, surprise test, quiz test etc	Attendance			
B. Tech IV Sem	IPUDTK2	Plant Layout& Material Handling	3	-	-	15	15	5	5	60	100	3

COURSE LEARNING OBJECTIVES:

The objectives of this course are:

1. To provide the basic concepts related to the interactions between the production system parameters and their impact on materials handling systems design.
2. To familiarize students with different methods available for the generation of plant layouts.
3. To provide students with information on materials handling systems design for various aspects of the manufacturing and service industry.

COURSE CONTENT:

Module - I

Plant facility locating: Concept of plant facility**,** its scope, importance and objectives nature of location decision, need for facility location planning, general procedures and factors influencing location decision, facility location models, economics and cost analysis, rural and urban location pattern in India.

Module - II

Layout designs: Industrial plant design consideration, types of production types of layout, factors affecting layout tools, techniques and procedure used in workstation and plant layout, quantitative technique in plant layout, developing product and process layout, comparing layouts, criteria for computerized facility layout, concept of computerized layout programs like CRAFT, CORELAP, ALDEP and PLANET.

Module - III

Flow pattern design: Overall system flow cycle, need and advantage of planned material flow, factors for consideration, designing flow pattern, flow patterns for production lines and assembly lines methods.

Module - IV

Material Handling: Scope and functions of material handling, manual mechanical handling ratio, principles of material handling, analysis of material handling problem, classification of material handling system, salient features and application of general purpose material handling equipment, material handling in stores and warehouses, automation in part handling and industrial robots, optimum allocation of material handling equipment.

Module - V

Automated material handling system: Concept of AGVs, AR/RS and methods to minimize cost of material handling, safety in material handling, evaluation of material handling process, design procedure of cranes, lifts.

TEXT & REFERENCE BOOKS:

1. Practical plant layout - Muther Richard, New York, McGraw-Hill
2. Plant layout and design - James More, New York, Macmillan
3. Manufacturing Management: A Quantitative approach - Robert Aolsem, International Textbook Co.
4. Productions and Operation Management - K.G. Lockyer, Alan Muhlemann, John Oakland, Financial Times Prentice Hall

COURSE OUTCOMES:

At the end of the course the students will be able to:

CO1: To describe and determine the effect of product, process, and schedule design parameters on plant layout and materials handling systems design.

CO2: To identify the characteristics of product and process layouts and their needs in terms of materials handling.

CO3: To develop and analyze plant layouts using manual and computer aided software methodologies.

CO4: To identify and select various types of material handling equipment.

CO5: To design material handling systems for a variety of scenarios pertaining to manufacturing and service industry

Mapping of Course Outcomes (COs) onto Program Outcomes (POs) and Program Specific Outcomes (PSOs):

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

Semester	Course No.	Subject	Teaching Hours/ Week/ Periods			Evaluation Scheme			Credits
			Theory Lectures	Tutorials	Practical	Continuous Internal Assessment	Semester Examination Assessment	Total Marks	
			L	T	P				
B. Tech IV Sem.	IPUDLT1	Material Testing Lab	-	-	3	25	25	50	1.5

COURSE LEARNING OBJECTIVES:

The objective of this course is to:

1. Ability to apply knowledge of mathematics and engineering in calculating the mechanical properties of structural materials.
2. Ability to function on multi-disciplinary teams in the area of materials testing.
3. Ability to use the techniques, skills and modern engineering tools necessary for engineering.
4. Ability to communicate effectively the mechanical properties of materials

LIST OF EXPERIMENT (Minimum 10 experiments to be performed):

1. To perform torsion test on mild steel specimen.
2. To perform bending tests on simply supported beam and cantilever beam.
3. To perform compression test on concrete.
4. To perform impact test.
5. To perform shear test.
6. Investigation of Hook's law that is the proportional relation between force and stretching in elastic deformation.
7. Determination of torsion and deflection.
8. Measurement of forces on supports in statically determinate beam.
9. Determination of shear forces in beams.
10. Determination of bending moments in beams.
11. Measurement of deflections in statically determinate beam.
12. Measurement of strain in a bar.
13. To perform bend test on steel bar.
14. To determine yield/tensile strength of steel bar.

COURSE OUTCOMES:

At the end of the course the students will be able to:

CO1. Perform the function on multi-disciplinary teams in the area of materials testing.

CO2. Use the techniques, skills and modern engineering tools necessary for engineering.

CO3. Apply professional and ethical responsibility in the areas of material testing.

Mapping of Course Outcomes (COs) onto Program Outcomes (POs) and Program Specific Outcomes (PSOs):

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

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

Semester	Course No.	Subject	Teaching Hours/ Week/ Periods			Evaluation Scheme			Credits
			Theory Lectures	Tutorials	Practical	Continuous Internal Assessment	Semester Examination Assessment	Total Marks	
			L	T	P				
B. Tech IV Sem.	IPUDLT2	Theory of Machines Lab	-	-	3	25	25	50	1.5

COURSE LEARNING OBJECTIVES:

The objective of this course is to:

1. Proficiency in the use of mathematical methods to analyze the forces and motion of complex systems of linkages, gears and cams.
2. Design linkage, cam and gear mechanisms for a given motion or a given input/output motion or force relationship.
3. Analyze the motion and the dynamical forces acting on mechanical systems composed of linkages, gears and cams.

LIST OF EXPERIMENTS (Minimum 10 experiments to be performed):

1. To study about the Oldham Coupling Mechanism with the help of Virtual-LAB.
2. To study about the quick return mechanism with the help of Virtual-LAB.
3. To study about the CAM follower mechanism with the help of Virtual-LAB.
4. Position analysis of Slider crank mechanism with the help of Virtual-LAB.
5. Velocity analysis of Slider crank mechanism with the help of Virtual-LAB.
6. To study about theElliptical Cam Mechanism with the help of Virtual-LAB.
7. To study about theCrank and Slotted Mechanism with thehelp of Virtual-LAB.
8. To study about theUniversal Joint with thehelp of Virtual-LAB.
9. To determine the jump phenomena of cam follower apparatus.
10. To draw displacement, velocity and acceleration curve of cam motion
11. To find the speed and torque of different gear in an epicyclic gear train.
12. To Study and analysis of Pantograph.
13. To study Four-bar mechanism and its inversions.

COURSE OUTCOMES:

At the end of the course the students will be able to:

CO1: Identify mechanisms in real life applications.

CO2: Perform kinematic analysis of simple mechanisms

CO3: Perform static and dynamic force analysis of slider crank mechanism.

CO4: Determine moment of inertia of rigid bodies experimentally.

Mapping of Course Outcomes (COs) onto Program Outcomes (POs) and Program Specific Outcomes (PSOs):

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

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