UNIVERSITY DEPARTMENT OF MATHEMATICS
RADHA GOVIND UNIVERSITY RAMGARH

Revised Syllabus

for

M.Sc. Mathematics

under

Choice Based Credit System

2018

Scheme for Choice Based Credit System in
M.Sc. Mathematics

06/04/2021

06/4/21

SEMESTER COMPULSORY FOUNDATION COURSE

(Credits: Theory-04, Tutorial-01)

MAT-F-101 MODERN ALGEBRA

Theory: 60 Hours;
Tutorial:15 Hours

Marks: 30(MSE: 2001 Hr. + 5 Attd. +5 Assignment)+70/ESE:3Hrs)=100Pass Marks (MSE:17+ESE:28)=45

Time-3 Hrs ***Instruction to faculty members and Question Seter for: Mid Semester Examination*** *(MSE): There will be Two groups of questions in written examination of 20 marks.* ***Group A is compulsory and*** *will contain* ***five questions of multiple type questions*** *consisting of 1 mark each* ***Group B will contain descriptive type five*** *questions of five marks each, out of which any three are to be answered. The Mid Semester Examination shall have three components. (a) Two Semester Internal Assessment Test (SIA) of 20 Marks each. (b) Class Attendance Score of 5 marks and (c) Day to Day & Extracurricular activities of 5 marks.* ***"Best of Two"*** *shall be applicable for computation of marks for SIA. (Attendance Upto 75%, 1 mark; 75<Attd <80, 2 marks; 80<Attd <85, 3 marks; 85<Attd <90, 4 marks; 90<Attd, 5 marks).* ***End Semester Examination*** *(ESE): There will be two groups of questions. Group A is compulsory and will contain two questions. Question No. 1(A) will be multiple type questions consisting of six questions of 1 mark each . Question no. 1(B) will be two short answer type of 4 marks. Group B will contain descriptive type eight questions of fourteen marks each, out of which any four are to be answered.*

SYLLABUS:

UNITI Group, Normal and Subnormal series, Isomorphism theorems, Jordan-Holder Theorem, Solvable groups, Nilpotent groups.

Group action, orbit-stabilizer theorem, orbit decomposition, Sylow's theorems(proofs using group actions)

(2 QUESTIONS)

UNIT II

Cononical Forms: Similarity of linear transformations, Invariant subspaces, Eigen values and Eigen vectors, Reduction to diagonal and triangular forms, Nipotent transformations index of nilpotency. Invariants of nilpotent transformation. The primary decomposition theorem.

(2 QUESTIONS)

CORE COURSE

(Credits : Theory-04, Tutorial-01) MAT-C-102 **REAL ANALYSIS**

Theory: 60 Hours;
Tutorial:15 Hours Marks: 30(MSE: 20" Hr. + 5 **Attd. +5 Assignment)+70(ESE:3Hrs)=100 Pass Marks (MSE:17+ESE:28)=45**

TIME-3 Hrs. ***Instruction to faculty members and Question Seter for : MI Semester Examination (MSE):*** *There will be Two groups of questions in written examination of 20 marks. Group A is compulsory and will contain five questions of multiple* ***type questions consisting of 1 inark each Group B will contain descriptive type five*** *questions of five marks each, out of which any three are to be answered. The Mid Semester Examination shall have three components (a) Two Semester Internal Assessment Test (SIA) of 20 Morks each, (b) Class Attendance Score of 5 marks and (c) Day to Day & Extracurricular activities of 5 marks. "Best of Two" shall be applicable for coinputation of marks for SIA (Altendance Upto 75%, 1 mark; 75<Attd. <80, 2 marks; 80<Attd.<85, 3 marks; 85<Attd.<90, 4 marks,90<Attd, 5 marks).* ***End Semester Examination*** *(ESE): There will be two groups of questions. Group A Is cornpulsory and will contain two questions. Question No. 1(A) will be multiple type quistions consisting of six questions of 1 mark each . Question no. 1(B) will be two shurt answer type of 4 marks. Group B will contain descriptive type eight questions of fourteen marks each, out of which any four are to be answered.*

SYLLABUS:

UNIT 1 Delinition and existence of Reiemann-Stieltjes integral, Properties of the Integral, Integration and differentiation, the fundamental theorem of Calculus (Fourier series, Bessels inequality, Perseval theorem, Fourier series representation of functions

(2 QUESTIONS)

UNIT II Sequences and series of functions, pointwise and uniforin convergence, Cauchy crilerion for uniform convergence, Weierstrass M-test, Abel's and Dirichlet's test for uniform convergence and continuity, uniform convergence.

(2 QUESTIONS)

UNIT III Riemann-Stieltjes integration, uniform convergence and differentiation, Weicrstarss approximation theorem, Power Series, uniqueness theorem for power series, Abel's and Tauber's theorem.

(2 QUESTION)

UNIT IV Functions of several variables, linear transformation. Derivatives in an open subset of R^n Chain rule, Partial derivatives, interchange of the order of differentiation, Derivatives of higher orders, Young theorem, Schwartz theorem, Taylor's theorem, Inverse function theorem, Implicit function theorem, Jacobians

References:

1. Walter Rudin, Principles of Mathematical Analysis (3rd edition) Mc. Graw-Hill. Kogakushu, 1976, Internations student edition. 2. T.M. Apostal, Mathematical Analysis, Narosa publishing House, New Delhi, 1985, 3. Shanti Narain, Real Analysis, S. Chand & Co. New Delhi. 4. Malik and Arora : Mathematical Analysis.

CORE COURSE **(Credits: Theory-04, Tutorial-01)**

MAT-C-103

TOPOLOGY

Theory: 60 Hours;
Tutorial:15 Hours

Marks: 30(MSE: 201 Hr. + 5 Attd. +5 Assignment)+70(ESE:3Hrs)=100Pass Marks (MSE:17+ESE:28)=45

TIME 3 Hrs.

Instruction to faculty members and Question Seter for: Mid Semester Examination (MSE): *There will be Two groups of questions in written examination of 20 marks. **Group A is compulsory** and will contain five questions of **multiple type questions** consisting of 1 mark each **Group B will contain descriptive type five questions** of five marks each, out of which any three **are to be answered**. The Mid Semester Examination shall have three components. (a) Two Semester Internal Assessment Test (SIA) of 20 Marks each, (b) Class Attendance Score of 5 marks and (c) Day to Day & Extracurricular activities of 5 marks. **"Best of Two"** shall be applicable for computation of marks for SIA. (Attendance Upto 75%, 1 mark; 75<Attd <80, 2 marks; 80<Attd <85, 3 marks; 85<Attd <90, 4 marks; 90<Attd, 5 marks). **End Semester Examination** (ESE) : There will be two groups of questions. Group A is compulsory and will contain two questions. Question No. 1 (A) will be multiple type questions consisting of six questions of 1 mark each. Question no. 1(B) will be two short answer type of 4 marks. Group B will contain descriptive type eight questions of fourteen marks each, out of which any four are to be answered.*

SYLLABUS:

UNIT I

Countable and uncountable sets. Infinite sets and the Axiom of Choice (statement onl.) Cardinal numbers Schroeder-Bernstein theorem. Cantor's theorem and continuum hypothesis . Zorn's lemma (statement only).

(2 QUESTIONS)

UNIT II

Definition and examples of topological spaces, closed sets, Closure. **Dense subscts.** Neighbourhoods, Interior, exterior and boundary. Accomulation points **and derived sets. Bases and sub-base. Subspaces and** relative topologies.

(2 QUESTIONS)

UNIT III

First and Second countable spaces. Lindelof's theorem, separable spaces, second countability and separability, separation axioms To, T1, T2, T3, T4: their Characterizations and basic properties. Urysohn's Lemma. Tietze extension **theorem.**

(2 QUESTIONS)

UNIT IV

Compactness, continuous functions and compact sets, Basic property of compactness. Compactness and finite intersection property Tychonoff's Theorem, connected and disconnected spaces and their basic properties, Connectedness and product spaces.

(2 QUESTIONS)

References :

- K.D. Joshi, Introduction to General Toplogy Wiley Eastern Ltd. 1983
- J.L. Kelley, General Topology, Van Nostrand. Reinhold Co, New York 1995.
- W.J. Pervin. Foundation of General Topology. Academic Prress Inc. New HYork , 1964.
- K.K. Jha, Advanced General Topology ,Nav Bharat Prakashan, Delhi . G.P. Simmons, Introduction to Topology and Modern Analysis, Mc Graw Hill

Int. book company.

- J.R Munkres, Topology A first course, Prentice hall India Pvt Ltd.
- S.Lipschutz, General Topology, Schaum's out line series.

MOV

CORE COURSE (Credits: Theory-04, Tutorial-01)

MAT-C-104

COMPLEX ANALYSIS

Marks: 301 MSE: 2001 Hr. + 5 Attd. + 5 Assignment)+70(ESE:3 Hrs)=100Pass Marks (MSE:17+ESE:28)=45

TIME- 3 Hrs.

Instruction to faculty members and Question Seter for : Mid Semester Examination (MSE):

*There will be Two groups of questions in written examination of 20 marks. **Group A is compulsory** and will contain five questions of multiple **type questions** consisting of 1 mark each **Group B will contain descriptive type five** questions of five marks each, out of which any three are to be answered. The Mid Semester Examination shall have three components. (a) Two Semester Internal Assessment Test (SIA) of 20 Marks each, (b) Class Attendance Score of 5 marks and (c) Day to Day & Extracurricular activities of 5 marks "Best of Two" shall be applicable for computation of marks for SIA. (Attendance Upto 75%, 1 mark; 75<Attd <80, 2 marks; 80<Attd.<85, 3 marks, 85<Attd <90, 4 marks, 90<Attd, 5 marks). **End Semester Examination (ESE)**: There will be two groups of questions. Group A is compulsory and will contain two questions. Question No. 1(A) will be multiple type questions consisting of six questions of 1 mark each . Question no 1(B) will be two short answer type of 4 marks. Group B will contain descriptive type eight questions of fourteen marks each, out of which any four are to be answered.*

SYLLABUS:

UNIT 1

Complex integration, Cauchy-Goursat Theorem, Cauchy's Integral formula, Higher order derivatives, Morera's theorem, Cauchy's inequality and Liouville's theorem.

(2 QUESTIONS)

UNIT II

The fundamental theorem of algebra, Taylor's theorem, Maximum modulus principle, Schwarz lemma , Laurent's series.

(2 QUESTIONS)

UNIT III

Isolated singularities, Meromorphic functions. The argument principle Rouche's theorem Poles and Zeros. Fundamental theorem. Residues. Cauchy's residue theorem. Evaluation of integrals.

(2 QUESTIONS)

UNIT IV

Bilinear transformations, their properties and classification. Definition and examples of conformal mapping.

Analytic continuation. Uniqueness of direct analytic continuation Uniqueness of analytic continuation along a curve. Power series method of analytic continuation.

(2 QUESTIONS)

References :

- L.V. Ahlfors, complex Analysis . MC-Graw Hill, 1979
- S.Lang. Complex Analysis Addison Wesely, 1977.
- Walter Rudin, Real and complex Analysis, Mc Graw Hill Book Co. 1966
- E.C. Titchmarsh, the Theory of Functions, Oxford University Press, London. S. Ponnusamy, Foundation of complex Analysis, Narosa Publishing House 1997.
- E.T. Copson, Complex variable.
- Shanti Narayan, complex variables.
- Chrchill and Brown, Complex variables and applications, McGraw-Hill Pub Company Murray R.Spiegel, complex variable, Schaum's out line special Indian edition TMH Education New Delhi

SEMESTER-2
Paper V
SKILL DEVELOPEMENT

BASIC COMPUTER AND PROGRAMMING IN C

THEORY AND PRACTICAL
(THEORY-40 AND PRACTICAL-30)

Theory paper

Time : 3 Hrs. Full Marks :40

In all ***nine*** questions of equal value (each of ***seven*** marks) will be set out of which candidates are required to answer 5 questions.

UNIT I
Introduction to Computers : Block Diagram of Computer, Functioning of Computer, Generations of Computer, Classification of Computers, Characteristics, Advantages & Limitations of Computer. Computer Memory: Primary & Secondary, Types of Primary Memory.

(2 QUESTIONS)

UNIT II
Number System: Decimal, Binary, Octal, Hexadecimal number systems, features and conversions, binary arithmetic, ASCII & EBCDIC codes.
Algorithm and Flow chart : *Algorithm for problem solving: An Introduction, Properties of an algorithm, Classification,Algorithm* logic, Flowchart.

(2 QUESTIONS)

UNIT III
C programming: An overview of programming, Programming language classification, history of C, inpotance of C, basic structure of C programme, excuting a C programme, compiling and linking.
Scalar data types-Declarations, Different types of integers, Different kinds of integer constants, Floating point types, Initialization, Mixing types Enumeration types, The void data type, Typedefs, Find the address of an object, Pointers. **(2 QUESTIONS)**

UNIT IV
Operators and expressions-introduction,arithmatic operators, relational operators, logical operators, assignment operators, increment and decrement operator, Bitwise operators, Arithmetic expressions, evaluation of expression, precedence of arithmetic operators.
Control flow -conditional branching, The switch statement, looping, nested loops, The "break" and "continue" statements, the go to statement, Infinite loops. Arrays and Pointers, Declaring an array, Arrays and memory, initializing array, Multidimensional arrays.
(3 QUESTIONS)

- Programming in ANSI C, E Balaguruswamy, Second Edition, Tata-McGraw Hill Publications.
- Pundir & Pundir : Fundamental of Computer Sciences
- Bipin C. Desai : Introduction to Database Management System.
- Balaswamy. Programming in C. TMH.
- V.Rajaraman, programming in C.
- Y. Kanitkar,programming in C
- S.Dey , programming in C.

PRACTICAL
Full Marks- 30

Term work/ Practical: Each candidate will submit a practical note book in which at least 08 practical assignments based on the above syllabus along with the flow chart and program will be submitted .

List of Practicals:
1. Program of bisection method
2. Program of false position method method.
3. Program of Newton's Raphson method.
4. Simpson's 1/3 rule.
5. Gauss elimination method.

6. gauss seidal method.
7. numerical differentiation.
8. Lagranges interpolation formula.
9. newton's interpolation formula
10. eulers method for first order ordinary differential equation.
11. Runga-Kutta method for first oerder ordinary differential equation.
12. Runga method for first oerder ordinary differential equation.

REFERENCES:

1. Computer Programming in C – V. Rajaraman, Prentice-Hall of India Pvt. Ltd.,2005.
2. Computer Applications of Mathematics and Statistics – A. K. Chattapadhyay and T.Chattapadhyay, Asian Books Pvt. Ltd., New Delhi, 2005.
3. The C Programming Language – B. W. Kernighan and D. M. Ritchie, Prentice Hall, India, 1995.
4. Primes and Programming – An Introduction to Number Theory with Programming – P. Goblin, Cambridge University Press, 1993.

Paper-VI DIFFERENTIAL EQUATIONS AND SPECIAL FUNCTIONS

Time : 3 Hrs. Full Marks :70

In all ***nine*** questions will be set out of which candidates are required to answer 5 questions. Q.No. 1 is compulsory consist of ***seven*** very short answer type questions each of **2 marks** covering entire syllabus.

SYLLABUS :

UNIT I

Introduction of generalized Hypergeometric function. Differential equation satisfied by pFq. Saclschut 'z' Theorem, whipples theorem Dixon's theorem. Integrals involving generalized Hypergeometric function. Contiguous function relations. Kummer's Theorem. Ramanujans theorem.

(2 QUESTIONS)

UNIT II

Introduction of Hermite Polynomials. Recurrence relation. Orthogonal properties, expansion of polynomials generating funtion. Rodrigues formula for Hermite polynomials.

(2 QUESTIONS)

UNIT III

Introduction of Laguerre polymials. Recurrence relations, generating relating. Rodrigues formula and orthogonality. Expamry special results. Laguerre's associated differential equation. More generating function.

(2 QUESTIONS)

UNIT IV

Introduction of Jacobi Polynomials generating function. Rodrigues formula and orthogonality. Introduction of Ellipite function. Properties. Weierstrass ellipite. Jacobion theta function zeros of theta function.

(2 QUESTIONS)

References :

• W. T. Reid. Ordinary Differential Equations. John Wiley & Sons. NY. (1971).
• E.A. Coddington and N.Levinson. Theory of Ordinary Differential Equations. Mc Graw-Hill, NY (1955). •
Sneddon, I. N. (1961) Special Function of Mathematical Physics and Chemistry :Oliver and Boyd. Edinburgh. •
Morse. P.M. and H. Fash bach (1953) Methods of theoretical Physics. Part-I, Mc-Graw Hill, Book, Conv. Lue. •
Labedev, N.N. (1965) Special function and their applications : Printice-Hall, Englewodd cliff. N.J.
• Bailey, W.N. (1963) Generalised Hyper geometric Cambridge Tracks in Mathematics and Mathematical Physics. Cambridge University, Press London.
• Bell. W.W. (1966) Special function for Scientific and Engineers; D. Van Nontrand Conv. Ltd. London.
• Rainville, E.D. (1960) Special Functions, Macmillan, New York.
• Pipes (1958) Applied Mathematics for Engineers, Physicists, Mc Graw Hill Book Company.
• Ince,E.L. , Ordinary diffential equations.

Paper-VII : DIFFERENTIAL GEOMETRY AND TENSOR CALCULUS

Time : 3 Hrs. Full Marks :70

In all ***nine*** questions will be set out of which candidates are required to answer 5 questions.Q.No. 1 is compulsory consist of ***seven*** very short answer type questions each of **2 marks** covering entire syllabus.

SYLLABUS :

UNIT I

Space curves-curvature and torsion. Serret-Frenet formula. Circular helix, the circle of curvature. Osculating sphere, Bertrand curves.

(2 QUESTIONS)

UNIT II

Curves on a surface-parametric curves. fundamental magnitude, curvature of normal section. Principal directions and principal curvatures, lines of curvature, Rodrigue's formula. Dupin's theorem, theorem of Euler, Conjugate directions and Asymptotic lines. **(2 QUESTIONS)**

UNIT III

One parameter family of surfaces – Envelope the edge of regression, Developables associated with space curves. Geodesics-differential equation of Geodesic. Torsion of a Geodesic.

(2 QUESTIONS)

UNIT IV

Tensors, Tensor Algebra, Quotient theorem. Metric Tensor, Angle between two vectors.

(2 QUESTIONS)

References :

- J. N. Sharma and A.R. Vasistha, Differential Geometry.
- C.E. Weatherburn. Differential geometry of three dimensions.
- P.P. Gupta & G.S.Malik. Three dimensional differential geometry.
- C.E. Weatherburn. Tensor calculus.
- R.S. Mishra, Tensor Calculus and Riemanian Geometry.

Paper-VIII : ANALYTICAL DYNAMICS AND GRAVITATION

Time : 3 Hrs. Full Marks :70

In all ***nine*** questions will be set out of which candidates are required to answer 5 questions. Q.No. 1 is compulsory consist of ***seven*** very short answer type questions each of **2 marks** covering entire syllabus.

SYLLABUS :

UNIT I

Generalized coordinates Holonomic and Non-holonomic systems. Scleronomic and Rheonomic systems. Generalized potential. Lagrange's equations of first kind. Lagrange's equations of second kind. Energy equation of conservative fields.

(2 QUESTIONS)

UNIT II

Hamilton's variables, Hamilton canonical equations. Cyclic coordinates Routh's equations, Jacobi-Poisson Theorem. Fundamental lemma of calculus of variations.

Motivating problems of calculus of variations. Shortest distance. Minimum surface of revolution. Brachstochrone problem, Geodesic.

(2 QUESTIONS)

UNIT III

Hamilton's Principle, Principle of least action. Jacobi's equations. Hamilton-Jacobi equations. Jacobi theorem. Lagrange brackets and Poisson brackets. Invariance of Langrange brackets and Poisson brackets under canonical transformations.

(2 QUESTIONS)

UNIT IV

Gravitation

Attraction and potential of rod, spherical shells and sphere. Laplace and Poisson equations. Work done by self attracting systems. Distributors for a given potential. Equipotential surfaces.

(2 QUESTIONS)

References :

- H. Goldstein, Classical Mechanics (2nd edition), Narosa Publishing House, New Delhi.
- I.M.Gelfand and S.V.Fomin Calculus of variation, prentice Hall.
- S.L. Loney, An elementary treatise on Statics, Kalyani Publishers, N. Delhi 1979.
- A.S.Ramsey, Newtonian Gravitation. The English Language Book Society and the Cambridge University Press. •

N.C. Rana & P.S.Chandra Joag, Classical Mechanics. Tata McGraw Hill 1991.

Lours N. Hand and Janel, D. Finch, Analytical Mechanics, Cambridge University Press, 1998.

SEMESTER - 3

CHOICE BASED (Open Elective Paper)

Paper-IX : DIFFERENCE EQUATIONS/ NUMBER THEORY/ ADVANCED DISCRETE MATHEMATICS

(Student should select any one these paper)

DIFFERENCE EQUATIONS

Time : 3 Hrs. **Full Marks :70**

In all ***nine*** questions will be set out of which candidates are required to answer 5 questions. Q.No. 1 is compulsory consist of ***seven*** very short answer type questions each of **2 marks** covering entire syllabus.

SYLLABUS :

UNIT I

The Calculus of finite differences: Introduction of finite difference – Differences. Differences formulae and problems. Fundamental theorem of difference calculus, properties of the operators Δ and E, Relation between operator E of finite differences and differential coefficient D of differential calculus. One or more missing terms method I and II, Factorial notation methods of representing any polynomial, Recurrence relations, Leibnitz rule, effect of an error in a tabular value.

(2 QUESTIONS)

UNIT II

Difference equations : Introduction. definition of difference equation. solution of the difference equations. various type of linear difference equation. differential equation as limit of difference equations. Linearly independent functions. Homogenous difference equation with constant co-efficients. Homogenous linear difference equations with variable coefficients. existence and uniqueness theorem.

(2 QUESTIONS)

UNIT III

Linear difference equation with constant coefficient, method of undetermined coefficient coefficient and special operator method to find particular solution, Solution of linear difference

equation with constant coefficient using Variation of parameter, calculation of nth power of a matrix A , matrix method for the solution of system of linear difference equation, generating function technique to solve linear difference equation, apllications of difference equations, cobweb phenomenon.

(2 QUESTIONS)

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UNIT IV

Numerical solution of partial differential equations : Boundary – value problem with boundary conditions. Laplace equations, wave equations. Heat equation.

(2 QUESTIONS)

References :

- Calvin Ahlbrandt and Allan C. Peterson. Discrete Hamiltonian Systems. Difference Equations. Continued Fractions and Riccati Equations. Kluwer. Boston 1996.
- Kolman Busby and Ross, Discreate Mathematical structure,Pearsion education.
- S.Elaydi, Difference equation, springer.

Number Theory

Time : 3 Hrs. **Full Marks :70**

In all ***nine*** questions will be set out of which candidates are required to answer 5 questions. Q.No. 1 is compulsory consist of ***seven*** very short answer type questions each of **2 marks** covering entire syllabus.

Syllabus:

UNIT I

Divisibity theory : Gretest Common divisor, Least common multiple, linear diophantine equation, Fundamental theorem of arithmetic.

(2 QUESTIONS)

UNIT II

Congruences : Residue system, test of divisibility, linear congruencs, Chinese Remainder Theorem, polynomial congruences, application in solution of Diophantine equation, Fermat's Little theorem(FLT1), Eulers genaralization of FLT1, Wilson's theorem.

(2 QUESTIONS)

UNIT III

Arithmetic functions($Eulers - \phi,\ \sigma\ and\ \tau$), definitions, examples and their properties, perfect numbers, the Mobius Inversion formula, properties of Mobius

function, convolution of arithmetic functions, group properties of arithmetic functions, recurrence functions, Fibonacci numbers and their elementary properties.

(2 QUESTIONS)

UNIT IV

Quadratic Residues, Quadratic Reciproctiy law, Euler's criterion, Legendre symbol and its properties, Gauss Lemma,Jacobi symbol and its properties.

Cryptography: some simple cryptosystem, Enciphering matrices, Idea of public key cryptography.

(2 QUESTIONS)

REFETRENCES:

1. S.B. Malic, Basic number thery, Vikas publishing house.
2. Niven and Zuckerman, An introduction to the Theory of Numbers,Wiley Publishers.
3. David Burton,Elementary Number Theory.
4. A course in Number Theory and Cryptography, N. Koblitz, Springer.
5. An Introduction to the Theory of Numbers (6th edition) – I. Niven, H. S. Zuckerman and H. L. Montegomery, John Wiley and sons, Inc., New York, 2003.
6. Elementary Number Theory (4th edition) – D. M. Burton, Universal Book Stall, New Delhi, 2002.
7. History of the Theory of Numbers (Vol. II, Diophantine Analysis) – L. E. Dickson, Chelsea Publishing Company, New York, 1971.
8. An Introduction to the Theory of Numbers (6th edition) – G. H. Hardy and E. M. Wright, The English Language Society and Oxford University Press, 1998.
9. An Introduction to the Theory of Numbers (3rd edition) – I. Niven and H. S. Zuckerman, Wiley Eastern Ltd., New Delhi, 1993.

ADVANCED DISCRETE MATHEMATICS

Time : 3 Hrs. **Full Marks :70**

In all ***nine*** questions will be set out of which candidates are required to answer 5 questions. Q.No. 1 is compulsory consist of ***seven*** very short answer type questions each of **2 marks** covering entire syllabus.

SYLLABUS :

UNIT I

Languge and grammars, Finite state machines with output, Finite state machines with no output, Finite state Machine, Finite state automata, deterministic finite state automata(DFSA), non deterministic finite state automata(NDFSA), transition diagram.

(2 QUESTIONS)

UNIT II

Equivalence of DFSA and NDFSA, Moor machine, Mealy machine and Turning machine, Languages and regular expressions,Language determined by finite state automaton, grammars.

(2 QUESTIONS)

UNIT III

Colouring : Vertex colouring, chromatic number, chromatic polynomial, Brooks theorem, edge colouring, chromatic index, map colouring, six colour theorem, Five colour theorem.

(2 QUESTIONS)

UNIT IV

Hamiltonian graph,Ore's theorem, Dirac' theorem, TheShortest path problem, Dijkstra's algorithm. Hall's marriage,theorem, transvalsal theory, Alternative proof of Hall's therem using transversal theory, applications of Hall's theorem.

(2 QUESTIONS)

References:

1. Graph Theory – R. J. Wilson.

2. Kolman Busby and Ross, Discreate mathematical structure, Pearsion education.

3. D. S. Malik and M. K. Sen : Discrete mathematical structures : theory and applications; Thomson;
Australia; 2004.
4. Edward R. Scheinerman : Mathematics A Discrete Introduction; Thomson Asia Ltd.; Singapore; 2001.

5. Discrete mathematical structure, R.P.Grimaldi, Pearson education.

6. J. P. Tremblay & R. Manohar, Discrete Mathematical Structures with Applications to Computer Science. Mc Graw Hill Book Co. 1997...

7. J.L. Gersting, Mathematical Structures for Computer Science. (3rd edition), Computer Science Press, New York.

8. Seymour Lepschutz. Finite Mathematics (International edition 1983), Mc Graw-Hill Book Company, New York.

9. Narsinghdeo, Graph theory, PHI New Delhi.

10. Kolman Busby and Ross, Discreate mathematical structure, Pearsion education.

11. J. P. Tremblay & R. Manohar, Discrete Mathematical Structures with Applications to Computer Science. Mc Graw Hill Book Co. 1997.

Paper-X : FUNCTIONAL ANALYSIS

Time : 3 Hrs. **Full Marks :70**

In all ***nine*** questions will be set out of which candidates are required to answer 5 questions. Q.No. 1 is compulsory consist of ***seven*** very short answer type questions each of **2 marks** covering entire syllabus.

SYLLABUS :

UNIT I

Normed linear spaces. Banach spaces and examples. Quotient space of normed linear spaces and its completeness, equivalent norms.

(2 QUESTIONS)

UNIT II

Bounded linear transformations, normed linear spaces of bounded linear transformations, dual spaces with examples.Hahn-Banach theorem Open mapping and closed graph theorem, the natural imbedding of N in N**. Reflexive spaces.

(2 QUESTIONS)

UNIT III

Inner product spaces. Hilbert spaces. Orthonormal Sets. Bessel's inequality. Complete orthonormal sets and Parseval's identity. Projection theorem. Rietz representation theorem Adjoint of an operator on a Hilbert space.

(2 QUESTIONS)

UNIT IV

Reflexivity of Hilbert spaces. Self-adjoint operators. Positive, normal and unitary operators. Linear transformation & linear functionals. **(2 QUESTIONS)**

References:

1. G.F.Simmons,Topology and modern analysis TMH.
2 G. Bachman and L. Narici, Functional Analysis, Academic Press, 1966.
3 R.E. Edwards, Functional Analysis. Holt Rinehart and Winston, New York 1958.
4. C. Goffman and G. Pedrick. First Course in Functional Analysis, Prentice Hall of India, New Delhi. 1987.
5. E.Kreyszig, Functional analysis with application, John wiley and sons.

Paper-XI : PARTIAL DIFFERENTIAL EQUATIONS

Time : 3 Hrs. **Full Marks :70**

In all ***nine*** questions will be set out of which candidates are required to answer 5 questions. Q.No. 1 is compulsory consist of ***seven*** very short answer type questions each of **2 marks** covering entire syllabus.

SYLLABUS :

UNIT I

Laplace equation – Fundamental solutions of two and three dimensional Laplace equation in Cartesian form. Properties of Harmonic functions. Boundary value problems.

(2 QUESTIONS)

UNIT II

Heat equation – Derivation and fundamental solution of one dimensional Heat equation in Cartesian form. Application problems.

(2 QUESTIONS)

UNIT III

Wave equation – Derivation and fundamental solution of one dimensional wave equation in Cartesian form. Application problems.

(2 QUESTIONS)

UNIT IV

Solutions of p.d.e. using Separation of variables, Fourier transform and Laplace transform, Green's function and solutions of boundary value problems.

(2 QUESTIONS)

References :

1. L.C. Evans, Partial Differential Equations, Graduate Studies in Mathematics, Volume 19, AMS, 1998.
2. I.N. Sneddon,Use of integrals transforms McGraw Hill.
3. P. Prasad and R. Ravindran ; Partial Differential equation.
4. K. Sankar Rio, Partial diffential eqution, new age.

Paper-XII : FLUID MECHANICS

Time : 3 Hrs. **Full Marks :70**

In all ***nine*** questions will be set out of which candidates are required to answer 5 questions. Q.No. 1 is compulsory consist of ***seven*** very short answer type questions each of **2 marks** covering entire syllabus.

SYLLABUS :

UNIT I

Kinematics – Lagrangian and Eulerian methods. Equation of continuity in different coordinate system. Boundary surfaces. Stream lines. Path lines and streak lines. Velocity potential, Irrotational and rotational motions. Vortex lines.

(2 QUESTIONS)

UNIT II

Equations of Motion – Lagrange's and Euler's equations of motion. Bernoulli's theorem. Equation of motion by flux method. Impulsive actions. Stream function Irrotational motion.

(2 QUESTIONS)

UNIT III

Complex velocity potential. Sources, sinks doublets and their images in two dimension. Conformal mapping. Milne-Thomson circle theorem.

(2 QUESTIONS)

UNIT IV

Two-dimensional Irrotational motion produced by motion of circular, co-axial and elliptic cylinders in an infinite mass of liquid. Theorem of Blasius. Motion of a sphere through a liquid at rest at infinity. Liquid streaming past a fixed sphere. Equation of motion of a sphere.

(2 QUESTIONS)

References :

- W.H.Besaint & A. S. Ramsey. A Treatise on Hydro mechanics. Part II. CBS Publishers. Delhi. 1988.
- G.K. Batchelor. An Introduction of Fluid Mechanics. Foundation Books. New Delhi. 1994.
- F. Choriton. Textbook of Fluid Dynamics. C.B.S. Publishers. Delhi 1985.
- Fluid mechanics – Bansal.
- Fluid dynamics, M.D. Raisinghania, S.Chand Publication.

SEMESTER - 4

Paper-XIII : FUZZY SETS AND THEIR APPLICATIONS/ALGEBRAIC TOPOLOGY

Time : 3 Hrs. **Full Marks :70**

In all ***nine*** questions will be set out of which candidates are required to answer 5 questions. Q.No. 1 is compulsory consist of ***seven*** very short answer type questions each of **2 marks** covering entire syllabus.

FUZZY SETS AND THEIR APPLICATIONS :

Syllabus:

UNIT I

Definitions – level sets. Convex fuzzy sets. Basic operations on fuzzy sets. Types of fuzzy sets. Cartesian products. Algebraic products. Bounded sum and difference. T-norms and t-conorms. The Extension Principle – The Zadeh's extension principle. Image and inverse image of fuzzy sets. Fuzzy numbers. Elements of fuzzy arithmetic.

(2 QUESTIONS)

UNIT II

Fuzzy Relations and Fuzzy Graphs – Fuzzy relations on fuzzy sets. Composition of fuzzy relations. Fuzzy relation equations. Fuzzy graph. Similarity relation.

(2 QUESTIONS)

UNIT III

Possibility Theory – Fuzzy measures. Evidence theory. Necessity measure. Possibility measure. Possibility distribution. Possibility theory and fuzzy sets. Possibility theory versus probability theo Fuzzy Logic – An overview of classical logic. Multivalued logics. Fuzzy propositions. Fuzzy quantifiers. Linguistic variables and hedges. Inference from conditional fuzzy propositions. the compositional rule of inference.

(2 QUESTIONS)

UNIT IV

An Introduction to Fuzzy Control-Fuzzy controllers. Fuzzy rule base. Fuzzy inference engine. Fuzzification. Defuzzification and the various defuzzification methods (the center of area. the center of maxima. and the mean of maxima methods). Decision making in Fuzzy Environment-Individual decision making. Multiperson decision making.

Multicriteria decision making. Multistage decision making. Fuzzy ranking methods. Fuzzy linear programming.

(2 QUESTIONS)

References :

- H.J. Zimmermann : Fazzy set theory and its Applications. Allied Publishers Ltd. New Delhi. 1991.
- G.J. Klir and B. Yuan-Fuzzy Sets and Fuzzy logic. Prentice-Hall of India. New Delhi, 1995.

ALGEBRAIC TOPOLOGY

Time : 3 Hrs. **Full Marks :70**

In all ***nine*** questions will be set out of which candidates are required to answer 5 questions. Q.No. 1 is compulsory consist of ***seven*** very short answer type questions each of **2 marks** covering entire syllabus.

SYLLABYS:

UNIT I

Fundamental group functo. homotopy of maps between topological spaces. homotopy equivalence. contractible and simply connected spaces. fundamental groups of S^1 and $S^1 \times S^1$ etc.

Calculation of fundamental group of S^n. N>1 using Van Kampen's theorem. fundamental groups of a topological group. Brouwer's fixed point theorem. fundamental theorem of algebra. vector fields on planner sets. Frobenius theorem for 3 x 3 matrices.

(2 QUESTIONS)

UNIT II

Covering spaces. unique path lifting theorem. covering homotopy theorems. group of covering transformations. criteria of lifting of maps in terms of fundamental groups. universal covering. its existence. special cases of manifolds and topological groups.

Singular homology, reduced homology. Eilenberg Steenrod axioms of homology (no proof for homotopy invariance axiom decision axiom and exact segnence axiom) and theory application. relation between fundamental group and first homology.

(2 QUESTIONS)

UNIT III

Calculation of homology of S^n. Brouwer's fixed point theorem for $f : E^n \to E^n$. application spheres. vector fields. Mayer-Vietoris sequence (without proof) & its applications. Singular cohomology modules. Kronecker product. connecting homomorphism. contra-functoriality of

singular cohomology modules. naturality of connecting homomorphism. exact cohomology sequence of pair. homotopy invariance. excision properties. cohomology of a point. Mayer vietoris sequence and its application in computation of cohomology of S^n. RP^n. CP^n torus. compact surface of genus g and non-orientable compact surface.

(2 QUESTIONS)

UNIT IV

Compact connected 2-manifolds. their orientabiligy and non-orientabiligy. examples. connected sum. construction of projective space and Klein's bottle from a square. Klien's bottle as union of two Mobius strips. canonical of sphere. torus and projective plannes. Klin's bottle as union of two Mobius strips. triangulation of compact surfaces.

Classification theorem for compact surfaces. connected sum of tours and projective plans as the connected sum of three projective planes. Euler characteristic as a topological invariant of compact surfaces. connected sum formula. 2-manofolds with boundary and their classifications. Euler characteristic of a bordered surface, models of compact bordered surfaces in R^3.

(2 QUESTIONS)

References :

- James R. Munkres. Topology – A first Course. Prentice Hall of India Pvt. Ltd., New Delhi, 1978.

Paper-XIV :
MACHANICS OF SOLIDS/OPERATIONS RESEARCH/DIFFERENTIABLE STRUCTURE ON A MANIFOLD/INFORMATION THEORY

Time : 3 Hrs. **Full Marks :70**

In all ***nine*** questions will be set out of which candidates are required to answer 5 questions. Q.No. 1 is compulsory consist of ***seven*** very short answer type questions each of **2 marks** covering entire syllabus.

MECHANICS OF SOLIDS

SYLLABUS:

UNIT I

Analysis off Strain-Affine transformation. Infinite simal affine deformation. Geometrical interpretation of the components of stain. Strain quadric of Cauchy. Principal strains and invariants. General infinite simal deformation. Saint-Venant's equations of Compatibility. Finite deformations.

(2 QUESTIONS)

UNIT II

Analysis of Stress-Stress tensor. Equations of equilibrium. Transformation of coordinates. Stress qudric of Cauchy. Principal stress and invariants. Maximum normal and shear stresses.

(2 QUESTIONS)

UNIT III

Equations of Elasticity. Generalized Hooke's law. Homogeneous isotropic media. Elasticity moduli for isotropic media. Elasticity moduli for isotropic media. Equilibrium and dynamic equations for an isotropic elastic solid. Strain energy function and its connection with Hooke's law. Uniqueness of solution Beltrami-Michell compatibility equations. Saint-Venant's principle. Torsion-Torsion of cylindrical bars. Tortional rigidity. Torsion and stress functions. Lines of shearing stress. Simple problems – Plane stress. Generalized plane stress. Airy stress function. General solution of Biharmonic equation. Stresses and displacements in terms of complex potentials. Simple problems. Stress function appropriate to problems of plane stress problems of semi-infinite solids with displacements or stresses prescribed on the plane boundary.

(2 QUESTIONS)

UNIT IV

Waves-Propagation of waves in an isotropic elastic solid medium. Waves of dilation and distortion. Plane waves. Elastic surface waves such as Rayleigh and Love waves.

Variational methods – Theorems of minimum potential energy. Theorem of minimum complementary energy. Reciprocal theorem of Betti and Rayleigh. Deflection of elastic string central line of a beam and elastic membrane. Torsion of cylinders. Variational problem related to biharmonic equation. Solution of Euler's equation by Ritz. Galerkin and Kantorovich methods.

(2 QUESTIONS)

References :

- I.S. Sokolnikoff, Mathematical Theory of Elasticity. Tata McGraw-Hill Publishing Company Ltd., New Delhi. 1977.
- A. E. Love. A Treatise on the Mathematical Theory of Elasticity. Cambridge University Press. London. 1963.
- Y.C. Fung Foundations of Solid Mechanics. Prentice Hall, New Delhi. 1965.
- S. Timoshenko and N. Goodier. Theory of Elasticity, McGraw Hill, New York 1970.

OPERATIONS RESEARCH

Time : 3 Hrs. **Full Marks :70**

In all ***nine*** questions will be set out of which candidates are required to answer 5 questions. Q.No. 1 is compulsory consist of ***seven*** very short answer type questions each of **2 marks** covering entire syllabus.

SYLLABUS:

UNIT I

Sequencing : Introduction, sequencing problem with n-jobs and two machines. optimal sequencing problems with n-jobs and three machine. Problems with n-jobs and m-machine, graphical solution.

(2 QUESTIONS)

UNIT II

Replacement Problems : Introduction, replacement of item that Deteriorate with time, Replacement of items whose maintenance costs change with time and the value of money remains same during the period. replacement of items whose maintenance costs increase with time and the value of money also changes with time. replacement of items that fail completely, individual replacement policy, group replacement policy.

Queuing theory : Introduction, characteristics of queuing system, queue discipline, symbols etc. Poisson process and exponential distribution, properties of Poisson process, classification of queues. definition of transient and steady state, model (M/M/L) (D/fl Fo), (M/M/I) (SIRO) (M/M/I) (MFIFO).

(2 QUESTIONS)

UNIT III

Non-Linear programming – Introduction, definitions of general non-linear programming problems, problems of constrained maxima and minima; necessary and sufficient conditions for non-linear programming problems, Hessian – matrix, Lagrangian functions with Lagrangian multiplier.

constraints are not all equality constraints. sufficiency of saddle point problem. Kuhn-Tucker condition.

(2 QUESTIONS)

UNIT IV

Non-linear programming techniques – Introduction of GMPP & GN 1 PP its sanction by Wolfe's method. Beale's method.

(2 QUESTIONS)

References :

- F.S. Hillier and G. J. Lieberman. Introduction to Operations Research (Sixth Edition). McGraw Hill International Edition. Industrial Engineering Series. 1995 (This book comes with a CD containing tutorial software).
- G. Hadley, Linear Programming. Narosa Publishing House. 1995.
- G. Haadly. Nonlinear and Dynamic Programming. Addisor-Wisely. Reading Mass.
- Kanti Swarup, P.K.Gupta and Man Mohan, Operations Research, Sultan Chand & Sons, New Delhi.
- S. S. Rao. Optimization Theory and Applications. Wiley Eastern Ltd., New Delhi.
- Prem Kumar Gupta and D.S. Hira. Operations Research-An Introduction, S. Chand & Company Ltd. New Delhi.
- H.A.Taha , Oprations research, Prentice Hall India.1997.

DIFFERENTIABLE STRUCTURES ON A MANIFOLD

Time : 3 Hrs. **Full Marks :70**

In all ***nine*** questions will be set out of which candidates are required to answer 5 questions. Q.No. 1 is compulsory consist of ***seven*** very short answer type questions each of **2 marks** covering entire syllabus.

SYLLABUS:

UNIT I

Almost Hermite manifolds. Riem Almost analytic vector fields. Curvature tensor. Linear connections. Kahler manifolds. Affine Connections. Holomorphic sectional curvature. Curvature tensor. Almost Analytic Vector fields.

(2 QUESTIONS)

UNIT II

Nearly Kahler manifolds. Curvature identities. Constant Holomorphic sectional curvature. Almost analytic Vector Fields.

(2 QUESTIONS)

UNIT III

Almost Kahler manifolds. Analytic vector fields. Conformal transformation. Curvature identities, Almost Contact Metric manifolds – Almost Grayan manifolds. K-Contact Riemannian manifolds. Sasakian manifolds. Cosymplectic manifolds.

(2 QUESTIONS)

UNIT IV

Subamanifolds of almost Hermite and Kahler manifolds. Sub-manifolds of almost contact metric manifolds. CR-Submanifolds of Kahler manifolds and Sasakian manifolds. The integrability of distributions.

(2 QUESTIONS)

References :

- R.S. Mishra. Structures on a differentiable manifold and their applications. Chadrama Prakashan. Allahabad, 1984.

INFORMATION THEORY :

Time : 3 Hrs. **Full Marks :70**

In all ***nine*** questions will be set out of which candidates are required to answer 5 questions. Q.No. 1 is compulsory consist of ***seven*** very short answer type questions each of **2 marks** covering entire syllabus.

SYLLABUS:

UNIT I

Measures of information. Axioms for a measure of uncertainty. The Shannon entropy and its properties. Joint and conditional entropies. Transformation and its properties.

Noiseless coding – ingredients of noiseless coding problem. Uniquely decipherable codes. Necessary and sufficient condition for the existence of instaneous codes. Construction of optimal codes.

(2 QUESTIONS)

UNIT II

Discrete memory less channel. Classification of channels. Information processed by a channel. Calculation of channel capacity. Decoding schemes. The ideal observer. The fundamental theorem of Information theory and its strong and weak converses

(2 QUESTIONS)

UNIT III

Continuous channels – The time-descrete Gaussian channel. Uncertainty of an absolutely continuous random variable. The converse to the coding theorem for time-discrete Gaussian channel. The time-continuous Gaussian channel. Band-limited channels.

(2 QUESTIONS)

UNIT IV

Information functions, the fundamental equation of information, information functions continuous at the origin, nonnegative bounded information functions, measurable information functions and entropy. Axiomatic characterizations of the Shannon entropy due to Tverberg and Leo. The general solution of the fundamental equation of information. Derivations and their role in the study of information functions.

The branching property. Some characterizations of the shannon entropy based upon the branching property. Entropies with the sum property. The Shannon inequality. Sub additive. additive entropies.

(2 QUESTIONS)

References :

- R.Ash. Information Theory, Inter science Publishers. New York 1965.
- F.M.Reza. An introduction to information Theory. Mc Graw-Hill Book Company inc. 1961.
- J. Aczel and Z. Daroczy. On measures of information and their characterizations. Academic press. New York.

Paper-XV :
INTEGRAL TRANSFORMS/ALGEBRAIC CODING THEORY MATHEMATICS OF FINANCE AND INSURANCE / APPLIED STATISTICS/BOUNDARY LAYER THEORY

INTEGRAL TRANSFORMS

Time : 3 Hrs. **Full Marks :70**

In all ***nine*** questions will be set out of which candidates are required to answer 5 questions. Q.No. 1 is compulsory consist of ***seven*** very short answer type questions each of **2 marks** covering entire syllabus.

SYLLABUS :

UNIT I

Fundamental Formulae-The Laplace Transform-Definition Region of convergence. abscissa of convergence, absolute convergence, Uniform convergence of Laplace Transform. Complex Inversion formula.

The Stieltje transform-Elementary properties of the transform. Relation to the Laplace transform. Complex Inversion formulae.

(2 QUESTIONS)

UNIT II

The Fourier transform : Dirichlet's conditions. Definition of Fourier transform. Fourier Sine Transform, Fourier cosine transform. Inversion theorem for complex fourier transform. Difinition of convolution and convolution theorem for Fourier transforms. Parseval's identity of Fourier transforms.

(2 QUESTIONS)

UNIT III

The Mellin transform : Definition of Mellin transform and its properties. Mellin transforms of derivatives and certain integral expressions.

(2 QUESTIONS)

UNIT IV

Hankel Transform : Definition of Hankel transform and its elementary properties. Inversion formula for the Hankel transform. Hankel transform of derivatives, Parseval's theorem.

(2 QUESTIONS)

References :

1. The Laplace Transforms - D.V.Widder
2. Use of Integral Transforms - Sneddon

ALGEBRAIC CODING THEORY

Time : 3 Hrs. **Full Marks :70**

In all ***nine*** questions will be set out of which candidates are required to answer 5 questions. Q.No. 1 is compulsory consist of ***seven*** very short answer type questions each of **2 marks** covering entire syllabus.

SYLLABUS :

UNIT I

Coding theory, Introduction, examples, Inpotant code parameters, Correcting and detecting errors, Sphere-packing bound, Gilbert-Varshamov bound, Sigleton bound.

(2 QUESTIONS)

UNIT II

Linear codes: Vector spaces over finite fields,Linear codes,Binary linear , Hamming weight, Bases of linear codes, Generator matrix and parity check matrix.

(2 QUESTIONS)

UNIT III

Equivalence of linear codes, Encoding with a linear code,Decoding of linear codes, Cosets, Nearest neighbour decoding for linear codes, Syndrom decoding.

(2 QUESTIONS)

UNIT IV

Cyclic codes: Definitions, Generator and parity check polynomials, Generator and parity check, matrices, Decoding of cyclic codes, Burst-error-correcting codes.Reed-Solomon codes.

(1 QUESTIONS)

Some special cyclic codes: BCH codes, RS codes, Defintions, Parameters of BCH codes,Decoding of BCH codes.Reed-Muller Codes.Maximum-distance Separable (MDS) Codes. Generator and Parity-check matrics
of MDS Code. Weight Distribution of MDS Code. MDS codes from RS codes. Codes derived from Hadamard Matrices.

(1 QUESTIONS)

Reference:

1. R.Hill, Afirst course in codding theory, oxford university press
2. F.Macwwilliams and N.Sloane, The Theory of error correcting codes, North Holland Publishing company, Amsterdom.
3. San Ling and Chaoing xing, Coding Theory- A First Course.
4. Applied Abstract Algebra - Lid and Pilz 2nd Edition.
5. Todd K. Moon, Error Correction Coding, Wiley India

6. Steven Roman, Coding and Information Theory, Springer-Verlag.

7. algebraic coding theory, E.R. Berlekamp

8. Error Correcting Coding Theory,Man Young Rhee.

9. Error-Correcting Codes,W.W. Peterson and E.J. Weldon, Jr.

10. Algebraic Coding Theory, E.R. Berlekamp

MATHEMATICS OF FINANCE AND INSURANCE

Time : 3 Hrs. **Full Marks :70**

In all ***nine*** questions will be set out of which candidates are required to answer 5 questions. Q.No. 1 is compulsory consist of ***seven*** very short answer type questions each of **2 marks** covering entire syllabus.

SYLLABUS:

UNIT I

Prerequisite – Application of Mathematics and Finance & Insurance Optional Paper BMG 1 304 (a & b) F)

Financial Derivatives – An Introduction : Types of Financial Derivatives – Forwards and Futures : Options and its kind : and SWAPS.

The Arbitrage Theorem and Introduction to portfolio Selection and Capital Market Theory – Static and Continuous – Time Model.

(2 QUESTIONS)

UNIT II

Pricing by Arbitrage – A Single – Period Option Pricing Model: Multi Pricing Model-Cox-Ross-Rubinstein Model : Bounds on Option Prices.

The Dynamics of Derivative Prices-Stochastic Differential Equations (SDEs) – Major Models of SDEs. Lonear Constant Coefficient SDEs: Geometric SDEs : Square Root Process: Mean Reverting Process and Omstein-Uhlenbeck Process.

Martingale Measue and Risk-Neutral Probabilities : Pricing of Binomial Options with equivalent martingale measures.

(2 QUESTIONS)

UNIT III

The Black-Scholes Option Pricing Model- Using no arbitrage approach, limiting case of Binomial Option Pricing and Risk-Neutral probabilities.The American Option Pricing-Extended Trading Strategies; Analysis of Amerivan Put Options: early exercise premium and relation to free boundary problems. Concepts from Insurance : Introduction : The Claim Number Process : The Claim Size Process: Solvability of the Portfolio: Reinsurance and Ruin Problem.Premium and Ordering of Risks-Premium Calculation Principles and Ordering Distributions.

(2 QUESTIONS)

UNIT IV

Distributions of Aggregate Claim Amount-Individual and Collective Model:Compound Distributions : Claim Number of Distributions: Recursive Computation Methods: Lundberg Bounds and Approximation by Compound Distributions. Risk Processes-Time-Dependent Risk

Models: Poisson Arrival Processes : Ruin Probabilities and Bounds Asymptotic and Approximation.Time Dependent Risk Models – Ruin Problems and Computations of Ruin Functions; Dual Queuing Model : Risk Models in Continuous Time and Numerical Evaluation of Ruin Functions.

(2 QUESTIONS)

References :

- John C. Hull, Options. Futures and other derivatives. Prentice Hall of India Pvt. Ltd.
- Sheldon M. Ross. An Introduction to Mathematical Finance. Cambridge University Press.

APPLIED STATISTICS

Time : 3 Hrs. **Full Marks :70**

In all ***nine*** questions will be set out of which candidates are required to answer 5 questions. Q.No. 1 is compulsory consist of ***seven*** very short answer type questions each of **2 marks** covering entire syllabus.

SYLLABUS:

UNIT I

Demand analysis. price elasticity and demand. partial elasticity of demand. Lontieg's method. Pigou's method. Engle's curve and Engle's law. Paretv's law of income distribution, curves of concentration.

(2 QUESTIONS)

UNIT II

Analysis of Variance. One way classification, statistical analysis of the mode.Design experiment-statistical analysis of C.R.D. (Completely randomized design) least square estimates of effects. exception of sum of squares. randomized block design (R.B.D.) – statistical analysis of R.B.D. for one observation per experiment unit. Variance of estimates. expectation of sum of squares. efficiency of R.B.D. relative to C.R.D.

(2 QUESTIONS)

UNIT III

Design of sample survey. Principle steps in a sample survey sampling and non-sampling error. types of sampling. selection of a simple random sample, simple random sampling, stratified random sampling.

Psychological and educational statistics – scaling of scores on a test. percentile scores, scaling of rankings, scaling of normal probability curves. scaling of ratings in terms of normal curve, reliability of test scars, error variance, index of reliability, parallel test method of determining test reliability.

(2 QUESTIONS)

UNIT IV

Vital Statistics – uses of vital statistics, methods of obtaining vital statistics, measurement of population , measurement of mortality, crude death rate (C.D.R.) specific death rate (SDR). specific rate, life table or (Mortality table). abridged life table, fertility measurement of population growth.

(2 QUESTIONS)

References:

- Fundamental of Applied Statistics – S.C.Gupta & V. K. Kappor
- Statistical Method – S.P. Gupta
- An Introduction to statistical method – S.B.Gupta

BOUDARY LAYER THEORY :

Time : 3 Hrs. **Full Marks :70**

In all ***nine*** questions will be set out of which candidates are required to answer 5 questions. Q.No. 1 is compulsory consist of ***seven*** very short answer type questions each of **2 marks** covering entire syllabus.

SYLLABUS:

UNIT I

Exact solution of Navier-Stoke's equation – flow between two concentric rotating cylinders. Hiemenz flow. flow due to lane wall suddenly set in motion, flow due to an oscillating wall.

(2 QUESTIONS)

UNIT II

Theory of very slow motion – flow past a sphere. (Stroke's flow). Flow past a sphere (Osceen's flow), Lubrication Theory.

Theory of laminar boundary layer – (a) two dimensional boundary layer equation for flow over a plane wall, boundary layer on a flat plate. (Blassius-Topler solution).

(2 QUESTIONS)

UNIT III

characteristic of boundary layer parameters. (b) Similar solution of the boundary layer equation. boundary layer. How past a wedge boundary layer along the wall of a convergent channel. boundary layer on a symmetrically placed cylinder and body of evolution.

(2 QUESTIONS)

UNIT IV

Boundary layer control in laminar flow – methods of boundary layer control in laminar flow, boundary layer suction.

(2 QUESTIONS)

References :

- Boundary layer theory –Slicsting.
- Foundation of fluid dynamics – S.W. Yuan, Prentice Hall of India (F)

- Laminar boundary layer – L. Rosenheard. C.U.P. Clarendon Press.
- Viscous fluid dynamics – J. L. Bansal. Oxford & IBM pub. co.

Paper-XVI

DESSERTAION

PROJECT

Time: 6 hours **F.M. 100**

ANY ONE OF SPECIAL PAPER

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