Department of Mechanical Engineering
National Institute of Technology Raipur
(Institute of National Importance)
G. E. Road, Raipur-492010 (CG)

B. Tech. in Mechanical Engineering

IV Semester CBCS Scheme

Sl. No	Course Title	Course Code	Course Name	Type	L	T	P	TA		MSE		ESE		Total Marks	Credits
								Max	Min	Max	Min	Max	Min		
1.	Program Core	ME104101ME	Fluid Mechanics	T	3	1	0	20	0	30	0	50	0	100	4
2.	Program Core	ME104102ME	Mechanics of Solids – II	T	3	1	0	20	0	30	0	50	0	100	4
3.	Program Core	ME104103ME	Internal Combustion Engines	T	3	1	0	20	0	30	0	50	0	100	4
4.	Program Core	ME104104ME	Kinematics of Machines	T	3	1	0	20	0	30	0	50	0	100	4
5.	Program Core	ME104105ME	Manufacturing Science – II	T	3	1	0	20	0	30	0	50	0	100	4
6.	Program Core	ME104001MA	Mathematics-IV	T	4	0	0	20	0	30	0	50	0	100	4
7.	Laboratory	ME104407ME	Mechanical Lab-3	P	0	0	2	40	0	20	0	40	0	100	1
8.	Laboratory	ME104408ME	Mechanical Lab-4	P	0	0	2	40	0	20	0	40	0	100	1
Total					19	5	4							800	26

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Semester-IV

1.	Department proposing the course	**Mechanical Engineering**
2.	Course Title	**Fluid Mechanics**
3.	L-T-P Structure	**3+1+0**
4.	Credits / # of period	4
5.	Course Number (Code)	**ME104101ME**
6.	Status (Core/Elective)	**Program Core**
7.	Pre-requisites (course no./title)	Nil
8.	Frequency of offer	Once in a Year
9.	**Course Objectives:** 1. Understand and apply mathematical principles for analyzing fluid flow problems using conservation of mass, momentum, and energy principles. 2. Understand mass, momentum, and energy balances to study fluid flow processes and Engineering systems. 3. Understand internal or external flow problems. 4. Understand concepts of fluid statics and dynamics. 5. Understand dimensional analysis. 6. Understand boundary layer theory. **Course Outcomes (CO):** At the end of the course, the students will be able to: 1. Apply mathematical principles for fluid flow. 2. Apply mass, momentum, and energy balances to study fluid flow processes and Engineering systems. 3. Solve various fluid flow problems. 4. Analyze and apply concepts of fluid statics and dynamics. 5. Analyze dimensionally different types of fluid flow formula through model analysis. 6. Understand and identify the boundary layer, flow control and flow separation.	
10.	**Course Syllabus** **Unit –I Properties of fluid and Fluid statics** Properties of fluid: Fluid, ideal and real fluid, Properties of fluid: Mass density, Weight density, Specific volume, Specific gravity, Viscosity, Surface tension, Capillarity, Vapor pressure, Compressibility and bulk modulus. Newtonian and non-Newtonian fluids. Fluid statics: Pressure, Pascal's law, Hydrostatic law, Pressure measurement, Hydrostatic force on submerged plane and curved surface, Buoyancy and Flotation, Liquid in relative equilibrium. **Unit –II Fluid Kinematics** Description of fluid motion, Langragian and Eulerian approach, Type of fluid flow, Type of flow lines-path line, Streak line, Stream line, Stream tube, Continuity equation,	

	Acceleration of a fluid particle, Motion of fluid particle along curved path, Normal and tangential acceleration, Rotational flow, Rotation and Vorticity, Circulation, Stream and potential function, Flow net, Its characteristics and utilities, Vortex motion. **Unit –III Fluid dynamics, Laminar & Turbulent flow and Flow through pipes** Fluid dynamics: Euler's Equation, Bernoulli's equation and its practical application, Venturimeter, Orifice meter, Nozzle, Pitot tube, Impulse momentum equation, Momentum of Momentum equation, Kinetic energy and Momentum correction factor. Laminar & Turbulent flow: Reynold's experiment, Shear stress and pressure gradient relationship, Flow of viscous fluids in circular pipe and between two parallel plates, Coutte flow. Flow through pipes: Loss of energy in pipes, Hydraulic gradient and total energy line, pipe in series and parallel, Equivalent pipe power transmission through pipe, Water hammer in pipes. **Unit –IV Internal flows and Dimensional analysis** Internal flows: Friction factor, Darcy-Weisbach friction factor, Moody's diagram, boundary Layer theory, Boundary layer equation, Laminar and turbulent boundary layer and its growth over flat plat. Momentum boundary layer and its solutions, separation of boundary layer and its control. Dimensional analysis: Methods of dimensional analysis, Rayleigh's method, Buckingham's theorem, Limitations, Model analysis, Dimensionless number and their significance, model laws, Reynolod's model law, Fraude's model law, Euler's model law, Weber's model law and Mach's Model law.
11.	**Text Books-** 1. Fluid Mechanics and Fluid Machines by S K Som and G Biswas, McGraw Hill Education (India) Private Limited. 2. Hydraulics and fluid Mechanics by Modi and Seth, 12th ed. 1998, Standard Book House, Delhi. 3. Engineering Fluid Mechanics: Theory and Practice by S. B. Thool and L. Sinha, Narosa publishing House, New Delhi.
12.	**Reference Books-** 1. Mechanics of Fluid – B. S. Massey – English Language Book Society (U.K.) 2. Fluid Mechanics by V. L. Streeter & E.B. Wylie, 1st SI metric ed. 1981, McGraw Hill Book Company.

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Semester-IV

1.	Department proposing the course	**Mechanical Engineering**
2.	Course Title	**Mechanics of Solids-II**
3.	L-T-P Structure	**3+1+0**
4.	Credits / # of period	4
5.	Course Number (Code)	**ME104102ME**
6.	Status (Core/Elective)	**Program Core**
7.	Pre-requisites (course no./title)	Mechanics of Solids-I
8.	Frequency of offer	Once in a Year
9.	**Course Objectives:** The course is the advanced version of Mechanics of Solids-1 which is designed keeping in view of advanced topics used in real time applications. The course is designed to provide an insight into designing various critical components in the industries like the crane hooks, fixed beams and continuous beams. Also, the course is intended towards providing preliminary concepts leading towards designed more complex cases like the Beams in unsymmetrical bending, thin and thick-walled pressure vessels. The course is designed to cover the stability and the buckling aspects associated with mechanical members like long thin columns. **Course Outcomes (CO):** At the end of the course, the students will be able to: 1. Visualize and apply mathematics to obtain analytical solutions in solid mechanics. 2. Interpret the principle of superposition, energy methods of determining the reaction and their applications for solving statically indeterminate structures. 3. Apply the basic concepts of stress and strain in dealing problems related to unsymmetrical bending, fixed beams, continuous beams, curved beams, thick and thin pressure vessels. 4. Discover principles of solid mechanics by solving engineering problems. 5. Develop appropriate models for practical situations to formulate solutions.	
10.	**Course Syllabus** **Unit 1 Energy Methods and Fixed Beams** (a) Energy Methods: Introduction, Principle of superposition, Strain energy, Reciprocal relations, Maxwell Betti theorem, Elastic strain energy in tension and compression, Strain energy in beams subjected to bending and shafts to torsion. Impact loading in tension and bending, first and second theorem of Castigliano and its applications. (b) Fixed Beams: Fixed beam subjected to different types of loads and couples, Calculations of fixing moments and reactions at supports, deflection. Effect of sinking of support. **Unit 2: Continuous beams and Unsymmetrical Bending** (a) Continuous beams: Continuous beams subjected to different type of loads and	

	couples, beams with overhang, beams with one end fixed, Clapeyron's theorem. Effect of sinking of supports. (b) Unsymmetrical Bending: Introduction to unsymmetrical bending, Stresses and deflection in unsymmetrical bending, **Unit 3: Shear Center and Bending of curved bars** (a) Shear Center: Shear center for angle, Channel, Circular and I-sections. (b) Bending of curved bars: Stresses in bars of small initial curvature, Winkler-Bach theory, Stresses in bars of large initial curvature, Deflection of Crane hooks, Chain links, circular rings, stresses in circular rings. **Unit 4: Columns, Thin Pressure Vessel and Thick Pressure Vessel** (a) Columns: Struts and Columns, Stability of columns, Euler's formula for different end conditions, Equivalent load, Eccentric loading and Rankine's formula. (b) Thin Pressure Vessel: Thin Pressure Vessels, Circumferential and longitudinal stresses in thin cylindrical shells and thin spherical shell under internal pressure, (c) Thick Pressure Vessel: Stresses in thick and compound cylinders. Application to pipe flow.
11.	**Text Books-** 1. Strength of Materials – G.H. Ryder, Macmillan Publishers 2. Strength of Materials, Part I & Part II – S. Timoshenko, CBS Publisher
12.	**Reference Books-** 1. Introduction to Solid Mechanics – I. H. Shames, PHI 2. Advanced Strength of Materials – J. P. Den Hartog – Dover Publication 3. Strength of Materials – S. S. Rattan, Tata McGraw Hill Publications 4. Strength of Materials – R. K. Rajput, S. Chand & Company Ltd 5. Advanced Mechanics of Materials – A. P. Boresi & O. M. Sidebottom, John Wiley & Sons 6. Mechanics of Materials – J. M. Gere and S. P. Timoshenko, CBS Publisher

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Semester-IV

1.	Department proposing the course	**Mechanical Engineering**
2.	Course Title	**Internal Combustion Engines**
3.	L-T-P Structure	**3+1+0**
4.	Credits / # of period	4
5.	Course Number (Code)	**ME104103ME**
6.	Status (Core/Elective)	**Program Core**
7.	Pre-requisites (course no./title)	Applied Thermodynamics
8.	Frequency of offer	Once in a Year
9.	**Course Objectives:** 1. To understand the working of an I.C. Engines and their various systems. 2. To understand the combustion process in I.C. Engines. 3. To understand and analyze the performance characteristics of an I.C. engine and their emissions. **Course Outcomes (CO):** At the end of the course, the students will be able to: 1. Understand the working of an I. C. Engines (i.e. S. I. and C. I. engine) and their applications. 2. Understand the combustion process in I. C engines and different type's fuels, their stochiometric compositions. 3. Understand and identify various systems (ignition, injection, and cooling and lubrication system) of an I.C. Engine. 4. Understand and analyze the performance characteristics of an I. C engine and their emissions from of I. C. engines.	
10.	**Course Syllabus** **Unit –I Introduction and Cycles** Introduction: Introduction of internal and external combustion engine and their comparison, two stroke and four stroke cycle S. I. and C. I. engine and their comparison, valve timing diagram for S. I. and C. I. engines, Effect of valve timing and engine speed on volumetric efficiency. Cycles: Reasons for deviation of actual cycle from air standard cycles, Variation specific heats and cycle analysis, fuel air cycles and their analysis, Actual cycles and their analysis, Purpose and Thermodynamic cycle of supercharging. **Unit –II Fuels and Combustion** Fuels: Basic requirement of I.C. Engine fuels, Requirement of an ideal gasoline, Structure of petroleum, Effect of fuel structure on combustion, Volatility of liquid fuels, effect of volatility on engine performance for starting, Vapour lock, Acceleration, Percolation, Carburettor, icing and Crank case dilution.	

	Combustion: Determination of stochiometric air fuel ratio, Fuel-air and exhaust gas analysis for a given combustion process. Combustion in S.I. and C.I. engines, Detonation, Pre-ignition, Knocking, Antiknock rating of fuels Octane number, Critical compression ratio, HUCR, performance number, Cetane number and Dopes. **Unit –III Carburetor, Ignition System, Cooling System, Lubrication System and Governing of I C Engine** Carburetor: Properties of air-petrol mixtures, Mixture requirement, Simple carburetor, limitation of simple carburetor, Modern carburetor, Main metering system, Idling system, Economizer system, Acceleration pump and cold starting system. Nozzle lip, Venturi depression, Calculation of fuel jet and venturi throat dia for given air fuel ratio. Petrol Injection, Electronic fuel injection, advantage and disadvantage of petrol injection, Multi point Fuel Injection System. Ignition System: Battery and magneto ignition system and their comparative study, Spark plug heat range, Electronic ignition system, Firing order, Ignition timing, Centrifugal and vacuum ignition advance. Injection System: Requirement, type, Fuel pump, Type of fuel injector, Type of nozzle, Atomization, Spray penetration and spray direction, multiple point fuel injection system. Cooling System: Cooling requirement, Air cooling, liquid cooling, Type of liquid cooling system, Advantage and disadvantage of air cooling and water cooling system, Antifreeze mixture. Lubrication System: Function of lubricating system, Properties of lubricating oil, Wet sump, Dry sump and mist lubrication system. Governing of I C Engine: Necessity of governing, various methods of governing. **Unit –IV Testing and Performance, Emission and Pollution** Testing and Performance: Performance parameters, Measurements of brake power, indicated power, Friction power, Fuel and air consumption, Exhaust gas calorimeter, Calculation of various performance parameter, Heat balance sheet. Performance current for S.I. and C.I. engine with load and speed. Emission and Pollution: S. I. Engine and C. I. Engine emissions and its control and comparison. Effect of pollution on Human health and biosphere.
11.	**Text Books-** 1. A Course in Internal Combustion Engines – M. L. Mathur & R.P. Sharma – Dhanpat Rai & Sons 2. Internal Combustion Engine – V. Ganeshan – TMH
12.	**Reference Books-** 1. A Course in Internal Combustion Engine – V. M. Domkundwar – Dhanpat Rai & Sons. 2. Internal Combustion Engine – R. Yadav – Central Publishing House, Allahabad 3. Fundamental of Internal Combustion Engine – Paul W. Gill, James H. Smith, Eugene J. Ziurys Oxford and IBH Publishing Company 4. Internal Combustion Engines – R. K. Rajput – Laxmi Publication

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Semester-IV

1.	Department proposing the course	**Mechanical Engineering**
2.	Course Title	**Kinematics of Machines**
3.	L-T-P Structure	**3+1+0**
4.	Credits / # of period	4
5.	Course Number (Code)	**ME104104ME**
6.	Status (Core/Elective)	**Program Core**
7.	Pre-requisites (course no./title)	Engineering Mechanics, Engineering Graphics
8.	Frequency of offer	Once in a Year
9.	**Course Objectives (CO):** At the end of the course, the students will be able to: 1. Explain the difference between link, mechanism and machine. 2. Analyze the difference between higher and lower pairs, understand kinematics of mechanisms by drawing the velocity and the accelerations diagrams. 3. Analyze and design the basic machine elements like flywheel, governor, brakes and dynamometers.	
10.	**Course Syllabus** **Unit-I Relative velocity and Relative Acceleration** Relative velocity: Elements, pairs, Mechanism, Four bar chain and its inversion, Velocity diagrams, Relative velocity method, Instantaneous centre method. Relative Acceleration: Synthesis of mechanism, Pantograph, Lower pair mechanism, Relative acceleration diagram, Kleins construction, Coriolis component of acceleration. **Unit-II Inertia force analysis, Turning moment diagram and flywheel** Inertia force analysis: Effective force and inertia force on link, Inertia force on reciprocating engine. Inertia force in four bar chain mechanism. Turning moment diagram and flywheel: Turning moment diagram for single and multi-cylinder internal combustion engine, Coefficient of fluctuation of speed. Coefficient of fluctuation of energy, Flywheel. **Unit-III Governors** Governors: Characteristics of centrifugal governors, Gravity controlled governors, porter and proell. Spring controlled centrifugal governor: Hartung and hartnell governor. Performance parameter: Sensitivity, stability, Isochoronism, Governor effort and power. **Unit-IV Friction, Brakes and dynamometer** Friction: Friction in turning pair, Application of friction circle in slider crank and four bar mechanism, Pivot and collar friction, Thrust bearing.	

	Brakes and dynamometer: Simple block and shoe brake, Band brake, Band and block brake, and internal expanding shoe brake, Absorption dynamometer, Transmission dynamometer.
11.	**Text Books-** 1. Theory of machine – S. S. Ratan-Tata McGraw Hill. 2. The Theory of machine – Thomas Beven – CBS Publishers.
12.	**Reference Books-** 1. Theory of mechanism and machine – A. Ghosh, A. K. Mallik –EWP Press. 2. Theory of Machine – Shigley, J. E. 3. Theory of Machine - Jagdish Lal. 4. Theory of machine – J. E. Singh – McGraw Hill

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Semester-IV

1.	Department proposing the course	**Mechanical Engineering**
2.	Course Title	**Manufacturing Science-II**
3.	L-T-P Structure	**3+1+0**
4.	Credits / # of period	4
5.	Course Number (Code)	**ME104105ME**
6.	Status (Core/Elective)	**Program Core**
7.	Pre-requisites (course no./title)	Manufacturing Science-I
8.	Frequency of offer	Once in a Year
9.	**Course Objectives:** 1. Apprehend machine tools like lathe, shaper, slotter and planner, milling machine etc. 2. Understand machine tool technology and mechanics of metal cutting. 3. Understand machinability, thermal aspects in machining and cutting fluids, jogs and fixtures. 4. Understand advanced manufacturing processes, CNC machines etc. 5. Understand additive manufacturing processes, reverse engineering and micro manufacturing. **Course Outcomes (CO):** At the end of the course, the students will be able to: 1. Associate and identify the use of various machine tools with its applications. 2. Understand and identify the significance of metal cutting operations and tool geometry of cutting tools and its impact on cutting process. 3. Infer the concept of machinability, thermal aspects in machining and cutting fluids and various locating & clamping elements like jigs & fixtures. 4. Describe and demonstrate details of the advanced machining process theory & practices and application of computers in manufacturing process. 5. Understand the need of inventing the additive manufacturing processes and unconventional processes with their range of applications. 6. Understand the need and application of micro manufacturing processes.	
10.	**Course Syllabus** **Unit-I Lathe, Shaper, Slotter, planner and Milling machine** Lathe: Introduction, type, specification, basic components of lathe machine, general and special operations, attachments for various operations, taper turning, thread cutting operations. Shaper, Slotter and planner: Introduction, specification, drives and classifications. Milling machine: Introduction, classifications and milling operations.	

	Unit-II Machine Tool Technology Cutting tool: Introduction, types, requirements, specifications and applications. Single point cutting tool: Tool geometry, tool nomenclature and tool signature. Mechanics of metal cutting: Theories of metal cutting, orthogonal and oblique cutting, chip formation, types of chips, chip breakers, stress and strain in the chip, velocity relations, power and energy requirement in metal cutting. Machinability: Concept and evaluation of machinability, mechanism of tool failure, tool wear mechanism, Taylor's tool life equation, machinability index, factors affecting machinability. Thermal aspects in machining and cutting fluid: Source of heat in metal cutting and its distributions, function of cutting fluid, types of cutting fluid. Jigs and fixtures: Concept and application, principles of location and clamping, degree of freedom, principle of jigs and fixtures design. **Unit-III Advanced Manufacturing Processes** Introduction, classifications, advanced, theory and applications, basic concepts and applications of USM, AJM, ECM, EDM, LBM, and EBM. CNC machines: Introduction, working principle and application of CNC machines (Tutorial classes will be organized in the CNC Lab). **Unit-IV Additive manufacturing processes, Reverse engineering and Micro manufacturing** Additive manufacturing processes: Working principle of additive manufacturing and rapid prototyping, rapid tooling. Reverse engineering: Basic concepts and applications, integration of rapid prototyping and reverse engineering. Micro manufacturing: Introduction, classifications, material removal methods, micro-electro mechanical system (MEMS).
11.	**Text Books-** 1. Manufacturing Engineering and Technology – Serope Kalpakjian & Steven R. Schmid – Pearson Education, Delhi. 2. Manufacturing Technology (Vol. - I & II) – P.N. Rao – Tata McGraw Hill Pub. Company, New Delhi. 3. Machine Tool Engineering – G. R. Nagpal – Khanna Publishers, New Delhi. 4. Design of Machine Tools – S. K. Basu & D. K. Pal- Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi
12.	**Reference Books-** 1. Production Technology – R. K. Jain – Khanna Publisher – New Delhi. 2. A Text Book of Production Technology (Manufacturing Processes & Technology) P. C. Sharma – S. Chand and Company Ltd., New Delhi. 3. Machine Tool Practices – Kibbe Richard R – PHI, New Delhi. 4. Principle of Metal Cutting – G. C. Sen, A. Bhattacharya – New Central Book Agency (P) Ltd. Calcutta. 5. Manufacturing Processes (Vol-I&II) – H. S. Bawa- Tata McGraw Hill pub. Company, New Delhi. 6. Advances in 3D Printing & Additive Manufacturing Technologies, David Ian Wimpenny, Pulak M. Pandey, L. Jyothish Kumar – Springer Science + Business Media Singapore 2017. 7. Micro manufacturing Engineering and Technology, Yi Qin, Publisher - William

	Andrew, 2015. 8. Micro Electro Mechanical Systems (MEMS): Technology, Fabrication Processes, and Applications, Britt Ekwall, Mikkel Cronquist, Publisher - Nova Science Publishers, 2011. 9. Reverse Engineering: Technology of Reinvention, Dr. Wego Wang, Publisher - CRC Press, 2010

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Semester-IV

1.	Department proposing the course	**Mechanical Engineering**
2.	Course Title	**Mathematics-IV**
3.	L-T-P Structure	**4+0+0**
4.	Credits / # of period	4
5.	Course Number (Code)	**ME104001MA**
6.	Status (Core/Elective)	**Program Core**
7.	Pre-requisites (course no./title)	Mathematics-I, Mathematics-II and Mathematics-III
8.	Frequency of offer	Once in a Year
9.	**Course Objectives (CO):** To enable the students to apply the knowledge of Mathematics in various fields: 1. Introduce the method to solve the algebraic, transcendental and simultaneous linear equations and its application. 2. Introduce the method to solve the problems related to data appear equal or unequal intervals and to know the application of regression analysis. 3. Introduce the method to calculate the derivative of the function and evaluate the definite Integral from set of numerical values. 4. Introduce the method to solve the ordinary and partial differential equations using different numerical techniques.	
10.	**Course Syllabus** **Unit-I NUMERICAL SOLUTIONS OF ALGEBRAIC, TRANSCENDENTAL AND SIMULTANEOUS LINEAR EQUATIONS** Errors in numerical computation, Error type, Bisection Method, Regula–Falsi Method, Secant Method, Newton-Raphson Method, Unique Solution, Singular Solution, Ill-Conditional Equations, Cramer's Rule, Matrix Method, Method of leading coefficients, Direct Methods-Gauss Elimination, Pitfalls of Elimination, Gauss-Jordan & Crout's Triangularization Method, Iterative Methods: Jacobi, Gauss-Siedel & Relaxation Methods. **Unit-II INTERPOLATION AND REGRESSION ANALYSIS** Finite Differences, Forward, Backward & Central Difference Interpolation, Lagrange's Formula and Newton's Divided Difference methods, Regression Analysis, Least square analysis, Formation of Normal Equation, Linear Regression, Polynomial regression, Exponential Geometric and Trigonometric Regression. **Unit-III NUMERICAL DIFFERENTIATION AND INTEGRATION** Derivatives using Forward, Backward and Central Difference methods, Derivatives using unequally spaced values, Newton-Cote's Quadrature method, Trapezoidal rule,	

	Simpson's 1/3 rule, Simpson's 3/8 rule, Weddle's Rule, Integration of equations, Romberg Integration, Gauss Quadrature method. **Unit-IV NUMERICAL SOLUTIONS OF ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS** Numerical solutions of ODE using Picard's Method, Taylor's Series Method, Euler's Modified Method, Runge-Kutta Method of Fourth Order, Finite Difference Method. Partial Differential Equation: Elliptic, Parabolic and Hyperbolic: Solution of Laplace and Poisson's Equations by Finite Difference Method, Iteration and Relaxation Techniques.
11.	**Text Books-** 1. M. K. Jain, S. R. K. Iyengar & R. K. Jain Numerical Methods for Scientific and Engineering Computation, New Age International (P) Limited, Publisher. 2. B. S. Grewal, Numerical Method in Engineering and Science, Khanna Publisher. 3. J. D. Hoffman, Numerical Methods for Engineers and Scientists, McGraw-Hill, Inc. Publisher. 4. S. C. Chapra, & R. P. Canale, Numerical Methods for Engineers, McGraw Hill Publisher.
12.	**Reference Books-** 1. P. Kandasamy, K. Thilagavathy, & K. Gunavathi, Numerical Methods, S. Chand Publisher. 2. E. Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons Inc. Publisher. 3. S. S. Sastry, Introductory methods of numerical analysis, PHI, Publisher.