

# **COURSES OF STUDIES**

## **P.G.DEPARTMENT OF MATHEMATICS**

M.A / M.Sc. First Semester Examination-2019 onwards

M.A / M.Sc. Second Semester Examination-2020 onwards

M.A / M.Sc. Third Semester Examination-2020 onwards

M.A / M.Sc. Fourth Semester Examination-2021 onwards



**KHALLIKOTE AUTONOMOUS COLLEGE**

**BERHAMPUR, GANJAM, ODISHA-760001**

# KHALLIKOTE AUTONOMOUS COLLEGE, BERHAMPUR

## PG DEPARTMENT OF MATHEMATICS

M.A /M.Sc. First Semester Examination-2019 onwards

M.A /M.Sc. Second Semester Examination-2020 onwards

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M.A /M.Sc. Fourth Semester Examination-2021 onwards

The P.G. Mathematics course shall comprise of **Four Semesters** each consisting of five (Theory, Practical and Dissertation) papers. Each theory paper carries 100 marks out of which 80(Eighty) marks are year marked for term-end Examination and 20 (Twenty) marks are earmarked for Internal assessment / seminar/project/home assignment etc. Alternative Questions shall be set from each unit. The duration of Examination for each theory papers shall be **Three Hours** and practical papers shall be **Three Hours**.

### COURSE STRUCTURE

<b>Paper</b>	<b>Topic</b>	<b>Full Mark</b>
<b><u>FIRST SEMESTER</u></b>		
Paper-I	Measure Theory& Integration	100 (80+20)
Paper-II	Complex Analysis	100 (80+20)
Paper-III	Operations Research	100 (80+20)
Paper-IV	Functional Analysis-I	100 (80+20)
Paper-V	Probability Theory	100 (80+20)
<b><u>SECOND SEMESTER</u></b>		
Paper-VI	Numerical Analysis	100 (80+20)
Paper-VII	Linear Algebra	100 (80+20)
Paper-VIII	Differential Geometry	100 (80+20)
Paper-IX	C- Language	100 (80+20)
Paper-X	Practical	100

### **THIRD SEMESTER**

Paper-XI	Functional Analysis-II	100 (80+20)
Paper-XII	Partial Differential Equation	100 (80+20)
Paper-XIII	Allied Elective	100 (80+20)
Paper-XIV	Special Paper-1(a)	100 (80+20)
Paper-XV	Special Paper 2 (a)	100 (80+20)

### **FOURTH SEMESTER**

Paper-XVI	Topology	100 (80+20)
Paper-XVII	Operation Research-II	100 (80+20)
Paper-XVIII	Special Paper-1(b)	100 (80+20)
Paper-XIX	Special Paper 2 (b)	100 (80+20)
Paper-XX	Dissertation, Seminar Presentation & Viva Voce	100(30+30+40)

**Special Paper-1:** A). Discrete Mathematical Structure with Applications

B). Graph Theory

**Special Paper-2:** A). Fluid Dynamics

B). An Introduction to the Theory of Numbers.

## **FIRST SEMESTER**

### **PAPER-I**

#### **MEASURE THEORY AND INTEGRATION**

##### **MEASURE THEORY AND INTEGRATION**

**MARK: 100 (80+20)**

##### **Unit-I**

**20 Marks**

Lebesgue Measure

##### **Unit-II**

**20 Marks**

Lebesgue Integral

##### **Unit-III**

**20 Marks**

Differentiation and Integration.

##### **Unit-IV**

**20 Marks**

Classical Banach Spaces

##### **Internal Assessment :-**

**20 Marks**

##### **BOOKS PRESCRIBED:**

Real Analysis By H. L Royden (Macmillan)

Chapters: 3, 4, 5 and 6

### **PAPER-II**

#### **COMPLEX ANALYSIS**

##### **COMPLEX ANALYSIS**

**MARK: 100 (80+20)**

##### **Unit-I**

**20 Marks**

Power Series, Analytic functions, Analytic functions as mapping; Mobius Transformations  
Rieman-Stieltjes integrals, Power series representation of analytic functions.

##### **Unit-II**

**20 Marks**

Zeros of an analytic function, Index of a closed curve; Cauchy's Theorem and integral formula,  
The homotopic version of Cauchy's theorem and simple connectivity Counting Zeros, the open  
Mapping Theorem, Goursat's Theorem.

##### **Unit-III**

**20 Marks**

Classification of Singularities, Residue, The Argument Principle, Maximum Principle,  
Schwarz's Lemma, Convex functions and Hadamard's three circles theorem.

**Unit-IV****20 Marks**

Basic properties of Harmonic function, Harmonic function on a disc, Entire functions.

**Internal Assessment: -****20 Marks****BOOKS PRESCRIBED:**

Function of one Complex Variable: **John B. Conway**

Chapters: 3, 4, 5 and 6 (excluding Article 4), 10(Art. 1, 2), 11

**PAPER-III**  
**OPERATIONS RESEARCH**

**OPERATIONS RESEARCH-I****MARK: 100 (80+20)****Unit-I****20 Marks**

Linear Programming Problem, Mathematical formulation of the problem, Graphical solution method. Some exceptional cases. General Linear Programming Problem. Canonical and standard form of L.P.P

**Unit-II****20 Marks**

Simplex method, Fundamental properties of solution. The computational procedure, use of Artificial Variable, Solution of simultaneous linear equations, inverting a matrix using simplex Method.

Duality in Linear Programming. General Primal- Dual pair, formulating a Dual Problem primal Dual pair in Matrix form. Duality theorem, Complementary Slackness theorem. Dual Simplex Method.

**Unit-III****20 Marks**

Integer programming, Gomory's All-I.P.P Method. Construction of Gomory's constraints, fractional cut method- All integers, fractional cut method-mixed integer, Branch and bound method.

Advanced Linear Programming Techniques, revised Simplex Method, Bounded variables.

**Unit-IV****20 Marks**

Transportation problem. General transportation problem. The transportation table. Duality in T.P, Loops in transportation table, LP formation of the T.P. Triangular basis in a T.P. solution of a T.P. finding initial basic feasible solution. Test for optimality Degeneracy in T.P. Transportation Algorithm. (Modi Method), stepping stone solution method. Unbalanced T.P time minimizations T.P.

**Internal Assessment :-****20 Marks****BOOKS PRESCRIBED:**

OPERATIONS RESEARCH: by **Kanti Swarup, P. K Gupta and Man Mohan**

Publisher-Sultan Chand & Sons

Chapters: 2, 3 (3.1-3.5), 4(4.1-4.6), 5(5.1-5.7,5.9), 7(7.1-7.6), 9(9.1-9.3), 10 (10.1-10.15)

## PAPER-IV

### FUNCTIONAL ANALYSIS

#### FUNCTIONAL ANALYSIS-I

MARK: 100 (80+20)

##### UNIT-I

20 Marks

Linear spaces and linear maps, matrices spaces and continuous function.

##### UNIT-II

Normed spaces, Inner product spaces, orthonormal sets.

##### UNIT-III

20 Marks

Continuity of linear maps, Hahn-Banach Theorem.

##### UNIT-IV

20 Marks

Banach Space, Uniform Boundedness principle.

**Internal Assessment :-**

20 Marks

#### BOOKS PRESCRIBED:

Functional Analysis by B.V.Limaye (New age International Publishers)

Chapter 1 (Art. 2, 3)

Chapter 2 (Art. 5, 6, 7, 8), Chapter 3 (Art. 9 excluding 9.4, 9.5, Chapter 6 (Art. 21, 22)

## PAPER-V

### PROBABILITY THEORY

Marks : 100 (80+20)

##### UNIT-I

20 Marks

Probability Space.

##### UNIT-II

20 Marks

Distribution, Expectation and Movement.

##### UNIT-III

20 Marks

Convergence of Random Variables.

##### UNIT-IV

20 Marks

Characteristic functions

**Internal Assessment :-**

20 Marks

#### BOOKS PRESCRIBED :

Modern Probability Theory by B.R.Bhatt

Chapter 3 (3.1 to 3.6), 4 (4.1 to 4.4), 5 (5.1-5.3) 6 (6.1 to 6.5), 7 (7.1 to 7.4).

## SECOND SEMESTER

### PAPER-VI NUMERICAL ANALYSIS

**MARK : 100 (80+20)**

#### NUMERICAL ANALYSIS

##### UNIT-I

**20 Marks**

Langrange interpolation and Newtons interpolation, Finite difference operator, Interpolating polynomial finite differences, Hermit and piece-wise splin interpolation.

##### UNIT-II

**20 Marks**

Bi-variate interpolation and approximation, Least square approximation, Uniform approximation, Rational approximation, Choice of Method

##### UNIT-III

Differentiation and Integration

**20 Marks**

##### UNIT-IV

Ordinary differential equations

**20 Marks**

**Internal Assessment :-**

**20 Marks**

#### **BOOK PRESCRIBED :**

NUMERICAL METHOD FOR SCIENTIFIC AND ENGINEERING COMPUTATION by Jain, Lyenger and Jain (Willey Estn Ltd.)

Chapter: 4 ,5, 6

### PAPER-VII LINEAR ALGEBRA

#### LINEAR ALGEBRA

**MARK: 100 (80+20)**

##### UNIT-1

Vector spaces

**20 Marks**

##### UNIT-II

LINEAR TRANSFORMATION-I

**20 Marks**

The algebra of Linear Transformations, Characteristics of Roots, Matrices.

##### UNIT-III

**20 Marks**

Canonical forms, Triangular Canonical form, Nilpotent Transforms, Canonical form, Traces transpose, Determinants.

##### UNIT-IV

LINEAR TRANSFORMATION-II

**20 Marks**

Hermitian, Unitary and Normal Transformation, Real quadratic Forms.

**Internal Assessment :-**

**20 Marks**

#### **BOOKS PRESCRIBED:**

TOPICS IN ALGEBRA by I.N. Herstein

Chapter: 4 (excluding 4.4), Chapter 6 (6.1 to 6.5, 6.8 to 6.11)

**PAPER-VIII**  
**DIFFERENTIAL GEOMETRY**

**MARK : 100 (80+20)**

**Differential Geometry :**

**UNIT-I**

**20 Marks**

Curves and Vector fields in  $\mathbb{R}^3$

Differentiable curves and its parametric representation. Tangent vectors and vector fields in  $\mathbb{R}^3$ . Directional derivatives.

and differentiable manifolds and examples ; Surface Differentiable manifolds and examples.

Differentiable manifolds on a manifold, differentiable mapping between two manifolds, immersions and imbedding.

**UNIT-II**

**20 Marks**

Forms and Covariant Differentiation.

1 Forms on  $\mathbb{R}^3$ , Differential forms and Exterior Algebra, Differential forms on a manifold and effect of mappings on them, Extension derivative of a vector field, Riemannian Metric, Affine and Riemannian connection and co-variant derivation on differentiable manifold.

**UNIT-III**

**20 Marks**

Tensors, Tensor Algebra & Tensor calculus :

Tensors, Tensors as multi-linear maps, Transformation formulas, Relative tensors & Tensor densities, Tensor product, Universal- factorisation property.

**UNIT-IV**

**20 Marks**

Theorems on Tensor products, Outer and Inner product, contraction map, Fundamental Theorem of Riemannian Geometry.

**Internal Assessment :-**

**20 Marks**

**BOOK PRESCRIBED :**

Differential Geometry- An Integrated approach- Nirmala Prakash (TMG Publishing Company Ltd.)

Ch.: 2 (2.1,2.3,2.4), 4(4.1,4.2,4.3), 5(5.1,5.2,5.3,5.4,5.5,5.7), 6(6.1,6.2,6.3,6.4,6.5,6.6,6.7)

**PAPER –IX**

**COMPUTER LANGUAGE  
(OVERVIEW OF C)**

**MARK: 100 (80+20)**

**UNIT-I**

**20 Marks**

Arrays, Character Arrays and Strings

**UNIT-II**

**20 Marks**

User defined function

**UNIT-III**

**20 Marks**



Structure and unions.

**UNIT-IV**

**20 Marks**

Pointer, dynamic memory allocation,

**Internal Assessment -**

**20 Marks**

**BOOKS PRESCRIBED:**

Programming in ANSI-C , E. Balguruswamy (3<sup>rd</sup> edition)

Tata Mac Graw Hill Pvt. Ltd., New Delhi.

Chapter : 7,8(8.1-8.5), 9,10,11.

**PAPER-X  
(PRACTICAL)**

**Marks : 100**

Practical Record -

20 Marks

Viva -

30 Marks

Experiment-

25+25 Marks

A Student has to perform experiments from the following list of experiments.

1. To find the value of the Legendre's Polynomial of degree 0,1,2,3,4,5 for x varying from -1 to 1 at the step length of 1 by computer and draw the graph.
2. Draw a programme of flow chart for solving a differential equation by 2<sup>nd</sup> order Range-Kutta Method.
3. Writing a programme to arrange an array of real number in (ascending order / descending order) by Bubble sort method.
4. Solving a nonlinear equation numerically by higher order Newton-Cotes rules.
5. Numerical evaluation of definite integrals by 2 and 3 points Gauss-Legendre rules.
6. Numerical solution of I.V.P (2<sup>nd</sup> order Ranga-Kutta Method).
7. Find the approximate solution of differential equation by Picard's Method.
8. Graphical solution of a production allocation problem.
9. Solution of LPP by Simplex Methods.
10. Solution of a Transportation problem.

**AND**

Using M. S. Window preparation of a Latex p.d.f file (Latex DVI or Latex p.s. file) Containing research articles having.

- i) A front page with title, Author's name and address, foot note, abstract of the article.
- ii) Body of the article having mathematical results such as theorems lemmas and corollaries.
- iii) References.

**BOOK PRESCRIBED :**

1. Learning latex by doing : By Andre Heck, 2005 AMSTEL institute.

2. A document preparation system Latex users Guide and Reference manual (2<sup>nd</sup> Edition) By. Leslie Lamport (Pearson Education)

**THIRD SEMESTER**  
**PAPER-XI**  
**FUNCTIONAL ANALYSIS-II**

**Marks : 100 (80+20)**

**UNIT-I** **20 Marks**

Closed graph theorem, Open mapping theorem, Bounded inverse theorem.  
(Sec. 10,11)

**UNIT-II** **20Marks**

Spectrum of a bounded operator, Dual transpose. (Sec. 12, 13)

**UNIT-III** **20 Marks**

Weak and Weak\* convergence, reflexivity. (Sec.15,16)

**UNIT-IV** **20 Marks**

Compact linear map, spectrum of compact operator (Sec. 17,18)

**Internal Assessment –** **20 Marks**

**BOOKS PRESCRIBED:**

Functional Analysis by B.V.Limaye (New age International Publishers)

**PAPER-XII**  
**PARTIAL DIFFERENTIAL EQUATIONS**

**Marks : 100(80+20)**

**UNIT-1** **20 Marks**

Concepts and definitions, Linear operators, Mathematical problems, Super positions, Second order equation in two independent variables, Canonical forms, Equation with constant coefficients, General solution

**UNIT-II** **20 Marks**

Couchy problem, Couchy- Kowalewsky theorem and Hardamard example, Homogeneous wave equation, IBV problem, Non-Homogeneous wave equations, Sturm-Liouville system, Eigen functions, Bassels function, Singular sturm-Liouville system, Leagendre functions, Boundary value problem for ordinary differential equation, Green's and generalized Greens functions, Eigen value problem and Greens function.

**UNIT-III****20 Marks**

Boundary value problem, maximum and minimum principle, Uniqueness and stability theorem, Dirichlet problem for a circle and circular annulus, Neumann problem for a circle.

**UNIT-IV****20 Marks**

Fourier transforms and properties, convolution theorem for Fourier transform, step function and Impulse function for fourier transform, Semi infinite region, Hankel & Mellon & Laplas Transforms, Properties, Convolution, Step function and Impuls function of Laplas Tranform, Greens function.

**Internal Assessment –****20 Marks****BOOKS PRESCRIBED :**

Partial Differential Equations of Mathematical Physics by Tyn Myint (Elsevie Pub.).  
Chapters : 1, 3, 4(4.6 excluded),7, 8(8.1-8.6) and 11.

**PAPER-XIII****Marks : 100(80+20)****UNIT-I****20 Marks**

Langrange interpolation and Newtons interpolation, Finite difference operator, Interpolating polynomial finite differences, Hermit and piece-wise splin interpolation.

**UNIT-II****20 Marks**

Linear Programming Problem, Mathematical formulation of the problem, Graphical solution method. Some exceptional cases. General Linear Programming Problem. Canonical and standard form of L.P.P.

**UNIT-III****20 Marks**

Measures of Dispersions, Skewness & Kurtosis, Moments of frequency distribution.

**UNIT-IV****20 Marks**

Laplace Transformation.

**Internal Assessment –****20 Marks****BOOK PRESCRIBED :**

NUMERICAL METHOD FOR SCIENTIFIC AND ENGINEERING COMPUTATION by

**Jain, Lyenger and Jain** (Willey Estn Ltd.) , Ch: 4.

OPERATIONS RESEARCH: by **Kanti Swarup, P. K Gupta and Man Mohan**, Publisher- Sultan Chand & Sons. Ch: 2, 3 (3.1-3.5)

MATHEMATICAL STATISTICS by **J. N Kapur & H. C Saxena**, S. Chand Publication.  
Ch. 3.

A COURSE ON ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS(APPLICATIONS),  
**J. Sinha & S Padhi**, Kalyani Publisher. Ch. 9(Art 9.1- 9.13)

**OR****Marks : 100(80+20)****UNIT-I****20 Marks**

Introduction, Paths and circuits.

**UNIT-II****20 Marks**

Discrete Probability Distribution

**UNIT-III****20 Marks**

Lattices as partially ordered Set, Definition and examples, Some properties of Lattices. Lattices as Algebraic systems. Sub-lattices, Direct product and Homomorphism, Some special Lattices, Boolean Algebra, Definition and Examples, Sub-algebra, Direct Product, Homomorphism.

**UNIT-IV****20 Marks**

Fourier series and Fourier Transform.

**Internal Assessment –****20 Marks**

Graph Theory with Application to Engineering and Computer Science, **N.Deo** (Prentice Hall)  
Chapters : 1,2.

MATHEMATICAL STATISTICS by **J. N Kapur & H. C Saxena**, S. Chand Publication.

Ch. 5(5.1.1 to 5.5.2).

Discrete Mathematical Structures with Applications to Computer Science By **J.P.Tremblay, R.Manohar** (McGraw Hill Book Company). Ch.4 (4-1.1 to 4-1.5, 4-2.1 , 4-2.2)

A COURSE ON ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS(APPLICATIONS),  
**J. Sinha & S Padhi**, Kalyani Publisher. Ch. 14

**PAPER-XIV****SPECIAL PAPER-1(a)****GROUP – A**

(Any one of the following is to be chosen)

**1.(a) Discrete Mathematical Structure with Applications****Marks :100(80+20)****UNIT-I****Marks- 20**

Statements and Notation, Connectives, Logical Capabilities of Programming Languages. Conditional and Bi-conditional Well formed Formulas, Tautology, Equivalence of Formula, Duality law, Tautological implications, Formula with distinct Truth Tables, Functionally complete sets of connectives, other connectives. Two state devises and statement logic.

**UNIT-II****Marks- 20**

Disjunctive normal form, conjunctive normal forms. Principal conjunctive normal form, Ordering and uniqueness of Normal form, Complete Parenthesized Infix Notations and Polish Notations.

**UNIT-III****Marks- 20**

Theory of Inference for statement Calculus, Validity using Truth Tables, Rules of Inference, Constituency of Premises and Indirect method of Proof, Automatic Theorem Proving, Predicate formula, Free and bounded variables, The Universe of Discourse.

**UNIT-IV****Marks- 20**

Inference Theory of predicate calculus, Valid formulas and Equivalences. Special Valid formulas involving quantifiers. Theory of Inference for predicate Calculus, Formula involving More than one quantifiers Relations, Properties of Binary Relations in a set, Relation Matrix, and the Graph of a Relation, partition and covering of a set, Equivalence Relation, Compatibility Relations, Composition of Binary Relations.

**Internal Assessment –**

**20 Marks**

**BOOK PRESCRIBED :**

Discrete Mathematical Structures with Applications to Computer Science By J.P.Tremblay, R.Manohar (McGraw Hill Book Company).

Ch. 1(Art. 1-1 to 1-2.15, 1-3.1 to 1-3.6, 1-4.1 to 1-5.5, 1-6.1 to 1-6.5), Ch.2 (2-3.1 to 2-3.7)

**OR**

**1(a). GRAPH THEORY**

**Full Marks 100(80+20)**

**UNIT-I**

**Marks-20**

Introduction, Paths and circuits.

**UNIT-II**

**Marks-20**

Tree and Fundamental Circuits.

**UNIT-III**

**Marks-20**

Cut sets, Cut vertices.

**UNIT-IV**

**20 Marks**

Plannar and dual graphs.

**Internal Assessment –**

**20 Marks**

**BOOKS PRESCRIBED :**

Graph Theory with Application to Engineering and Computer Science, N.Deo (Prentice Hall)  
Chapters : 1,2,3,4,5.

**PAPER-XV  
SPECIAL PAPER-2(a)  
GROUP – B**

(Any one of the following is to be chosen)

**2(a). FLUID DYNAMICS**

**Full Marks 100(80+20)**

**UNIT-I**

**Marks: 20**

Basic concepts, Fundamental equations of the flow of viscous fluids.

**UNIT-II**

**Marks: 20**

Dynamical similarity Inspection Analysis and Dimensional Analysis, Physical importance of non-dimensional parameters, important non-dimensional coefficient in the dynamics of viscous fluids, Exact Solutions of the Navier-Stokes' equations (Steady incompressible flow with constant fluid properties)

**UNIT-III**

**Marks: 20**

Exact solutions of Navier –stokes' equations [Steady incompressible flow with constant fluid properties, flow between parallel plates(Velocity and temperature distribution ) , flow in a circular pipe, flow in tubes of uniform cross- section, flow between two concentric rotating cylinders(Couette flow), Flow in convergent and divergent channels, stagnation point flows, flow due to rotating disc.]

**UNIT-IV****Marks: 20**

Exact solutions of Navier –stokes' equations [Variable viscosity plane Couette flow, Variable viscosity plane Poiseuille flow, flow due to a plane wall suddenly set in motion, flow due to an oscillating plane wall, starting flow in a plane Couette motion, starting flow in a pipe, plane Couette flow of a viscous compressible fluid, plane Couette flow with transpiration cooling.

**Internal Assessment –****Marks: 20****BOOK PRESCRIBED :****Viscous Fluid Dynamics By J. L. Bansal (OXFORD & IBH PUBLISHING CO. PVT. LTD)****Ch :1,2,3 (except 3.5,3.6,3.7) 4,****OR****2(a). IN INTRODUCTION TO THE THEORY NUMBER Full Marks: 100(80+20)****UNIT-I****Marks: 20**

Congruences, Solutions of Congruences, Congruences of Degree I, The function  $\Phi(n)$ , Congruences of Higher degree, Prime power moduli, Prime modulus, Congruences of Degree two, Prime Modulus, Power residues,

**UNIT-II****Marks: 20**

Number theory from Algebraic viewpoint, Multiplicative Groups, Rings, and fields. Quadratic Residues, Quadratic Reciprocity, The Jacobi Symbol.

**UNIT-III****Marks: 20**

Greatest Integer Function, Arithmetic Functions, The Moebius inversion Formula, The multiplication of Arithmetic Functions, Recurrence Functions.

**UNIT-IV****Marks: 20**

Diophantine Equations, The Equation  $ax + by = c$ , Positive solutions, Other Linear Equations, The equations  $x^2 + y^2 = z^2$ , The equations  $x^4 + y^4 = z^2$ , Sums of Four and Five Squares, Waring's Problem, Sum of Fourth Powers, Sums of two squares, The Equation  $4x^2 + y^2 = n$ , The Equation  $ax^2 + by^2 + cz^2 = 0$ , Binary Quadratic Forms, Equivalence of Quadratic Forms.

**Internal Assessment****Marks: 20****AN INTRODUCTION TO THE THEORY OF NUMBERS by Ivan Niven, Herbert S Zuckerman****Chapter 2, 3, 4, 5.**

## **FOURTH SEMESTER**

### **PAPER-XVI**

### **TOPOLOGY**

**Marks : 100 (80+20)**

#### **TOPOLOGY**

##### **UNIT-I**

Topological Spaces and Continuous functions **20 Marks**

Topological Spaces, Basics for a topology, the order topology, Product topology on  $X \times Y$ . Subspace topology, Closed sets and limit points, Continuous functions, The product topology.

**UNIT-II** **20 Marks**

Connected Spaces, Connected sets in Real lines, Components & Path components, Compact Spaces, Compact sets in Real line, limit point compactness.

**UNIT-III** **20 Marks**

The Countability axioms, Separation axioms, Normal spaces, The Urysohn's Lemma.

**UNIT-IV** **20 Marks**

The Tychonoff Theorem, Complete metric spaces, compactness in metric spaces.

**Internal Assessment –** **20 Marks**

#### **BOOK PRESCRIBED :**

Topology (Second Edition) by James R. Munkers, Prentice Hall of India, New Delhi.

Chapters : 2(12 to 19), 3(23,24,26 to 28),4(30 to 33),5(37), 7(43,45).

### **PAPER-XVII**

### **OPERATIONS RESEARCH**

#### **OPERATIONS RESEARCH- II**

**Marks: 100(80+20)**

**UNIT-I** **20 Marks**

Assignment problem, Mathematical formulation of the problem, The assignment method, Special cases in assignment problems, A Typical assignment problem, The travelling salesman problem.

**UNIT-II** **20 Marks**

Dynamic Programming, Introduction. The recursive equation approach, characteristics of dynamic programming, Dynamic programming algorithm, solution of Discrete D.P.P some Application, solution LPP dynamic programming.

**UNIT-III** **20 Marks**

Games and strategies, Introduction, Two person zero-sum games, some basic terms. The maximin-minimax principle, Games without saddle points-mixed strategies, Graphic solution of  $2 \times n$  and  $m \times 2$  games, dominance property arithmetic method of  $n \times n$  games, general solution of  $m \times n$  rectangular games.

**UNIT-IV****20 Marks**

Non-Linear Programming, Introduction, Formulating a non linear programming problem (NLPP), General NLPP, constrained optimization with inequality constraints, saddle point problem, saddle points and NLPP.

Non-Linear programming methods, Introduction, Graphical solution, Kuhn-Tucker condition with Non-Negative constraints, Quadratic programming, Wolfe's Method simplex Method, Beale's Method.

**Internal Assessment –****20 Marks**

OPERATIONS RESEARCH: by **Kranti Swarup, P. K Gupta and Man Mohan**

Publisher-Sultan Chand & Sons

Chapters: 11, 13, 17(17.1-17.9), 24, 25 (25.1-25.6)

**PAPER-XVIII**  
**SPECIAL PAPER-1(b)**

**Marks : 50(40+10)****1.(b) Discrete Mathematical Structure with Applications****Marks :100(80+20)****UNIT-I****Marks- 20**

Grammars and Language Discussion on Grammar, Formulae and definition of a language, Notations of Syntax Analysis, Partial ordering, Partial ordered set: Representation and associated Terminology, Recursive Functions, Sets and Predicates.

**UNIT-II****Marks- 20**

Lattices as partially ordered Set, Definition and examples, Some properties of Lattices. Lattices as Algebraic systems. Sub-lattices, Direct product and Homomorphism, Some special Lattices, Boolean Algebra, Definition and Examples, Sub-algebra, Direct Product, Homomorphism.

**UNIT-III****Marks- 20**

Boolean Functions, Boolean Forms, Free Boolean Algebra, Value of Boolean Expression and Boolean functions, Representation and minimization of Boolean Functions, Finite state Machines, introductory Sequential circuits, Equivalence of finite state Machines.

**UNIT-IV****Marks- 20**

Basic concept of Graph Theory, Basic Definition, Paths, Reachability and Connectedness, Matrix Representation of Graphs, Trees.

**Internal Assessment -****Marks-20****BOOK PRESCRIBED :**

Discrete Mathematical Structures with Applications to Computer Science By J.P.Tremblay, R.Manohar (McGraw Hill Book Company).

Ch.2 (2-3.8, 2- 3.9, 2-6.1 to 2-6.2) Ch. 3(3-3.1 to 3-3.3) Ch.4 (4-1.1 to 4-1.5, 4-2.1 , 4-2.2, 4-3.1 , 4-3.2 ,4-4.1,4-4.2,4-6.1,4-6.2) Ch.5 (5-1.1 to 5-1.4)

**OR****1(b). GRAPH THEORY****Full Marks 100(80+20)**



<b>UNIT-I</b> Vector spaces of graphs	<b>20 Marks</b>
<b>UNIT-II</b> Matrix representation of graphs.	<b>20 Marks</b>
<b>UNIT- III</b> Covering colouring and Partitioning of graphs.	<b>20 Marks</b>
<b>UNIT- IV</b> Directed graphs.	<b>20 Marks</b>
<b>Internal Assessment</b>	<b>20 Marks</b>

**BOOKS PRESCRIBED :**

Graph Theory with Application to Engineering and Computer Science, N.Deo (Prentice Hall)  
Chapters : 6,7,8,9(excluding 9.10,9.11).

**PAPER-XIX  
SPECIAL PAPER-2(b)**

**2(b). FLUID DYNAMICS** **Full Marks 100(80+20)**

**UNIT-I** **Marks: 20**  
Theory very slow motion, stokes equations, stokes' flow, Oseen equations, flow past a sphere, Lubrication theory.

**UNIT-II** **Marks: 20**  
Theory of Laminar Boundary layers, Two-dimensional boundary layer equations for flow over a plane wall. The boundary layer on a flat plate, similar solutions of the boundary layer equation, boundary layer flow past a wedge, boundary layer flow along the wall of convergent channel, Two-dimensional boundary layer equations for flow over a curved surface.

**UNIT-III** **Marks: 20**  
Theory of Laminar Boundary layers(except 6.1-6.7)

**UNIT-IV** **Marks: 20**  
Thermal Boundary Layers in Two-dimensional flow

**Internal Assessment** **Marks: 20**

**BOOK PRESCRIBED :**

**Viscous Fluid Dynamics By J. L. Bansal (OXFORD & IBH PUBLISHING CO. PVT. LTD)**  
**Ch : 5, 6, 8**

**'OR'**

**2(b). IN INTRODUCTION TO THE THEORY NUMBER** **Full Marks: 100(80+20)**

**UNIT-I****Marks: 20**

The Euclidean Algorithm, Uniqueness, Infinite Continued Fractions, Irrational Numbers, Approximations to Irrational Numbers, Best Possible Approximations, Periodic Continued Fractions, Pell's Equation, Numerical Computation.

**UNIT-II****Marks: 20**

The Function  $\pi(x)$ , The Sequence of Primes, Bertrand's Postulate. Polynomials, Algebraic Numbers, algebraic Number fields, Algebraic Integers, Quadratic fields, Units in Quadratic fields, Primes in Quadratic fields, unique factorization, Primes in Quadratic fields Having the Unique Factorization Property, The Equation  $x^2 + y^2 = z^2$ .

**UNIT-III****Marks: 20**

Partitions, Graphs, Formal Power Series and Euler's Identity, Euler's Formula, Jacobi's Formula, A Divisibility Property

**UNIT-III****Marks: 20**

Asymptotic Density, Square-Free Integers, Sets of Density Zero, Schnirelmann Density and the  $\alpha\beta$  Theorem.

**Internal Assessment****Marks: 20****BOOKS PRESCRIBED :**

AN INTRODUCTION TO THE THEORY OF NUMBERS by **Ivan Niven, Herbert S Zuckerman**  
Chapter 7, 8, 9, 10, 11.

**PAPER-XX****DISSERTATION, SEMINAR PRESENTATION & VIVA VOCE****MARK: 100**

<b>Thesis</b>	<b>30 Marks</b>
<b>Seminar</b>	<b>30 Marks</b>
<b>Viva Voce</b>	<b>40 Marks</b>

Topic selected as per the direction of Guide