Maharaja Surajmal Brij University

Bharatpur (Raj.)

SYLLABUS

MATHEMATICS

M.A. / M.Sc.

(Final)

(Session 2020-21)

Only For Session 2020-21

अकादमिक प्रभारी
महाराजा सूरजमल बृज विश्वविद्यालय
भरतपुर (राज.)

M.A./M.Sc. (Mathematics)

Syllabus

Scheme of Examination: There shall be ten papers in two years duration and five papers in each year. In first year all five papers are compulsory. In the final year two papers shall be compulsory and three papers shall be optional(elective).

The syllabus of each paper is divided into four units. There shall be two parts in the question paper. Part 'A' of the question paper shall contain FIRST question which is compulsory. The first question shall contain 10 subparts consisting of very short answer type questions based on the knowledge, understanding and applications of the topics covering the syllabus of all four units. Each question of subpart will carry 2 marks. Part 'B' of the question paper shall be divided into FOUR units . Each unit will contain TWO questions and each question will have two subparts. Student has to attempt one question from each unit Each question is of 20 marks.

M. A. / M. Sc. (Final) Examination 2022 & onwards

Five Papers (Two compulsory and three optional(elective) papers)

Total Max Marks 500 for regular and non collegiate students.

Paper	Name of paper	Teaching hrs per weak	Exam Duration	Max. Marks
Compulsory Papers				
I	Analysis and Advanced Calculus	6	3	100
II	Fluid Dynamics	6	3	100
Optional Papers (Any three of the following)				
III	Mathematical Programming	6	3	100
IV	Mathematical Theory of Statistics	6	3	100
V	Combinatorics and Graph Theory	6	3	100
VI	Integral Transforms and Integral Equations	6	3	100
VII	Relativistic Mechanics and Cosmology	6	3	100
VIII	Advanced Numerical Analysis	6	3	100
IX	Continuum Mechanics	6	3	100
X	Boundary Layer Theory	6	3	100

अकादमिक प्रभारी
महाराजा सूरजमल बृज विश्वविद्यालय
भरतपुर (राज.)

Paper - I

Analysis and Advanced Calculus

Teaching : 6 hours per weak **Theory Paper**

Exam Duration: 3 Hours **Maximum Marks 100**

Note :- *The syllabus of this paper is divided into four units. There shall be two parts in the question paper. Part 'A' of the question paper shall contain FIRST question which is compulsory The first question shall contain 10 subparts consisting of very short answer type questions based on the knowledge, understanding and applications of the topics covering the syllabus of all four units. Each question of subpart will carry 2 marks. Part 'B' of the question paper shall be divided into FOUR units . Each unit will contain TWO questions and each question will have two subparts. Student has to attempt one question from each unit. Each question is of 20 marks.*

Unit-I : Normed Linear Space- Topological properties of normed linear spaces, Equivalent norms, Quotient normed linear spaces, Reisz Theorem **Banach Spaces -** Banach spaces and examples. Bounded linear transformations, Normed linear space of bounded linear transformations, Haun-Banach Theorem and its consequences.

Unit-II : Open mapping theorem, Closed graph theorem, Uniform boundedness principle, Conjugate of an operator, Uniform boundedness theorem, Embedding and reflexivity of normed spaces, Dual spaces with examples **Inner product space,** Hilbert space and its properties, Orthogonality and functionals in Hilbert space, Pythagorean theorem, Projection theorem, Orthonormal sets, Bessel's inequality, Complete orthonormal sets, Parseval's identity, Structure of a Hilbert space, Reisz representation theorem, Reflexivity of Hilbert space.

Unit-III : Adjoint of an operator on a Hilbert space, Self adjoint, normal and unitary operators and their properties, Projection on a Hilbert space, Invariance , Reducibility, Orthogonal projections, Spectral analysis of self adjoint operators, Spectral theorem. The space of Continuous functions, Stone-Weierstrass Approximation theorem, Equicontinuous sets, Derivative of a continuous map from an open subset of Banach space to a Banach space, Rules of differentiation, Derivative of a composite function, Directional derivative, mean value theorems and its applications.

Unit-IV : Partial derivatives and Jacobian matrix, Continuously differentiable maps, Higher derivatives, Taylor's theorem, Taylor's formula, Existence theorem on differentiable maps. Fixed point theorems, inverse function theorem, implicit function theorem, step function, regulated function, primitive and integrals, differentiation under the integral sign, Riemann integral of function of real variable with values in normed linear space, solution of differential equation in normed linear space, Lipschitz's property, Existence theorem, uniqueness theorem.

अकादमिक प्रभारी
महाराजा सूरजमल बृज विश्वविद्यालय
भरतपुर (राज.)

Paper – II
Fluid Dynamics

Teaching : 6 hours per week **Theory Paper**

Exam Duration: 3 Hours **Maximum Marks 100**

Note :- *The syllabus of this paper is divided into four units. There shall be two parts in the question paper. Part A' of the question paper shall contain FIRST question which is compulsory The first question shall contain 10 subparts consisting of very short answer type questions based on the knowledge, understanding and applications of the topics covering the syllabus of all four units. Each question of subpart will carry 2 marks. Part 'B' of the question paper shall be divided into FOUR units . Each unit will contain TWO questions and each question will have two subparts. Student has to attempt one question from each unit . Each question is of 20 marks.*

Unit-I : Kinematics- Approaches of study, Lagrangian and Eulerian methods, Equation of continuity by Eulerian method (in vector form, Cartesian coordinates, Spherical polar coordinates, Cylindrical coordinates), Equation continuity by Lagrangian method, Boundary surface, Stream lines, path lines and streak lines, Velocity potential, Rotational and irrotational motion, **Equations of Motion-** Euler's dynamical equation of motion, Equation of motion under impulsive forces, Lagrange' equations, Cauchy's integral, Hemholtz equations, Bernoulli's equations and its application.

Unit-II : Motion in two dimensions- Stream function, Complex potential, Stagnation points, sources, sinks, doublets, Images in two dimensions, Milne-Thomson circle theorem, Theorem of Blasius. **Motion of a sphere -** Motion of a sphere through an infinite mass of a liquid at rest, Liquid streaming past a fixed sphere. Equation of motion of a sphere, Pressure distribution on a sphere, Concentric spheres(initial motion). Rectilinear Vortices(vortex motion)vorticity, vortex line, vortex tube, Helmholtz's vorticity theorem, rectilinear vortices, two vortex filament, image of a vortex filament in a plane, vortex doublet, Karman's vortex street.

Unit-III : Theory of stress and strain- Viscosity, stress, stress vector and stress tensor, principal stresses, principal directions stress tensor, strain, normal and shearing strain, Stoke's law of friction, Thermal conductivity and generalised law of heat conduction, Equation of state and continuity. Naveir-Stoke's equation of motion, Vorticity and Circulation. Dynamical similarity, Inspectional and dimensional analysis , Bukingham theorem and its applications, non-dimensional parameters and their physical significance. Reynolds number, Froude number, Mach number, Prandtl number, Eckart number, Grashoff, number, Brickmann number, nondimensional coefficient, Exact solution of Naveir-Stoke's equations, steady incompressible flowwith constant fluid properties, Flow between parallel

Only For Session 2020-21

अकादमिक प्रभारी
महाराजा सूरजमल बृज विश्वविद्यालय
भरतपुर (राज.)

plates, velocity and temperature distribution for plane couette flow, plane Poiseuille flow, generalised plane couette flow.

Unit-IV: Flow in a circular pipe (Hagen Poisueille flow), Flow in a tube of uniform cross section, Flow between two concentric rotating cylinders, flow in convergent and divergent channels, Stagnation point flows, Homann flow, flow due to rotating disc, variable viscosity plane couette flow, Variable viscosity plane Poisueille flow Unsteady incompressible flow with set in motion, Flow due to an oscillating plane wall, starting flow in a plane Couette motion, starting flow in a pipe, Steady compressible flow, plane Couette flow with transpiration cooling. Theory of very slow motion. Stoke and ocean's flow past a sphere. Stoke and ocean's flow past a cylinder, lubrication theory.

Paper – III

Mathematical Programming

Theory Paper

Teaching : 6 hours per week

Maximum Marks 100

Exam Duration: 3 Hours

Note :- *The syllabus of this paper is divided into four units. There shall be two parts in the question paper. Part A' of the question paper shall contain FIRST question which is compulsory The first question shall contain 10 subparts consisting of very short answer type questions based on the knowledge, understanding and applications of the topics covering the syllabus of all four units. Each question of subpart will carry 2 marks. Part 'B' of the question paper shall be divided into FOUR units . Each unit will contain TWO questions and each question will have two subparts. Student has to attempt one question from each unit. Each question is of 20 marks.*

Unit - I : Separating and supporting hyperplane theorems, Revised simplex method to solve linear programming problems, Bounded variable problems of l.p.p., **Integer programming:** Gomory's algorithm for all and mixed integer programming problems, Branch and bound algorithm.

Unit-II : Separable programming: Piecewise linear approximations to non linear functions. Reduction of separable programming problem to l p p, Separable programming algorithm; **Dynamic Programming:** Introduction, Bellman Principle of optimality, solution of problems with finite number of stages, Solution of lp p by dynamic programming.

Unit-III : Convex functions, Quadratic forms, Constrained problems of maxima minima, Lagrange's method , Nonlinear programming: Formulation and graphical method, Non linear programming and its fundamental ingredients, Kuhn Tucker necessary and sufficient conditions, Saddle point and saddle point theorems.

Only For Session 2020-21

अकादमिक प्रभारी
महाराजा सूरजमल बृज विश्वविद्यालय
भरतपुर (राज.)

Unit-IV : Quadratic Programming: Kuhn-Tucker conditions, Wolfe's method, Duality in quadratic programming, Beale's method to solve QPP, Geometric Programming: Formulation, geometric arithmetic inequality, necessary conditions of optimality, **Fractional programming**, Computational procedure.

Paper - IV

Mathematical Theory of Statistics

Teaching : 6 hours per week **Theory Paper**

Exam Duration: 3 Hours **Maximum Marks 100**

Note :- *The syllabus of this paper is divided into four units. There shall be two parts in the question paper. Part 'A' of the question paper shall contain FIRST question which is compulsory The first question shall contain 10 subparts consisting of very short answer type questions based on the knowledge, understanding and applications of the topics covering the syllabus of all four units. Each question of subpart will carry 2 marks. Part 'B' of the question paper shall be divided into FOUR units . Each unit will contain TWO questions and each question will have two subparts. Student has to attempt one question from each unit. Each question is of 20 marks.*

Unit-I : Probability : Classical and Empirical definition, Axiomatic approach, Sample space , Mutually exclusive and compound events, Addition theorem, Conditional probability, Mathematical Expectation, Baye's theorem. **Continuous Frequency Distributions** : Beta distribution, Gamma distribution, Chi-square distribution, sum of random variables, Convolution, Marginal and Conditional Probabilities, Chebyshev's and Markov inequalities, Bivariate distributions, Marginal distribution, Binomial distribution.

Unit-II : Poisson distribution, Hypergeometric distribution, Normal distribution, Fitting of Normal distribution, Central limit theorem, Laws of large numbers, week law of large number numbers, Method of Least Squares and Curve Fitting. **Bivariate Distributions :** Correlation and regression coefficients, Rank correlation, Cauchy and Schwarz's Inequalities, Multiple and Partial Correlation, Association of attributes.

Unit-III : Index number: Introduction, Price relatives, Quantity relatives, Value relatives, Link and Chain relatives. Aggregate methods, Fisher's ideal index, Change of the base of the index numbers. **Moment Generating Function and Cumulants,** Characteristic Function. Sampling :Simple Sampling of Attributes, Test of Significance, Comparision of Large Samples, Testing of Hypothesis, Null Hypothesis, Levels of Significance, Fiducial and Confidence Limit, Test of Significance of the means of two large samples.

अकादमिक प्रभारी
महाराजा सूरजमल बृज विश्वविद्यालय
भरतपुर (राज.)

Unit-IV : χ^2-distribution, Test of goodness of fit, Test for Independence, Yate's Correction for Continuity, t- distribution, Z- test, F- distribution, Test of Significance of correlation coefficient (Small Samples). Analysis of Variance, Two Criterion of Classification, Design of Experiments, Randomization and Latin Squares, Estimation, Method of Maximum of Likelyhood, Maximum Likelyhood Estimation, Consistent Estimator. Efficiency Estimator, Sufficient Estimator, Simple and Composite Hypothesis, Neymen-Pearson Lemma

Paper-V
Combinatorics and Graph Theory

Teaching : 6 hours per weak **Theory Paper**
Exam Duration: 3 Hours **Maximum Marks 100**

Note :- *The syllabus of this paper is divided into four units. There shall be two parts in the question paper. Part 'A' of the question paper shall contain FIRST question which is compulsory The first question shall contain 10 subparts consisting of very short answer type questions based on the knowledge, understanding and applications of the topics covering the syllabus of all four units. Each question of subpart will carry 2 marks. Part 'B' of the question paper shall be divided into FOUR units. Each unit will contain TWO questions and each question will have two subparts. Student has to attempt one question from each unit. Each question is of 20 marks.*

Unit-I : Combinatorics- Counting of sets and multi-sets, binomial and multinomial numbers, unordered section with repetitions, selection without repetition. Counting objects and functions. Functions and the Pigeonhole principle, inclusion and exclusion principle. Discrete numeric functions and combinatorial problems. Generating function and recursions. Power series and their algebraic properties. Homogeneous and non-homogeneous recursions.

Unit- II : Graphs- Basic terminology, simple graphs, multi graphs, weighted graphs. Walk and connectedness, Paths and circuits, Shortest paths in weighted graphs, Eulerian paths and circuits, Hamiltonian paths and circuits. Travelling salesman problem, operations on graphs. Trees- Trees, rooted trees, path-lengths in rooted trees, spanning trees, minimum spanning trees.

Unit-III : Cut sets- Cut sets, cut vertices, fundamental cut sets, connectivity and separativity, network flows, Max-flow min-cut theorem. **Planner graphs-** Combinatorial and Geometric graphs, Kuratowski's graphs, Euler's formula, Detection of planarity, Geometric dual, Thickness and crossing number.

Unit-IV : Graph colouring, vertex colouring, Edge colouring and Map colouring, Chromatic number, Chromatic polynomials, The four and five colour theorems. Digraphs- Binary relations, Directed graphs and directed trees, Arborescence, Polish notation method, Tournaments. Counting of labelled trees-caley's theorem, Counting methods, Polya's theory.

अकादमिक प्रभारी
महाराजा सूरजमल बृज विश्वविद्यालय
भरतपुर (राज.)

Paper –VI

Integral Transforms and Integral Equations

Teaching : 6 hours per weak — **Theory Paper**

Exam Duration: 3 Hours — **Maximum Marks 100**

Note :- *The syllabus of this paper is divided into four units. There shall be two parts in the question paper. Part 'A' of the question paper shall contain FIRST question which is compulsory The first question shall contain 10 subparts consisting of very short answer type questions based on the knowledge, understanding and applications of the topics covering the syllabus of all four units. Each question of subpart will carry 2 marks. Part 'B' of the question paper shall be divided into FOUR units . Each unit will contain TWO questions and each question will have two subparts. Student has to attempt one question from each unit. Each question is of 20 marks.*

Unit -I : Laplace Transform- Definition and its properties, Rules of manipulation, Laplace transform of derivatives and integrals, Properties of inverse Laplace transform, Convolution theorem. Complex inversion formula. Fourier transform- Definition and properties of Fourier sine, cosine and complex transforms. Convolution theorem, Inversion theorems, Fourier transform of derivatives.

Unit- II : Mellin Transform- definition and properties of Mellin transform, Mellin transform of derivatives and integrals, Inversion theorem, Convolution theorem. Hankel transform- Definition and properties of Hankel transform, Hankel transform of derivatives, Inversion theorem, Parseval Theorem. Solution of Ordinary differential equations with constant and variable coefficients by Laplace Transforms.

Unit -III : Solution of boundary value problems by Laplace, Fourier and infinite Hankel transforms. **Linear Integral Equations-** Definition and classification, conversion of initial and boundary value problems to the integral equations, Eigen values and Eigen functions, Solution of homogeneous and general Fredholm integral equations of second kind with separable kernels. Solution of Fredholm and Volterra integral equations of second kind by methods of successive substitutions and successive approximations. Resolvent kernel and its results.

Unit- IV : Conditions of uniform convergence and uniqueness of series solutions. **Integral Equations with symmetric kernels-** Orthogonal system of functions, Fundamental properties of eigen values and eigen functions for symmetric kernels. Expansion in eigen functions and bilinear forms, Hillbert-Schmidt theorem, solution of Fredholm integral equations of second kind by using Hillbert-Schmidt theorem. Solution of Volterra integral equations of second kind with convolution type kernels by Laplace transforms, Solution of singular integral equations by Fourier transform. Classical Fredholm theory- Fredholm theorems, solution of Fredholm integral equation of second kind by using Fredholm first theorem.

Paper – VII

Relativistic Mechanics and Cosmology

Teaching : 6 hours per week
Exam Duration: 3 Hours

Theory Paper
Maximum Marks 100

Note :- *The syllabus of this paper is divided into four units. There shall be two parts in the question paper. Part 'A' of the question paper shall contain FIRST question which is compulsory The first question shall contain 10 subparts consisting of very short answer type questions based on the knowledge, understanding and applications of the topics covering the syllabus of all four units. Each question of subpart will carry 2 marks. Part 'B' of the question paper shall be divided into FOUR units . Each unit will contain TWO questions and each question will have two subparts. Student has to attempt one question from each unit . Each question is of 20 marks.*

Unit-I : Relative Character of space and time, Principle of relativity and its postulates, derivation of special Lorentz transformation equations, Composition of parallel velocities, Lorentz-Fitzgerald contraction formula, Time dilation. Simultaneity, Relativistic transformation formulae for velocity, Lorentz contraction factor, Particle acceleration, velocity of light as fundamental velocity, relativistic aberration and its deduction to Newtonian theory.

Unit-II : Variation of mass with velocity, equivalence of mass and energy, transformation formula for mass, momentum and energy, problems on conservation of mass, Momentum and energy, Relativistic Lagrangian and Hamiltonian . Minkowski's space, spacelike, time-like and light-like intervals, Null cone, Relativity and Causality, Proper time, World line of a particle, Principle of equivalence and general covariance.

Unit-III : Mach's principle, Newtonian approximation of equation of motion, Einstein's field equation for matter and empty space, Reduction of Einstein's field equation to Poisson's equation, removal of clock paradox in general relativity, Schwarzschild exterior metric, its isotropic form, Singularity and singularities in Schwarzschild exterior metric, derivation of the formula GM = com, mass of sun in gravitational unit, Relativistic differential equation for the orbit of the planet.

Unit-IV : Three crucial tests in general relativity and their detailed descriptions, Analogues of Kepler's laws in general relativity, trace of Einstein tensor, Energy-momentum tensor and its expression for perfect fluid, Schwarzschild interior metric and boundary condition. Lorentz invariance of Maxwell's equations in empty space, Lorentz force on charged particle, Energy-momentum tensor for electro-magnetic field, Einstein's field equation with cosmological term, static cosmological models (Einstein & de-Sitter models) with physical and geometrical properties, Non-static form of de-Sitter line-element and Red shift in this metric, Einstein space, Hubble's law, Weyl's postulate.

अकादमिक प्रभारी
महाराजा सूरजमल बृज विश्वविद्यालय
भरतपुर (राज.)

Paper – VIII

Advanced Numerical Analysis

Teaching : 6 hours per week
Exam Duration: 3 Hours

Theory Paper
Maximum Marks 100

Note :- 1. *The syllabus of this paper is divided into four units. There shall be two parts in the question paper. Part 'A' of the question paper shall contain FIRST question which is compulsory The first question shall contain 10 subparts consisting of very short answer type questions based on the knowledge, understanding and applications of the topics covering the syllabus of all four units. Each question of subpart will carry 2 marks. Part 'B' of the question paper shall be divided into FOUR units . Each unit will contain TWO questions and each question will have two subparts. Student has to attempt one question from each unit . Each question is of 20 marks.*

2. *Scientific calculator is to be permitted for numerical calculation.*

Unit -I: Numerical solution of Algebraic and transcendental equations: Iteration methods based on first degree equation – Secent and Regula-Falsi methods, Newton-Raphson method; Iterative methods based on second degree equation - Chebyshev method, Muller's method, methods for multiple and complex roots, Rate of Convergence, General iteration methods Acceleration of convergence, Newton-Raphson method for simultaneous equations, Convergence of iteration process in the case of several unknowns. Polynomial equations: Descartes' rule of signs, Sturm functions and Sturm sequences, Real and complex roots, synthetic division, Birge-Vieta method, Bairstow method, Graeffe's root squaring method.

Unit-II : Solution of system of simultaneous linear equations: LU factorization method, Doolitle's, Crout's and Cholesky's partition methods, method of successive approximation, relaxation methods. **Eigen value problems:** Basic properties of Eigen values and Eigen vectors, Power method, Method for finding all eigen values of a matrix, Jacobi's, Given's and Rutishauser method, Householder's method, Complex Eigen values.

Unit- III: Numerical Solution of Ordinary Differential Equations Initial Value problems: local truncation error, Convergence Stability, Euler's method- backward and mid point Euler's methods, Singlestep methods, Taylor's series method, Picard method, Runge-Kutta methods upto fourth order, Multi-step method- Explicite multi-step method, Adoms Baseforth method, Nystrom method, Predictor and Corrector method. Stability analysis- single and multi-step methods.

Unit-IV : Boundary Value Problems of Ordinary differential equations: Boundary value problems (BVP's), Boundary conditions of first kind, second kind and third kind, Shooting method (Initial value problem method), Linear and nonlinear second order differential equations. Finite difference methods, Difference schemes for linear boundary value problems of the type-$y''= f(x,y)$, $y''= f(x,y,y')$, $y^{iv} = f(x,y)$. Convergence and Stability of finite difference schemes. Finite Element methods: Solution of variation problem, Ritz method, Finite elements solution of Linear boundary value problem, Assembly of element equations mixed boundary conditions.

अकादमिक प्रभारी
महाराजा सूरजमल बृज विश्वविद्यालय
भरतपुर (राज.)

Paper – IX
Continuum Mechanics

Teaching : 6 hours per week
Exam Duration: 3 Hours

Theory Paper
Maximum Marks 100

Note :- 1. *The syllabus of this paper is divided into four units. There shall be two parts in the question paper. Part 'A' of the question paper shall contain FIRST question which is compulsory The first question shall contain 10 subparts consisting of very short answer type questions based on the knowledge, understanding and applications of the topics covering the syllabus of all four units. Each question of subpart will carry 2 marks. Part 'B' of the question paper shall be divided into FOUR units . Each unit will contain TWO questions and each question will have two subparts. Student has to attempt one question from each unit . Each question is of 20 marks.*

2. *Scientific calculator is to be permitted for numerical calculation.*

Unit-I : Cartesian Tensors, Index notation and transformation laws of Cartesian tensors, Addition, Subtraction and Multiplication of Cartesian tensors, Gradient of a scalar function, Divergence of a vector function and Curl of a vector function using index notation, e-S identity, Conservative vector field and concept of a scalar potential function, Stocke's, Gauss's and Green's theorems. Continuum approach, Classification of continuous media , Body forces and surface forces, Components of stress tensor

Unit-II : Force and Moment equations of equilibrium, transformation of laws of stress tensor , Stress quadric, Principal stress and principal axes , Stress invariants and stress deviator, maximum shearing stress. Lagrangian and Eulerian description of deformation of flow, Comoving derivative , Velocity and Acceleration, Continuity equation, Strain tensors, Linear rotation tensor and rotation vector, Analysis of relative displacements. Geometric meaning of the components of the linear stress tensor, properties of linear strain tensors, Principal axes, Theory of linear strain. Linear strain components.

Unit- III: Rate of strain tensors. The vorticity tensor, rate of rotation vector and vorticity, properties of rate strain tensor, rate of cubical dilation. Law of conservation of mass and Eulerian continuity equation, Reynold's transport theorem, Momentum integral equation and equation of motion, Kinetic equation of state. First and second law of thermodynamics and dissipation function, Applications (Linear elasticity and Fluids) - Assumptions and basic equations. Generalised Hooks' law for an isotropic homogeneous solid.

Unit-IV : Compatibility equations (Beltrami – Michell equation), Classification of types of problems in linear elasticity. Principle of superposition, Strain energy function, Uniqueness theorem, p-p relationship and work kinetic energy equation, irrotational flow and velocity potential, Kinetic equation of state and first law of thermodynamics, Equation of continuity. Equation of motion, Voticity - stream surfaces for inviscid flow, Bernaulli's equations, Irrotation flow and velocity potential, Similarity parameters of fluid flows.

अकादमिक प्रभारी
महाराजा सूरजमल बृज विश्वविद्यालय
भरतपुर (राज.)

Paper - X

Boundary Layer Theory

Teaching : 6 hours per weak | **Theory Paper**

Exam Duration: 3 Hours | **Maximum Marks 100**

Note :- 1. *The syllabus of this paper is divided into four units. There shall be two parts in the question paper. Part 'A' of the question paper shall contain FIRST question which is compulsory The first question shall contain 10 subparts consisting of very short answer type questions based on the knowledge, understanding and applications of the topics covering the syllabus of all four units. Each question of subpart will carry 2 marks. Part 'B' of the question paper shall be divided into FOUR units. Each unit will contain TWO questions and each question will have two subparts. Student has to attempt one question from each unit. Each question is of 20 marks.*

2. *Scientific calculator is to be permitted for numerical calculation.*

Unit-I : Derivation of boundary layer equations for two dimensional flow, boundary layer along a flat plate (Blasius Topfer solution), Characteristic boundary layer parameters, similar solutions, Exact solution of the steady state boundary layer equations in two dimensional flow, Flow past a wedge, Flow along the wall of a convergent channel, Boundary layer separation. Flow past a symmetrically placed cylinder (Blasius series solution), Gortler new series method.. Plan free jet, Circular jet, Plane wall jet.

Unit-II : Prandtl-Mises transformation and its application of plane free jet, Axially symmetrical boundary layers on bodies at rest, Boundary layers on a body of revolution, Mangler's transformation. Three dimensional boundary layers - Boundary layer flow on yawed cylinder, Growth three dimensional boundary layer on a rotating disc impulsively set in motion. Unsteady boundary layers – method successive approximation, Boundary layer growth after impulsive start of motion.

Unit- III: Boundary layer for periodic flow (Pulsatile pressure gradient). Approximate methods for the solution of the boundary layer equations, Karman momentum integral equation, Karman- Pohlhausen method and its application, Waltz - Thwaites method. Energy integral equation, Derivation of two dimensional thermal boundary layer equation for flow over a plane wall.

Unit-IV: Forced convection in a laminar boundary layer on a flat plate, Crocco's first and second integral s, Reynold's analogy. Temperature distribution in the spread of a jet - (i) Plane free jet, (ii) Circular jet (iii) Plane wall jet. Free Convection from a heated vertical plate, Thermal energy integral equation. Approximate solution of the Pohlhausan's problem of free convection from a heated vertical plate.

अकादमिक प्रभारी
महाराजा सूरजमल बृज विश्वविद्यालय
भरतपुर (राज.)