SYLLABUS FOR SEMESTER I

Course code	**BSC101**				
Category	**Basic Sciences**				
Course title	**Engineering Chemistry**				
Scheme and credits	L	T	P	C	Semester
	3	**0**	**2**	**4**	**1**
Pre-requisites if any	**-----**				

Module 1 Analytical techniques for engineers.

Role of materials in engineering fields - Qualitative and quantitative analysis - Emerging trends and applications of analytical techniques for engineering - Instrumental methods of analysis: Principles and applications of UV-visible spectroscopy, IR spectroscopy, chromatography (GLC and HPLC), Nuclear magnetic resonance and BET surface area analysis - Thermo-gravimetry: TGA - Microscopy: SEM and TEM.

Module 2 Corrosion and material protection.

Introduction to corrosion and its impact on engineering materials - Mechanism and types / forms of corrosion - Factors that enhance corrosion and choice of parameters to mitigate corrosion - Corrosion prevention techniques - Advanced surface coatings and corrosion inhibitors - Case studies and real-world applications in corrosion prevention.

Module 3 Electrochemical energy systems.

Electrode potential - Electrochemical series - Nernst equation and its applications - Characteristics of a battery - Classification of batteries - High energy electrochemical energy systems - Lithium-ion batteries: Principle, construction, working, advantages and applications - Na-ion battery - New emerging fuel cells: Working principles, advantages and applications - Solar cells: Types Importance of silicon single crystal, polycrystalline and amorphous silicon solar cells - working principles, characteristics and applications - Green hydrogen technology.

Module 4 Nanomaterials.

Nanomaterials classification - Quantum effects - Top-down and bottom–up approach - Synthesis methods: ball milling, RF sputtering, pulsed laser deposition, sol-gel technique, and reduction method - Applications of nanomaterials - Fundamentals and fabrication of sensors and materials used in sensors - Fundamentals and fabrication of super capacitor and materials used in super capacitor.

Module 5 Polymers.

Classification of polymers - Mechanism of polymerisation - Techniques of polymerization - Bulk, solution, suspension, and emulsion polymerization - Molecular weight of polymers - Number average and weight average molecular weight - Glass transition temperature and its significance - Structure-property relationship - Synthesis, properties and applications of commercially important polymers: Polypropylene, PVC, Teflon, Nylon, Bakelite, and Polyurethane - Functional polymers: Conductive polymers, elastomers, biopolymer, polymer composites and industrial applications - Liquid crystalline polymers.

Textbooks / References.

1) Hobart Hurd Willard, Lynne Merritt, and John A. Dean, Instrumental Methods of Chemical Analysis, Wadsworth Publishing Company.
2) Gurdeep R. Chatwal, Instrumental Methods of Chemical Analysis, Himalaya Publishing House.
3) Jain and Jain, A Textbook of Engineering Chemistry, Dhanpat Rai Publications.
4) S. S. Dara, A Textbook of Engineering Chemistry, S. Chand Publications.
5) Shashi Chawla, A Textbook of Engineering Chemistry, Dhanpat Rai Publications, 2010.
6) Jianmin Ma, Battery Technologies: Materials and Components, John Wiley & Sons.
7) Charles P. Poole and Frank J. Owens, Introduction to Nanotechnology, John Wiley & Sons, 2003.
8) Ryan O' Hayre and Suk-Won Cha, Fuel Cell Fundamentals, John Wiley & Sons, 2016.
9) G. Odian, Principles of Polymerization, John Wiley & Sons, 2004.
10) F. W. Billmeyer, Textbook of Polymer Science, John Wiley & Sons, 2007.

Course code	**BSC102**				
Category	**Basic Sciences**				
Course title	**Mathematics I (Calculus & Linear Algebra)**				
Scheme and credits	L	T	P	C	Semester
	3	**1**	**0**	**4**	**1**
Pre-requisites if any	**-----**				

Module 1 Matrices and linear algebra.

Matrices and vectors: addition, scalar multiplication, and matrix multiplication - Linear systems of Equations - Linear Independence - Rank of a matrix - Determinants - Cramer's rule - Inverse of a Matrix - Gauss elimination and Gauss-Jordan elimination - Eigenvalues and eigenvectors - Symmetric, skew-symmetric, and orthogonal matrices - Eigen bases - Diagonalization - Inner product spaces - Gram-Schmidt orthogonalization - Vector space - Linear dependence of vectors, basis, and dimension - Linear transformations (maps), range and kernel of a linear map, rank, and nullity - Inverse of a linear transformation - Rank-nullity theorem - Composition of linear maps - Matrix associated with a linear map.

Module 2 Differential calculus.

Rolle's theorem - Mean value theorems - Indeterminate forms and L' Hospital's rule - Maxima and minima - Expansions of function of one variable using Taylor's and Maclaurin's series - Asymptotes - Curve tracing - Limit and continuity of two variables - Partial and total derivatives - Chain rule - Jacobian - Taylor's theorem - Higher order derivatives - Maxima and minima of two variables - Method of Lagrange's multipliers.

Module 3 Integral calculus.

Beta and Gamma functions - Evaluation of double integrals in Cartesian and polar coordinates - Change of order of integration - Evaluation of triple integrals in Cartesian, spherical and cylindrical coordinates - Change of variables - Applications to area, volume, surface area and centre of mass - Vector differentiation - Gradient, divergence and curl - Line integrals and arc length parameterization - Surface integral - Volume integral - Path independence - Statements and illustrations of theorems of Green, Stokes and Gauss - Applications.

Textbooks / References.

1) Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, Wiley Eastern Ltd.
2) Howard Anton and Chris Rorres, Elementary Linear Algebra, John Wiley & Sons, 10th Edition.
3) K. D. Joshi, Calculus for Scientists and Engineers, CRC Press.
4) G. B. Thomas and R. L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson Reprint.
5) B. V. Ramana, Higher Engineering Mathematics, Tata McGraw-Hill, New Delhi, 11th Reprint.
6) D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole.
7) B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition.
8) Serge Lang, Linear Algebra, Springer, 3rd Edition.
9) Gilbert Strang, Linear Algebra and its applications, Cengage Learning, 4th Edition.
10) Sudhir Ghorpade and Balmohan Limaye, A course in Calculus and Real Analysis, 1st Edition, Springer-Verlag, New York.

Course code	**ESC101**				
Category	**Basic Engineering Sciences**				
Course title	**Basic Electrical and Electronics Engineering**				
Scheme and credits	L	T	P	C	Semester
	3	**0**	**2**	**4**	**1**
Pre-requisites if any	**-----**				

Module 1 Elementary concepts of electric circuits.

Concepts of DC electric circuits - Basic terminology including voltage, current, power, resistance and EMF - Resistances in series and parallel - Current and voltage division rules - Capacitors and inductors - V-I relations and energy stored - Ohm's and Kirchhoff's laws - Star-delta conversion (resistive networks only-derivation not required) - Problems - Analysis of DC electric circuits - Mesh current method - Matrix representation - Solution of network equations - Node voltage methods - Matrix representation - Solution of network equations by matrix methods - Numerical problems.

Module 2 Elementary concepts of magnetic circuits.

Electromagnetic induction and AC fundamentals - Magnetic circuits - Basic terminology: MMF, field strength, flux density, reluctance - Comparison between electric and magnetic circuits - Series and parallel magnetic circuits with composite materials - Electromagnetic induction: Faraday's laws, problems - Lenz's law - Statically induced and dynamically induced EMFs - Self-inductance and mutual inductance - Coefficient of coupling - Alternating current fundamentals: Generation of alternating voltages - Representation of sinusoidal waveforms: frequency, period, average, RMS values and form factor of waveforms - Numerical Problems.

Module 3 AC circuits.

Phasor representation of sinusoidal quantities - Trigonometric, rectangular, polar and complex forms - Analysis of simple AC circuits: purely resistive, inductive and capacitive circuits - Inductive and capacitive reactance - Concept of impedance - Average power factor - Analysis of RL, RC and RLC series circuits - Active, reactive and apparent power - Three phase AC systems: generation of three phase voltages; advantages of three phase systems, star and delta connections (balanced only), relation between line and phase voltages, line and phase currents - Simple numerical problems.

Module 4 Introduction to semiconductor devices.

Evolution of electronics - Vacuum tubes to nano electronics - Resistors, capacitors, and inductors (constructional features not required): types, specifications - Standard values and colour coding - PN Junction diode: principle of operation, V-I characteristics, principle of avalanche breakdown - Bipolar Junction Transistors: PNP and NPN structures - Principle of operation, relation between current gains in CE, CB and CC, input, and output characteristics of common emitter configuration.

Module 5 Basic electronic circuits and instrumentation.

Rectifiers and power supplies - Block diagram description of a DC power supply - Working of a full wave bridge rectifier, capacitor filter (no analysis), working of simple Zener voltage regulator - Amplifiers: block diagram of public address system - Circuit diagram and working of common emitter (RC coupled) amplifier with its frequency response - Concept of voltage divider biasing - Electronic instrumentation: block diagram of an electronic instrumentation system.

Module 6 Digital electronics.

Introduction to number systems - Basic Boolean laws - Reduction of Boolean expressions and implementation with logic gates.

Textbooks / References.

1) D. P. Kothari and I. J. Nagrath, Basic Electrical Engineering, Tata McGraw Hill Co.
2) Floyd, Electronic Devices, 9th Edition, Pearson Education.
3) R. J. Smith and R. C. Dorf, Circuits, Devices and Systems, 5th Edition, John Wiley & Sons.
4) P. S. Dhogal, Basic Electrical Engineering, Vols. I & II, 42nd Reprint, McGraw Hill.
5) A. P. Malvino, D. P. Leach and Gowtham Sha, Digital Principles and Applications, 6th Edition, Tata McGraw Hill Co.
6) Vincent Del Toro, Electrical Engineering Fundamentals, Prentice Hall India.

Course code	**MES101**				
Category	**Basic Engineering Sciences**				
Course title	**Engineering Mechanics**				
Scheme and credits	L	T	P	C	Semester
	3	**1**	**0**	**4**	**1**
Pre-requisites if any	**-----**				

Module 1

Introduction - Basic concepts of force, moment, and couple - Equilibrium of coplanar force systems - Friction.

Module 2

Internal forces in members of Trusses and (Method of joints, Method of Sections) and Analysis of Frames (Method of Members).

Module 3

Properties of surfaces: Centroid and moment of inertia of plane figures - Polar moment of inertia - Product of inertia - Principal axes - Principle of virtual work and applications.

Module 4

Kinetics of rectilinear motion and curvilinear motion of a particle - D'Alembert's principle - Linear momentum and impulse - Angular momentum - Work and energy - Impact.

Module 5

Rigid body motion: Kinematics of rotation equation of motion of a rotating rigid body - Compound pendulum - Energy equations for rotating bodies - Plane motion: Kinematics of plane motions - Instantaneous centre of rotation - Equations of plane motion of a rigid body and energy equations for plane motion - D'Alembert's principle for rotation and plane motion.

Textbooks / References.

1) R. C. Hibbeler, Engineering Mechanics - Statics, Prentice Hall, 14th Edition.
2) R. C. Hibbeler, Engineering Mechanics - Dynamics, Prentice Hall, 14th Edition.
3) F. P. Beer, E. R. Johnston, et al., Vector Mechanics for Engineers: Statics Dynamics, McGraw-Hill Co., 12th Edition.
4) S. Timoshenko, D. H. Young, J. V. Rao and Sukumar Pati, Engineering Mechanics, McGraw-Hill Co.
5) J. L. Meriam and L. G. Kraige, Engineering Mechanics - Statics, John Wiley and Sons, 8th Edition.
6) J. L. Meriam and L. G. Kraige, Engineering Mechanics - Dynamics, John Wiley and Sons, 8th Edition.
7) Bedford and W. Fowler, Engineering Mechanics - Statics and Dynamics, Pearson Publications.

Course code	**MES102**				
Category	**Basic Engineering Sciences**				
Course title	**Engineering Graphics and Design**				
Scheme and credits	L	T	P	C	Semester
	1	**0**	**4**	**3**	**1**
Pre-requisites if any	**-----**				

Module 1 Introduction.

Graphics as language for communication - Need for instruments, scaling, and upkeep of instruments - Freehand lettering - Construction of certain common curves: ellipse, parabola, and hyperbola, cycloid, and involute - Tangents to these curves.

Module 2 Orthographic projections.

Need for orthographic projection - Preferring the first angle projection - Conversion of pictorial views into orthographic views - Dimensioning - IS codes.

Module 3 Solid geometry.

Projections of solids: Projection of simple solids, like cylinders, cones, prisms, pyramids, etc. with locations of specific lines or points on the surface - Sections of solids: Need for sectioning - Exercises with simple objects like prisms, pyramids, and cones - True shape of sections.

Module 4 Development and interpenetration of sheet metal components.

Development of simple surfaces and non-developable surfaces - Approximate solutions for sphere - Transition pieces - Application to sheet metal work - Interpenetration of simple solids like, prism-prism, cone-cylinder, and cylinder-cylinder.

Module 5 Isometric Projection.

Definition of isometric projection - Isometric scales - Simple exercises on isometric views - Perspective projection of prisms and pyramids by vanishing point method.

Module 6 Overview of computer graphics.

Listing the computer technologies that impact on graphical communication - Demonstrating knowledge of theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable) and The Status Bar - Different methods of zoom as used in CAD - Select and erase objects - Isometric views of lines, planes, simple and compound solids.

Module 7 CAD drawing: Customization, applying dimensions and annotations to drawings.

Setting up of drawing page and printer, including scale settings, setting up of units and drawing limits - ISO and ANSI standards for coordinate dimensioning and tolerancing - Orthographic constraints, snap to objects manually and automatically - Producing drawings by using various coordinate input entry methods to draw straight lines - Applying various ways of drawing circles - Setting up and use of layers, layers to create drawings, create, edit and use customized layers - Changing line lengths through modifying existing lines (extend / lengthen) - Printing documents using the print command - Orthographic projection techniques - Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface - Drawing annotations - Computer-aided design (CAD) software modelling of parts and assemblies - Parametric and nonparametric solids, surfaces, and wireframe models - Part editing and two-dimensional documentation of models - Planar projection theory including sketching of perspective, isometric, multi-view, auxiliary, and section views - Spatial visualization exercises - Dimensioning guidelines, tolerancing techniques; dimensioning and scale multi-views of dwelling.

Textbooks / References

1) SP46 - 2003, Engineering Drawing Practice for Schools and Colleges, Bureau of Indian Standards.
2) N. D. Bhatt, V. M. Panchal and P. R. Ingle, Engineering Drawing, Charotar Publishing House.
3) M. B. Shah and B. C. Rana, Engineering Drawing and Computer Graphics, Pearson Education.
4) B. Agrawal and C. M. Agrawal, Engineering Graphics, TMH.
5) K. L. Narayana and P. Kannaiah, Textbook on Engineering Drawing, Scitech Publishers.
6) H. R. Gopalakrishna, Engineering Drawing, Subhas Stores, Bengaluru.
7) Relevant standards.

SYLLABUS FOR SEMESTER III

Course code	**MES201**				
Category	**Basic Sciences**				
Course title	**Mathematics III (Transforms & Numerical Analysis)**				
Scheme and credits	L	T	P	C	Semester
	3	**1**	**0**	**4**	**3**
Pre-requisites if any	**-----**				

Module 1 Fourier series and Fourier transforms.

Fourier series: Dirichlet's conditions - Half range Fourier cosine and sine series - Parseval's relation - Fourier series in complex form - Harmonic analysis - Fourier transforms: Fourier cosine and sine transforms - Inverse transforms - Convolution theorem and Parseval's identity for Fourier transforms - Finite cosine and sine transforms.

Module 2 Introduction to numerical computation, and Solution of algebraic and transcendental equations.

Introduction to numerical computation: Representation of numbers - Inherent errors - Round-off errors - Truncation errors - Absolute, relative and percentage errors - Accuracy of numbers - Solution of algebraic and transcendental equations: Introduction - Bisection method - Method of false position - Newton Raphson's method - Secant method - Muller's method - Rate of convergence - Solution to systems of nonlinear equations.

Module 3 Finite difference and interpolation.

Finite difference operators - Factorial notation - Divided differences - Finite difference interpolation - Newton's forward and backward difference interpolation formula - Central difference formula - Gauss forward and backward central differences formula - Stirling's formula - Bessel's interpolation formula - Newton's divided differences interpolation formula - Lagrange's polynomial interpolation formula - Spline interpolation - Cubic Splines - Choice of interpolation formula.

Module 4 Curve fitting, numerical differentiation, and numerical integration.

Curve fitting: Fitting linear equations - Least squares regression - Fitting transcendental equations - Fitting a polynomial function - Numerical differentiation: Numerical differentiation based on equal interval interpolation - Second order derivative - Derivatives using Newton's formula and central differences formula - Derivatives using Lagrange's Interpolation formula, and Newton's divided difference interpolation formula - Numerical integration: General quadrature formula - Trapezoidal rule - Simpson's rule - Weddle's rule - Gaussian quadrature formula.

Module 5 Solution of linear system of linear equations.

Direct methods: Gauss elimination method, Identifying ill-conditioned system, Gauss Jordan method, and Triangularization methods - Iterative methods: Jacobi Method and Gauss Seidel method - Comparisons of various methods.

Module 6 Numerical solution of ordinary differential equations.

Taylor's Series method, Euler's method, Modified Euler's method, and Runge-Kutta formulas - Multistep methods: Adam-Moulton method and Milne's method.

Textbooks / References.

1) Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition.
2) D. Zill, W. S. Wright, and M. R. Cullen, Advanced Engineering Mathematics.
3) S. S. Sastry, Introductory Methods of Numerical Analysis.
4) E. Balagurusamy, Numerical Methods.
5) Steven C. Chapra, Numerical Methods for Engineers.

Course code	**MEC201**				
Category	**Professional Core**				
Course title	**Engineering Thermodynamics**				
Scheme and credits	L	T	P	C	Semester
	3	**1**	**0**	**4**	**3**
Pre-requisites if any	**-----**				

Module 1 Fundamentals of thermodynamics.

Thermodynamic system and control volume - Thermodynamics equilibrium, properties, states, processes and cycles, exact and inexact differentials - Definition and classification of thermodynamic work and heat - Displacement work and illustrations for simple processes - Electrical, magnetic, and shaft work - Zeroth law of thermodynamics - Temperature scales and thermometric property.

Module 2 First law of thermodynamics.

First law for cyclic and non-cyclic processes - Concept of total energy E - Demonstration that E is a property - Various modes of energy - Internal energy and enthalpy - First law for a closed system undergoing a cycle and change of state - First law of thermodynamics for steady flow process - Steady flow energy equation applied to nozzle, boiler, turbine, compressor, pump, heat exchanger and throttling process.

Module 3 Second law of thermodynamics.

Second law of thermodynamics: Definitions of direct and reverse heat engines - Definitions of thermal efficiency and COP - Kelvin-Plank and Clausius statements - Definition of reversible process - Internal and external irreversibility - Carnot cycle - Corollary of Carnot theorem.

Module 4 Entropy.

Clausius theorem - Property of entropy - Inequality of Clausius - Entropy change in an irreversible process - Principle of increase of entropy - Entropy change for non-flow and flow processes - Availability and irreversibility and exergy.

Module 5 Pure substance.

Pure substances - p-V-T- surfaces - T-S and h-s diagrams - Mollier charts - Phase transformations - Triple point at critical state properties during change of phase - Dryness fraction - Clausius-Clapeyron equation.

Textbooks / References.

1) P. K. Nag, Engineering Thermodynamics, Tata McGraw-Hill, 1995.
2) R. E. Sonntag, C. Borgnakke and G. J. Van Wylen, Fundamentals of Thermodynamics, 6th Edition, John Wiley & Sons, 2003.
3) J. B. Jones and R. E. Duggan, Engineering Thermodynamics, Prentice Hall of India, 1996.
4) Yunus Cengel and Boles, Thermodynamics - An Engineering Approach, McGraw-Hill Education.
5) P. Chattopadhyaya, Engineering Thermodynamics, Oxford University Press, 2010.
6) G. F. C. Rogers and Y. R. Mayhew, Engineering Thermodynamics - Work and Heat Transfer, 4th Edition, Pearson, New Delhi, 2012.

Course code	**MEC202**				
Category	**Professional Core**				
Course title	**Fluid Mechanics and Hydraulic Machines**				
Scheme and credits	L	T	P	C	Semester
	3	**0**	**2**	**4**	**3**
Pre-requisites if any	**-----**				

Module 1 Introduction.

Introduction to fluids - Hypothesis of continuum - Shear stress in a moving fluid - Properties of fluids - Pressure and head - Pascal's law - Variation of pressure vertically in a fluid under gravity - Equality of pressure at the same level in a static fluid - General equation for variation of pressure due to gravity from a point to point in a static fluid - Pressure measurements using elastic pressure transducers, force balance pressure gauge, and electrical pressure transducers.

Module 2 Static forces on surface and buoyancy.

Fluid statics - Action of fluid pressure on surface: resultant force and centre of pressure on a plane surface under uniform pressure - Resultant force and centre of pressure on a plane surface immersed in a liquid - Forces on a curved surface due to hydrostatic pressure - Buoyancy - Equilibrium of floating bodies - Stability of a submerged body - Stability of floating bodies - Metacentric height and its determination.

Module 3 The energy equation and its application.

Momentum and fluid flow - Momentum equation for 2D and 3D flow along a streamline - Momentum correction factor - Euler's equation of motion along a streamline - Bernoulli's theorem - Kinetic energy correction factor - Pitot tube, venturi meter and orifice meter - Theory of small orifices discharging to atmosphere - Theory of large orifices - Rotameter - Elementary theory of notches and weirs - Flow in a curved path.

Module 4 Dimensional analysis and similarities.

Dimensional analysis using Rayleigh's method, and Buckingham π-theorem - Similarities: geometric similarity, dynamic similarity, and kinematic similarity - Model testing and model laws - Undistorted and distorted models.

Module 5 Viscous flow.

Reynolds number and Reynolds experiment - Flow of viscous fluid through circular pipe - Hagen Poiseuille formula - Flow of viscous fluid between two parallel fixed plates - Power absorbed in viscous flow through journal, footstep, and collar bearing - Movement of piston in dash pot - Turbulent flow: expression for coefficient of friction - Darcy-Weisbach equation - Moody diagram - Resistance of smooth and rough pipes - Velocity distribution in turbulent flow through pipes.

Module 6 Flow through pipes.

Major energy losses - Minor energy losses - Hydraulic gradient and total energy lines - Pipes in series and parallel - Equivalent pipes - Power transmission through pipe - Flow through nozzle at the end of pipe - Water hammer in pipes - Compressible flow: basic equations for one dimensional compression, pressure wave propagation, sound velocity in fluid, Mach number, stagnation properties.

Module 7 Hydraulic machines.

Euler equation for turbomachines - Velocity triangles - Centrifugal and axial flow pumps - Hydraulic turbines - Cavitation - Water hammer.

Textbooks / References

1) D. S. Kumar, Fluid Mechanics and Fluid Power Engineering, S. K. Kataria & Sons.
2) R. K. Bansal, Fluid Mechanics and Hydraulic Machines, Laxmi Publications.

3) Frank M. White, Fluid Mechanics, McGraw Hill Publishing Company Ltd.
4) P. M. Gerhart, A. L. Gerhart and J. I. Hochstein, Fundamentals of Fluid Mechanics, Wiley India Pvt. Ltd.
5) R. W. Fox and A. T. McDonald, Introduction to Fluid Mechanics, 10th Edition, John Wiley & Sons.
6) Y. A. Cengel and John Cimbala, Fluid Mechanics Fundamental and applications, 3rd Edition, Tata McGraw-Hill Education.
7) S. K. Som, G. Biswas, and S. Chakraborty, Introduction to Fluid Mechanics and Fluid Machines, 3rd Edition, Tata McGraw-Hill Education.

Course code	**MEC203**				
Category	**Professional Core**				
Course title	**Strength of Materials**				
Scheme and credits	L	T	P	C	Semester
	3	**0**	**2**	**4**	**3**
Pre-requisites if any	**-----**				

Module 1 Fundamentals.

Analysis of stress: Introduction to stress tensor - Cauchy's stress equation - 3D-Equation of equilibrium (Cartesian coordinates) - Plane stress transformation (analytical and Mohr's circle method) - Principal stresses - Maximum in-plane shear stress - Strain: Deformation in the neighbourhood of a point - State of strain at a point - Compatibility conditions - Plane strain transformation (analytical and Mohr's circle method) - Mechanical properties of materials: Stress-strain behaviour of ductile and brittle materials - Elasticity - Hooke's law - Strain energy - Poisson's ratio - Yield strength, ultimate strength, toughness, ductility, and relations between the elastic constants.

Module 2 Analysis of members under loading.

Axial loading: Elastic deformation of an axially loaded member - Principle of superposition - Statically indeterminate axially loaded member - Thermal stresses - Stress concentration - Torsion: Torsion of general prismatic section solid bars - Torsion problems for circular section - Statically indeterminate torque-loaded members - Thin-walled tubes having closed cross sections - Bending: Shear force and bending moment diagrams for various loading conditions - Flexural formula - Straight beam (symmetric and unsymmetric bending) - Curved beams.

Module 3 Buckling of columns.

Critical load - Columns having diverse types of supports - Secant formula - Design of columns for concentric and eccentric loading.

Module 4 Energy methods.

Principle of virtual work - Castigliano's theorem applied to trusses and beams.

Module 5 Advanced topics.

Combined loading: Superposition principle for bars and beams under combined axial, shear, and bending loads - Pressure vessels: Thick and thin-walled pressure vessels subjected to internal and external pressure - Transverse shear: Shear in straight members - Shear formula - Deflection of beams: Slope and displacement by integration method, moment of area method, and method of superposition.

Textbooks / References.

1) Russell C. Hibbeler, Mechanics of Materials, 8th Edition, Pearson Asia, 2010.
2) Egor P. Popov, Engineering Mechanics of Solids, 2nd Edition, Pearson India, 2015.
3) S. Crandall, N. Dahl, T. Lardner, R. Archer, N. Cook, F. A. McClintock, E. Rabinowicz, G. S. Reichenbach and M. S. Shiva Kumar, An Introduction to the Mechanics of Solids, 3rd Edition, McGraw-Hill Education, 2017.
4) William Nash, Strength of Materials, 4th Edition, McGraw Hill Education, 2017.
5) F. P. Beer, E. R. Johnston Jr., J. T. DeWolf, D. F. Mazurek, and S. Sanghi, Mechanics of Materials, 8th Edition, McGraw Hill, 2020.
6) R. Subramanian, Strength of Materials, 2nd Edition, Oxford Higher Education, 2010.
7) James M. Gere and Stephen P. Timoshenko, Mechanics of Materials, 4th Edition, CBS Publisher, 1996.
8) G. H. Ryder, Strength of Materials, 1st Edition, Macmillan Press Ltd, 1961.

Course code	**MEC204**				
Category	**Professional Core**				
Course title	**Kinematics of Machines**				
Scheme and credits	L	T	P	C	Semester
	3	**1**	**0**	**4**	**3**
Pre-requisites if any	**-----**				

Module 1 Mechanisms.

Classification of links, pairs, and degree of freedom - Mobility of mechanisms - Kinematic inversions of four bar chain and slider crank - Mechanical advantage - Transmission angle - Description of some common mechanisms - Quick return mechanism - Straight line generators (Peaucellier, Hart, Watt, Roberts straight line motion) - Universal coupling - Motor car steering.

Module 2 Velocity and acceleration.

Displacement, velocity, and acceleration analysis of simple mechanisms - Graphical velocity analysis using instantaneous centres - Kennedy's theorem - Angular velocity theorem - Velocity and acceleration analysis using loop closure equation - Kinematics analysis of simple mechanisms -

Slider crank mechanism dynamics - Quick return mechanism - Coincident points - Velocity and acceleration image - Coriolis component of acceleration.

Module 3 Kinematics synthesis of mechanism.

Number synthesis - Kinematics synthesis - Graphical methods of dimensional synthesis for four bar mechanism - Introduction to motion and path generation.

Module 4 Cam and follower mechanism.

Classification of cams and followers - Terminology and definitions - Displacement diagrams - Uniform velocity, parabolic, simple harmonic, and cycloidal motions - Derivatives of follower motion-specified contour, cams-circular and tangents cams - Pressure angle and undercutting - Sizing of cams, graphical and analytical disc cam profile synthesis for roller and flat face followers.

Module 5 Gears and gear trains.

Involute and cycloidal gear profiles - Gear parameters - Fundamental law of gearing and conjugate action, spur gear, arc, and path of contact, contact ratio and interference / undercutting - Helical gears - Simple, compound and epicyclic gear train kinematics.

Textbooks / References.

1) S. S. Ratan, Theory of Machines, 1st Edition, McGraw Hill Education India Private Limited, 2017.
2) Ashok G. Ambekar, Mechanism and Machine Theory, 1st Edition, PHI Learning, 2007.
3) Thomas Bevan, Theory of Machines, 3rd Edition, Pearson Education India, 2009.
4) W. L. Cleghorn and Nikolai Dechev, Mechanisms of Machines, 2nd Edition, Oxford University Press, 2014.
5) A. Ghosh and A. K. Mallick, Theory of Mechanism and Machines, Affiliated East-West Pvt. Ltd, New Delhi.

Course code	**MAA201**				
Category	**Mandatory and Audit Courses**				
Course title	**Environmental Science**				
Scheme and credits	L	T	P	C	Semester
	2	**0**	**0**	**0**	**3**
Pre-requisites if any	**-----**				

Module 1 Introduction.

Concept and scope of Environment science, components of environment, environmental segment, and their importance.

Module 2 Ecology.

Ecosystem and its characteristics features, structure and function of forest ecosystem, grassland ecosystem, desert ecosystem and aquatic ecosystem, ecological balance, and consequences of imbalance.

Module 3 Atmosphere.

Atmospheric composition, energy balance, climate, weather, depletion of ozone layer, greenhouse effect, acid rain, particles, ions and radicals in the atmosphere, chemical and photochemical reactions in the atmosphere.

Module 4 Air pollution and control.

Air pollutants, sources and effect of air pollutants, primary and secondary pollutants, photochemical smog, fly ash, inorganic and organic particulate matter. Air quality standards, sampling, monitoring and control measures for pollutants.

Module 5 Water pollution and control.

Aquatic environment, water pollution, sources and their effect, lake and ground water pollution, eutrophication, water quality standard and water pollution control measures, wastewater treatment.

Module 6 Land pollution.

Lithosphere, composition of soil, acid base and ion exchange reactions in soil, soil erosion, landslides, desertification, pollutants (municipal, industrial, commercial, agricultural, hazardous solid wastes), origin and effects, collection and disposal of solid wastes, recovery, and conversion methods.

Module 7 Noise pollution.

Noise classification and its sources, effects and measurement, noise pollution hazards, standards, and noise pollution control.

Textbooks / References.

1) G. M. Master, Introduction to Environmental Engineering and Science, Pearson Education.
2) B. J. Nebel, Environment Science, Prentice Hall Inc.
3) E. P. Odum, Ecology: The link between the natural and social sciences. IBH Publishing Company.
4) B. K. Sharma, Environmental Chemistry, Krishna Prakashan Media, Meerut.
5) A. Kaushik and C. P. Kaushik, Perspectives in Environmental studies, New Age International Publication.
6) S. E. Menon, Environmental Chemistry.