Paper Code(s): ES-201	L	P	C
Paper: Computational Methods btechnotes.in	4	-	4

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1^{st}) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand numerical methods to find roots of functions and first order unconstrained minimization of functions.
2.	To introduce concept of interpolation methods and numerical integration.
3.	To understand numerical methods to solve systems of algebraic equations and curve fitting by splines.
4.	To understand numerical methods for the solution of Ordinary and partial differential equations.

Course Outcomes (CO)

CO 1	Ability to develop mathematical models of low level engineering problems
CO 2	Ability to apply interpolation methods and numerical integration.
CO 3	Ability to solve simultaneous linear equations and curve fitting by splines
CO 4	Ability to numerically solve ordinary differential equations that are initial value or boundary value problems

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	2	-	-	-	2	2	2	3
CO 2	3	2	2	2	2	-	-	-	2	2	2	3
CO 3	3	3	3	3	2	-	-	-	2	2	2	3
CO 4	3	3	3	3	2	-	-	-	2	2	2	3

UNIT-I

Review of Taylor Series, Rolle 's Theorem and Mean Value Theorem, Approximations and Errors in numerical computations, Data representation and computer arithmetic, Loss of significance in computation

Location of roots of equation: Bisection method (convergence analysis and implementation), Newton Method (convergence analysis and implementation), Secant Method (convergence analysis and implementation). Unconstrained one variable function minimization by Fibonacci search, Golden Section Search and Newton's method. Multivariate function minimization by the method of steepest descent, Nelder- Mead Algorithm.

UNIT-II

Interpolation: Assumptions for interpolation, errors in polynomial interpolation, Finite differences, Gregory-Newton's Forward Interpolation, Gregory-Newton's backward Interpolation, Lagrange's Interpolation, Newton's divided difference interpolation

Numerical Integration: Definite Integral, Newton-Cote's Quadrature formula, Trapezoidal Rule, Simpson's one-third rule, simpson's three-eight rule, Errors in quadrature formulae, Romberg's Algorithm, Gaussian Quadrature formula.

UNIT-III

System of Linear Algebraic Equations: Existence of solution, Gauss elimination method and its computational effort, concept of Pivoting, Gauss Jordan method and its computational effort, Triangular Matrix factorization methods: Dolittle algorithm, Crout's Algorithm, Cholesky method, Eigen value problem: Power method
Approximation by Spline Function: First-Degree and second degree Splines, Natural Cubic Splines, B Splines, Interpolation and Approximation

UNIT - IV

Numerical solution of ordinary Differential Equations: Picard's method, Taylor series method, Euler's and Runge-Kutta's methods, Predictor-corrector methods: Euler's method, Adams-Bashforth method, Milne's method.
Numerical Solution of Partial Differential equations: Parabolic, Hyperbolic, and elliptic equations
Implementation to be done in C/C++

Textbook(s):

1. E. Ward Cheney & David R. Kincaid , "Numerical Mathematics and Computing" Cengage; 7th ed (2013).

References:

1. R. L. Burden and J. D. Faires, "Numerical Analysis", CENGAGE Learning Custom Publishing; 10th Edition (2015).
2. S. D. Conte and C. de Boor, "Elementary Numerical Analysis: An Algorithmic Approach", McGraw Hill, 3rd ed. (2005).
3. H. M. Antia, "Numerical Methods for Scientists & Engineers", Hindustan Book Agency, (2002).
4. E Balagurusamy "Numerical Methods" McGraw Hill Education (2017).

Paper Code(s): HS-203	L	P	C
Paper: Indian Knowledge System	2	-	2

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks
3. This is an NUES paper, hence all examinations to be conducted by the concerned teacher.

Instruction for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the Indian knowledge System.
2.	To understand the foundational concepts for science and technology.
3.	To understand the ancient Indian mathematics and astronomy.
4.	To understand the ancient Indian engineering and technology.

Course Outcomes (CO)

CO 1	Ability to understand the Indian knowledge System.
CO 2	Ability to understand and apply foundational concepts for science and technology.
CO 3	Ability to understand and apply ancient Indian mathematics and astronomy
CO 4	Ability to understand ancient Indian engineering and technology.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	-	-	-	-	-	3	-	-	-	-	-	2
CO 2	-	-	-	-	-	3	-	-	-	2	-	2
CO 3	3	3	-	-	-	-	-	-	-	-	-	2
CO 4	3	3	-	-	-	-	-	-	-	-	-	2

UNIT-I

Indian Knowledge System (IKS) - An Introduction:
Overview of IKS - Importance of Ancient Knowledge; Defining IKS; The IKS Corpus – A Classification Framework; Chaturdaśa-Vidyāsthāna; History of IKS, Some unique aspects of IKS;
The Vedic Corpus – Introduction to Vedas; The Four Vedas and their divisions; Vedāngas; Vedic Life;
Philosophical Systems – Indian Philosophical Systems; Vedic Schools of Philosophy; Non-Vedic Philosophical Systems; Wisdom through the Ages – Purānas, Itihāsa as source of wisdom, Rāmāyana, Mahābhārata, Niti-śāstras, Subhāssitas.

UNIT-II

Foundational Concepts for Science and Technology:
Linguistics - Components of Language; Pānini's work on Sanskrit Grammar; Phonetics in Sanskrit; Patterns in Sanskrit Vocabulary; Computational Concepts in Astādhyāyi, Logic for Sentence Construction; Importance of Verbs; Role of Sanskrit in Natural Language Processing
Number System and Units of Measurement – Number System in India; Salient Features of the Indian Numeral System; Unique approaches to represent numbers; Measurements for Time, Distance and Weight; Pingala and

the Binary System
Knowledge: Framework and Classification – The Knowledge Triangle; Prameya; Pramāna; Samśaya; Framework for establishing Valid Knowledge

UNIT-III

Mathematic and Astronomy in IKS:
Mathematics – Unique aspects of Indian Mathematics; Great Mathematicians and their Contributions; Arithmetic; Geometry; Trigonometry; Algebra; Binary Mathematics and Combinatorial Problems in Chandah-śāstra of Pingala, Magic Squares in India
Astronomy - Unique aspects of Indian Astronomy; Historical Development of Astronomy in India; The Celestial Coordinate System; Elements of the Indian Calendar; Āryabhatiya and the Siddhāntic Tradition; Pancānga; Astronomical Instruments; Jantar Mantar of Rājā Jai Singh Sawai

UNIT - IV

Engineering and Technology in IKS:
Engineering and Technology: Metals and Metalworking – The Indian S & T Heritage; Mining and Ore Extraction; Metals and Metalworking Technology; Iron and Steel in India; Lost wax casting of Idols and Artefacts; Apparatuses used for Extraction of Metallic Components
Engineering and Technology: Other Applications – Literary sources for Science and Technology; Physical Structures in India; Irrigation and Water Management; Dyes and Painting Technology; Surgical Techniques; Shipbuilding; Sixty-four Art Forums; Status of Indigenous S & T

Textbook(s):
1. B. Mahadevan, Vinayaka Rajat Bhat & Nagendra Pavana R.N., "Introduction to Knowledge System: Concepts and Applications" PHI (2022).

References:
1. C.M Neelakandhan & K.A. Ravindran, "Vedic Texts and The Knowledge Systems of India", Sri Sankaracharya University of Sanskrit, Kalady (2010).
2. P.P. Divakaran, "The Mathematics of India: Concepts, Methods, Connections", Springer (2018)
3. C.A. Sharma, "Critical Survey of Indian Philosophy", Motilal Banarasidass Publication (1964)
4. G. Huet, A. Kulkarni & P. Scharf, "Sanskrit Computational Linguistics", Springer (2009).
5. A.K. Bag, "History of Technology in India", Indian National Science Academy, Vol 1, (1997)

Paper Code(s): MEC-205	L	P	C
Paper: Theory of Machines	4	-	4

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart knowledge of various types of mechanisms and perform their synthesis by analytical and graphical method.
2.	To develop the understanding of Gears, Gear trains and Gyroscope.
3.	To facilitate students to understand the function and working of flywheels and governor.
4.	To learn and study the phenomena of balancing and mechanical vibrations.

Course Outcomes (CO)

CO 1	Examine various types of mechanisms and execute their kinematic analysis.
CO 2	Explain the concept of Gears, Gear Trains and Gyroscope.
CO 3	Describe the working principle of flywheel and governor.
CO 4	Understand the concept of balancing and mechanical vibration system.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	-	2	-	-	-	-	-	2
CO 2	3	3	3	3	-	2	-	-	-	-	-	2
CO 3	3	3	3	3	-	2	-	-	-	-	-	2
CO 4	3	3	3	3	-	2	-	-	-	-	-	2

UNIT-I

Mechanisms And Machines: Introduction of Simple mechanism, Different types of Kinematics pair, Grubler's rule for degree of freedom, Grashof's Criterion for mobility determination, Inversions of 4R, 3R-P, and 2R-2P chains. Kinematic Analysis of Planar Mechanisms: Velocity and acceleration diagrams, Application of relative velocity method in Slider crank and four bar mechanism, Instantaneous centre method, Kennedy-Arnold theorem, Acceleration diagrams for simple mechanism.
Cams: Classification, Construction of Cam profile, Analysis of Cams with uniform acceleration, and retardation, SHM, Cycloidal motion.

UNIT-II

Gears and Gear Trains: Classification of gears, Terminology, Geometry of tooth profiles, Law of gearing, Cycloidal and Involute profile, Undercutting and interference, Methods to avoid interference, Condition for minimum number of teeth to avoid interference, Contact ratio, Interference, Simple, Compound and Epicyclic gear trains, Tabular column method for Epicyclic gear trains, Fixing torque.
Gyroscopes: Principles of Gyroscope, Effect of Gyroscopic couple on automobiles, ships and aircrafts.

UNIT-III

Dynamic Analysis: Analysis of single slider crank mechanism for displacement, velocity and acceleration using analytical method, Klein's Construction, Turning moment diagrams, Flywheel.
Mechanical governors:Function of a governor, types of governors: weight and spring loaded, Hunting and Sensitivity, efforts and power of a governor, controlling diagrams.

UNIT - IV

Balancing: Static and Dynamic balancing, balancing of rotating and reciprocating masses, single and multicylinder engines.
Vibrations: Free vibration of a body, single degree of freedom system, Rayleigh method, free vibrations with viscous damping, Logarithmic decrement, Response of damped spring mass system to harmonic forces, Whirling of shafts, Vibration isolation, Transmissibility Ratio.

Textbook(s):

1. S.S. Rattan, "Theory of Machines", Tata McGraw Hill.
2. V.P. Singh, "Theory of Machines", Dhanpat Rai & Co.(P)Ltd.

References:

1. J E Shigley "Theory of Machines", Pearson.
2. Thomas Beven, "The Theory of Machines", CBS Publishers.
3. R.L. Norton, "Kinematics and Dynamics of Machinery", Tata McGraw-Hill.
4. P.L. Ballaney, "Theory of Machines & Mechanism", Khanna Publishers.

Paper Code(s): MEC-207	L	P	C
Paper: Strength of Materials	4	-	4

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand about different types of load conditions and determine the stress, strain and change in geometrical parameters of different types of materials.
2.	To understand the resistance mechanism of beams due to bending and shearing.
3.	To understand the principal stresses, behaviour of torsional members, columns and failure mechanisms in materials.
4.	To understand the difference between thin & thick pressure vessels and the design of springs.

Course Outcomes (CO)

CO 1	Evaluate the stress induced in structural members subjected to tension, compression, tangential and thermal loads.
CO 2	Analyse the performance of the beam for different types of loads and support conditions using SFD and BMD and determine the bending stress, shear stress and deflection induced.
CO 3	Analyse the stress induced in columns and members under torsion.
CO 4	Distinguish between thin and thick pressure vessels and estimate the different stresses induced in pressure vessels and springs.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	-	2	-	-	-	-	-	2
CO 2	3	3	3	3	-	3	-	-	-	-	-	2
CO 3	3	3	3	3	-	3	-	-	-	-	-	2
CO 4	3	3	3	2	-	3	-	-	--	-	-	2

UNIT-I

Simple Stresses & strains: Concept of stress and strain. Hooke's law, Stress-Strain diagram, factor of safety, Elongation of tapering bars of circular and rectangular cross sections, Elongation due to self-weight. Saint Venant's principle, Compound bars, state of simple shear, complementary shear stress, Volumetric stresses and Strains, Elastic constants and their relationship, Thermal stresses, Compound section subjected to thermal stresses, Sudden, gradual & impact load, Strain energy & Proof Resilience, Strain energy under normal and shear stress.

UNIT-II

Shear Force and Bending Moment in Beams: Types of beams, supports and loadings, Definition of bending moment and shear force, Sign conventions, relationship between load intensity, Bending moment and shear

force, Shear force and bending moment diagrams for statically determinate beams subjected to points load, Uniformly distributed loads, Uniformly varying loads, Couple and their combinations.

Bending and Shear Stresses in Beams: Introduction, Pure bending theory, Assumptions, Derivation of bending equation, Modulus of rupture, Section modulus, Flexural rigidity, Beam of uniform strength, Expression for transverse shear stress in beams, Bending and shear stress distribution diagrams for circular, rectangular, 'I', and 'T' sections, Castigliano's theorem, Shear Centre (only concept).

Slope and deflection of Beams: Definition of slope, Deflection and curvature, Sign conventions, Derivation of moment curvature equation, Double integration method, Macaulay's method and Principle of superposition method, Slope and deflection for standard loading cases and for determinate prismatic beams subjected to point loads, UDL, UVL and couple. [12]

UNIT-III

Columns: Introduction, Short, Medium and Long columns, Slenderness ratio, Euler's theory; Assumptions, Derivation for Euler's Buckling load for different end conditions, Limitations of Euler's theory, Rankine-Gordon's formula for columns.

Torsion: Stresses and strains in pure torsion of solid circular shafts and hollow circular shafts, Power transmitted by shafts, Shaft in series and parallel, Combined bending and torsion.

Compound stresses and strains: State of stress at a point, General two-dimensional stress system, Principal stresses and strains, Principal planes. Mohr's circle of stresses, Theories of Failures.

UNIT - IV

Springs: Analysis of Close-coiled helical springs, Springs in series and parallel, Stress in leaf springs.

Pressure vessels: Thin cylindrical and Spherical vessels subjected to internal pressure, Hoop stresses, Longitudinal stress and change in volume, Thick cylinders subjected to internal and external pressure, Lame's equation, Radial and hoop stress distribution.

Textbook(s):

1. Sadhu Singh, "Strength of Materials", Khanna Pub.
2. S.S. Bhavikatti, "Strength of Materials", Vikas Publishers;(2000)
3. R.K. Bansal, "A Textbook of Strength of Materials", Laxmi Publications; 4th ed.(2010)

References:

1. S.P. Timoshenko and J. Gere, "Elements of Strength of Materials", East-West affiliated, New Delhi.
2. R.C. Hibbler, "Mechanics of Materials", Prentice Hall, New Delhi;(1994)
3. L.S. Sri Nath et.al., "Strength of Materials", McMillan, New Delhi;(2001)
4. Eger P. Popov, "Engg. Mechanics of solids", Prentice Hall, New Delhi;(1998)
5. Roger T. Fenner, "Mechanics of Solids", U.K. B.C. Publication, New Delhi;(1990)

Paper Code(s): MEC-209	L	P	C
Paper: Manufacturing Science & Technology - I	4	-	4

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1^{st}) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To acquire knowledge in casting processes and develop an understanding of the various variables which control the casting process.
2.	To introduce students to different welding processes, weld testing and advanced processes.
3.	To acquire a fundamental knowledge on metal forming technology.
4.	To make student familiar with the various sheet metal work and powder metallurgy.

Course Outcomes (CO)

CO 1	Understand the working of different manufacturing processes and apply knowledge to use appropriate manufacturing process based on the need.
CO 2	Identify the capabilities of the different manufacturing processes.
CO 3	Analyse the different design aspects of the manufacturing processes
CO 4	Evaluate the effects of process parameters on the performance of Manufacturing processes and prepare a report in a team for different processes.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	-	-	2	-	-	-	-	-	-
CO 2	3	2	2	-	-	2	-	-	-	-	-	-
CO 3	3	3	3	2	-	2	-	-	-	-	-	-
CO 4	3	3	3	3	-	2	-	-	3	3	-	-

UNIT-I

Casting: Introduction to sand moulding, Testing of moulding sand, Moulding and core making machine, Design of metal moulds, Gating system and its design, Riser design and its placement, Mould filling time, Melting, Pouring and Fluidity, Selection of melting furnaces, Control of melt and Cupola charge calculations, Solidification of pure metals and alloys, Solidification time, Fundamentals of Casting of complicated shapes: automotive components, casting of light alloys – Aluminium, Magnesium and Titanium alloys and Other casting processes, like investment, continuous, slush, squeeze casting, stir casting.

UNIT-II

Welding: Types of metal transfer in arc welding, Analysis of Voltage-Arc length Characteristics, Welding processes like GTAW, GMAW and SAW processes and their recent variants, Plasma arc welding process: transferred and non- transferred arc welding and their applications, Plasma cutting, Surfacing and plasma spray forming, Explosive, Ultrasonic, Laser Beam, Electron Beam, Friction Stir, Thermit, Atomic Hydrogen welding,

Cold metal transfer Welding, Resistance welding, Soldering and brazing, welding of special materials – Stainless steel, Aluminium etc. weldability of cast iron, steel, stainless steel, aluminium alloys, Soldering, Brazing and their applications, Joint design, welding symbols and Joint evaluation through destructive and non-destructive testing methods, Defects in welding: causes and remedies, Related numerical problems on electric arc welding and resistance welding.

UNIT-III

Forming: Plastic deformation of metals, Elements of theory of plasticity, Flow curve, True stress & true strain, stress-strain relationships, Yield criteria for ductile metals, Von Misses & Teresa yield criteria, combined stress tests, Hot working and Cold working, Friction and lubrication in metal working, Analysis of bulk forming Process: Extrusion: Analysis of extrusion process, extrusion pressure, Rolling: Forces & geometrical relationship in rolling, Rolling load and torque in cold rolling, Von-Karman work equation, Wire and Tube Drawing, Drawing stress, Reduction factor, Unconventional forming processes, Defects in metal forming.

UNIT - IV

Sheet Metal and other Processes: Classification - conventional and HERF processes-presses-types and selection of presses, formability of sheet metals- principle, process parameters, equipment and application of the following processes: deep drawing, spinning, stretch forming. Plate bending, spring back, press brake forming, Introduction to forming, electro hydraulic forming, magnetic pulse forming. Introduction to press work – coining, embossing etc., Design of sheet metal dies. Powder Metallurgy: fabrication routes, powder size determination – micro and nano level, powder consolidation routes, compacting, sintering, hot pressing, sintering, hot isostatic pressing, field assisted sintering technologies.

Textbook(s):

1. Kalpakjian, “Manufacturing Engineering and Technology”, Addison Wesley.
2.A. Ghosh and A.K. Mallik, “Manufacturing Science”, East West Press.

References:

1. M.P. Groover, “Modern Manufacturing Processes”.
2. R. W. Heine, C. R. Loper and P. C. Rosenthal, “Principles of Metal Casting”, Tata-McGraw Hill.
3. G. E. Dieter, “Mechanical Metallurgy (Part IV)”, Tata-McGraw Hill.
4. B. Avitzur, “Metal Forming: Processes and Analysis”.
5. G.W. Rowe, “Industrial Metal Working Processes”.

Paper Code(s): MEC-211	L	P	C
Paper: Thermal Engineering – I	4	-	4

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1^{st}) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the concepts of laws of thermodynamic and apply them to determine the feasibility of any process.
2.	To understand the principles of pure substance and to be able to determine exergy of any system.
3.	To understand the principle of vapour power cycle and its thermal refinement.
4.	To understand the working of I.C engine and Gas Turbine engine and able to compute its performance parameters.

Course Outcomes (CO)

CO 1	Develop understanding of first and second law of thermodynamics and use it to determine feasibility of a process
CO 2	Evaluate the properties of a pure substance using different property relations and determine entropy changes for different types of processes and the reversibility or irreversibility of such processes.
CO 3	Analyze the performance of simple Rankine cycle and improve its performance with thermal refinement.
CO 4	Examine various gas power cycles and their applications in automotive and aviation sector.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	-	-	-	-	-	-	-	2
CO 2	3	3	3	3	-	-	2	-	-	-	-	2
CO 3	3	3	3	3	-	-	2	-	-	-	-	2
CO 4	3	3	3	3	-	-	2	-	-	-	-	2

UNIT-I

Basic definitions and Laws of Thermodynamics: Thermodynamic systems: Closed, Open and Isolated systems, Microscopic and Macroscopic view, Intensive and Extensive properties, Zeroth law of Thermodynamics, Phase, State, Process, Cycle, Point functions and Path functions, Work and Heat, First Law of Thermodynamics, Internal energy, Non flow processes, Concept of Flow work, Analysis of steady flow and unsteady flow processes and their applications, Limitations of First law, Second Law of Thermodynamics, Reversible and Irreversible processes, Reversed Carnot cycle, Carnot's Theorem, Clausius inequality, Entropy, Change in Entropy during various processes.

UNIT-II

Availability and Irreversibility: High grade and low grade energy, Available and unavailable energy, Dead state, Loss of available energy due to Heat transfer through a Finite temperature difference, Availability, Reversible

work and Irreversibility, Availability in non flow systems, Second law efficiency.
Thermodynamic Property Relations: Maxwell Relations, Clapeyron Equation.
Properties of a Pure Substance: Phase equilibrium of a pure substance on T-V diagram, Normal boiling point of Pure substance, Saturation states, Compressed liquid, P-V & P-T diagram of a pure substance, Steam and its different states, Use of Steam tables and Mollier diagram, Different processes of vapour on P-V and T-S diagrams, Measurement of Dryness fraction.

UNIT-III

Vapour Power Cycles: Carnot vapour power cycles, drawbacks as a reference cycle, Simple Rankine cycle, description, T- S diagram, Analysis for performance, comparison of Carnot and Rankine cycles, Effects of pressure and temperature on Rankine cycle performance, Actual vapour power cycles, Ideal and practical regenerative Rankine cycle, open and closed feed water heaters, Reheat Rankine cycle.
Boiler: Classification of Boiler, Boiler mountings and Boiler Accessories, Once through Boiler, Working and construction of Babcock and Wilcox boiler, Lancashire boiler.

UNIT – IV

Gas power cycle: Carnot cycle, Otto cycle, Diesel cycle, Dual cycle, Two stroke and Four stroke Cycles, Working of S.I Engine and C.I Engine, Valve timing diagram of S.I engine and C.I engine.
Gas Turbines: Brayton cycle, Thermal refinements, Performance of Gas turbines, Combined cycle, Principles of Jet Propulsion, Turbojet engines.

Textbook(s):

1. P K Nag Basic and Applied Thermodynamics 5th edition McGraw Hill
2. Mathur & Sharma Internal Combustion Engine, Dhanpat Rai Publication.

References:

1. M.J. Moran & H.N. Shapiro “Fundamentals of Thermal Engineering” John Wiley & sons.
2. S L Somasundaram “Engineering Thermodynamics”, New Age International Publishers.
3. R. K. Rajput, “Engineering Thermodynamics”, Lakshmi Publications
4. Y. A. Cengel & M. A Boles “Thermodynamics- An Engineering Approach ”, 6th edition Tata McGraw Hill
5. Gordon Rosers, & Yon Mahew; Engineering Thermodynamics”, Pearson.

MECHANICAL ENGINEERING LABS
(VISIT WEBSITE FOR LAB FILES, NOTES, PYQs)

Paper Code(s): ES-251	L	P	C
Paper: Computational Methods Lab	-	2	1

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Computational Methods) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

Implementation to be done in C/C++

1. Program for finding roots of f(x)=0 Newton Raphson method.
2. Program for finding roots of f(x)=0 by bisection method.
3. Program for finding roots of f(x)=0 by secant method.
4. To implement Langrange's Interpolation formula.
5. To implement Newton's Divided Difference formula.
6. Program for solving numerical integration by Trapezoidal rule
7. Program for solving numerical integration by Simpson's 1/3 rule
8. To implement Numerical Integration Simpson 3/8 rule.
9. Inverse of a system of linear equations using Gauss-Jordan method.
10. Find the Eigen values using Power method.
11. Program for solving ordinary differential equation by Runge-Kutta Method.

Paper Code(s): MEC-253	L	P	C
Paper: Theory of Machines Lab	-	2	1

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Theory of Machines) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To study and verify the inversions of four bar (4R), single slider (3R-1P) crank and double slider (2R-2P) crank mechanism and also prove Grashof's Law.
2. To find out experimentally the Coriolis component of acceleration and compare with theoretical values
3. To study various types of CAM and follower mechanisms. Also, draw the CAM profile for the given CAM apparatus and determine jumping speed.
4. Draw velocity and acceleration diagram of engine mechanism using Klien's construction
5. To study various types of gear and gear trains and to determine gear ratio of simple, compound and epicyclic gear trains.
6. To calculate the torque on a Planet Carrier and torque on internal gear using epicyclic gear train and holding torque apparatus.
7. To determine the radius of gyration and moment of Inertia of a given rod.
8. To study and verify the motion of any one Governor.
9. To study and verify the gyroscopic law of motion.
10. To study and verify the dynamic balancing of rotating masses.
11. To determine the natural frequency of undamped free vibration of the given spring mass system.
12. To find the moment of inertia of a fly wheel.
13. To determine whirling speed of shaft theoretically and experimentally.

Paper Code(s): MEC-255	L	P	C
Paper: Strength of Materials Lab	-	2	1

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Strength of Materials) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To perform the Hardness Test (Rockwell, Brinell & Vicker's test) and find the Hardness Number of different materials (MS, HSS, Wood, C.I., Al specimens).
2. To perform the Impact Test on a standard notched specimen to evaluate its Impact Number.
3. To perform the Tensile/Compression Test in ductile/brittle materials, draw a stress-strain curve and evaluate various mechanical properties of a given specimen.
4. To perform Shear Test and find maximum (ultimate) shear strength of given test specimen.
5. To perform the Bending /Deflection Test on a beam and evaluate its Young's Modulus.
6. To perform the Torsion Test and find modulus of rigidity, rupture stress (maximum shear stress), shear stress at yield point.
7. To determine Buckling loads of long columns with different end conditions.
8. To measure mechanical strain in a given beam using strain gauges.
9. To determine the different mechanical properties of given material under creep failure.
10. To determine flexural strength (modulus of rupture) of concrete beam.
11. To determine the endurance limit of the given specimen under fatigue or cyclic loading.
12. To find the Shear Modulus of two different materials; Aluminium and Steel using two twist and bent test rigs are used.
13. To determine the different mechanical properties of a given close coiled helical spring.

Paper Code(s): MEC-257	L	P	C
Paper: Thermal Engineering – I Lab	-	2	1

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Thermal Engineering - I) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To draw the valve timing diagram of a Single Cylinder Four Stroke CI Engine.

2. To draw the valve timing diagram of a Single Cylinder Four Stroke SI Engine.

3. To determine Exergy destruction of Exhaust Gas Calorimeter of Petrol Engine test rig at different load.

4. To determine Exergy destruction of Exhaust Gas Calorimeter of Diesel Engine test rig at different load.

5. To determine the dryness fraction of given steam sample.

6. Visit and understanding of thermal power plant.

7. Thermodynamic analysis of Rankine cycle.

8. Comparative thermodynamic analysis of Otto, diesel and dual for the given condition.

9. Comparative analysis of air standard cycles under stated condition.

10. Study and analysis of Gas-Turbine cycle.

11. To study the working and construction different type of Boilers.

Paper Code(s): MEC-259	L	P	C
Paper: Manufacturing Science and Technology – I Lab	-	2	1

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Manufacturing Science and Technology - I) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To determine the percentage of clay content in dry sand.
2. To determine the grain fineness number of a given sand specimen.
3. To Determine the moisture content quickly in fresh sand and moulding sand.
4. To determine the compressive strength of moulding sand.
5. To determine the permeability number of moulding sand.
6. Mould preparation and casting of metals after preparation of suitable moulds.
7. Laboratory experiments in fabrication processes using GMAW process.
8. Laboratory experiments in fabrication processes using Plasma Arc welding.
9. Laboratory experiments in fabrication processes using GTAW process.
10. Inspection of weld joints and welding defects.
11. Develop a flat blank layout, transfer the layout to the sheet metal, cut and form to the desired shape.
12. Practicing smithy or forging of carbon steels and testing of its property changes.
13. Form parts from metallic powders, record and plot pressing data, perform destructives tests on sintered powder metal parts.

Third Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
ES	ES-201	Computational Methods	4		4
HS/MS	HS-203	Indian Knowledge System*	2		2
PC	MEC-205	Theory of Machines	4		4
PC	MEC-207	Strength of Materials	4		4
PC	MEC-209	Manufacturing Science and Technology-I	4		4
PC	MEC-211	Thermal Engineering - I	4		4
Practical / Viva Voce					
ES	ES-251	Computational Methods Lab		2	1
PC	MEC-253	Theory of Machines Lab		2	1
PC	MEC-255	Strength of Materials Lab		2	1
PC	MEC-257	Thermal Engineering – I Lab		2	1
PC	MEC-259	Manufacturing Science and Technology-I Lab		2	1
Total			**22**	**10**	**27**

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WE WISHES YOU GOOD LUCK!!