PEOs PSOs and POs.

NATIONAL EDUCATION POLICY-2020

J.S. UNIVERSITY , SHIKOHABAD

PAPER CODING AND CREDIT DISTRIBUTION

M.Sc. (MATHEMATICS)

S.No.	Name of Degree	SEMESTER	TITLE OF PAPER		CREDITS	CODE NUMBER
1	Bachelor (Research) of Science in Mathematics	VII	Abstract Algebra		5	B030701T
			Real Analysis		5	B030702T
			Ordinary Differential Equations		5	B030703T
			Complex Analysis		5	B030704T
			Introductory Statistical Methods (Minor For OTHER FACULTY)		4	B030705T
			Research Project			
2		VIII	Inventory and Queuing Models		4	B030801T
			Fluid Mechanics		4	B030802T
			Computational Numerical Methods		4	B030803T
			Fuzzy Mathematics	Choose Any one	4	B030804T
			History & Development of Indian Mathematics		4	B030805T
			Wavelet Analysis		4	B030806T
			Riemannian Geometry & Tensor Analysis		4	B030807T
			Computer Programing with C/C++		4	B030808P
			Research Project		8	B030809R
		One Minor Paper to be selected from OTHER FACULTY in VII or VIII Semester			4/5/6	
3	Master of Science in Mathematics	IX	Topology		5	B030901T
			Operations Research		5	B030902T
			Advanced Fluid Mechanics		5	B030903T
			Financial Mathematics	Choose Any one	5	B030904T
			Computational Fluid Dynamics		5	B030905T
			Bio-Mathematics		5	B030906T
			Integral Equations & Boundary Value Problems		5	B030907T
			Research Project			
4		X	Functional Analysis		4	B031001T
			Space Dynamics		4	B031002T
			Calculus of Variations	Choose Any one	4	B031003T
			Coding Theory		4	B031004T
			Special Functions		4	B031005T
			Fractional Calculus		4	B031006T
			Mathematical Modelling		4	B031007T
			Discrete Mathematical Structure	Choose Any one	4	B031008T
			Cryptography			B031009T
			Vadic Ganita			B031010T
			Cosmology			B031011T
			Theory of Relativity			B031012T
			Computer Programming with MatLab (Problems of Operations Research and Problems of Numerical Methods)		4	B031013P
			Research Project		8	B031014R

Students of Science Faculty may choose MINOR paper from Faculty of Commerce/ Arts, Humanities and Social Sciences/ Languages/Fine Art and Performing Art/Education/Rural Science.

M.SC. (MATHEMATICS) FIRST SEMESTER SYSTEM

Sr. No.	Course Code	Credit/Total Marks	Course Name	Remarks
1	C1	5/100	Abstract Algebra	Core Paper
2	C2	5/100	Real Analysis	Core Paper
3	C3	5/100	Ordinary Differential Equations	Core Paper
4	C4	5/100	Complex Analysis	Core Paper
5	C5	4/100	Introductory Statistical Method	Minor Paper
6	C6		Research Project	Project
Total		**24/500**		

M.SC. (MATHEMATICS) SECOND SEMESTER SYSTEM

Sr. No.	Course Code	Credit/Total Marks	Course Name	Remark
1	C1	4/100	Inventory and Queuing Models	Core Paper
2	C2	4/100	Fluid Mechanics	Core Paper
3	C3	4/100	Computational Numerical Method	Core Paper
4	C4	4/100	**(Any one of the following)** (a)- Fuzzy Mathematics (b)- History & Development of Indian Mathematics (c)- Wavelet Analysis (d)-Riemannian Geometry & Tensor Analysis	Elective Paper
5	C5	4/100	Computer programming with c/c++	Practical
6	C6	8/100	Research Project	Project
Total		**28/500**		

M.SC. (MATHEMATICS) THIRD SEMESTER SYSTEM

Sr. No.	Course Code	Credit/Total Marks	Course Name	Remark
1	C1	5/100	Topology	Core Paper
2	C2	5/100	Operations Research	Core Paper
3	C3	5/100	Advanced Fluid mechanics	Core Paper
4	C4	5/100	**(Any one of the following)** (a)- Financial Mathematics (b)- Computational Fluid Dynamics (c)- Bio-Mathematics (d)-Integral Equations & Boundary Value Problems	Elective Paper
5	C5	5/100	Research Project	Project
Total		**20/500**		

M.SC. (MATHEMATICS) FOURTH SEMESTER SYSTEM

Sr. No.	Course Code	Credit/Total Marks	Course Name	Remark
1	C1	4/100	Functional Analysis	Core Paper
2	C2	4/100	Space Dynamics	Core Paper
3	C3	4/100	**(Any one of the following)** (a)- Calculus of Variations (b)- Coding Theory (c)- Special Functions (d)- Fractional Calculus (e)- Mathematical Modelling	Elective Paper
4	C4	4/100	**(Any one of the following)** (a)- Discrete Mathematical Structure (b)- Cryptography (c)- Vadic Ganita (d)- Cosmology (e)- Theory of Relativity	Elective Paper
5	C5	4/100	Computer Programming with Matlab (Problems of Operations Research & Problems of Numerical Methods)	Practical
6	C6	8/100	Research Project	Project
Total		**28/600**		

Note:

1- There will be a research project of 4 Credit in each semester. The students shall submit the research projects done in the 1st and 2nd semester in the form of a Dissertation at the end of 2nd semester. The submitted dissertation will be evaluated by supervisor and an external examiner nominated by the University. The total marks for the dissertation will be 100. The evaluation of research project of semester 3 and 4 will be done at the end of 4th semester in the same way as done for the 1st and 2nd semester at the end of 2nd semester.

2- There will be a minor elective of 4 credit/100 marks from [redacted] to be taken in 1st year (1st or 2nd semester, only once).

M.Sc. First Semester

Mathematics

Paper 1

ABSTRACT ALGEBRA

B030701T

Credits: 05 **Max. Marks: 100**

Evaluation: Continuous Internal Assessment – 25 marks

Semester End Examination – 75 Marks

Course Title: Abstract Algebra

Course Type: Core paper

Course Level: PG

Unit-1

Group Homomorphism, Isomorphism; Natural Homomorphism, Cayley's theorem, Quotient group, Fundamental theorem of Homomorphisms, Endomorphism, Automorphism, Inner Automorphism, Direct Product.

Unit-2

Conjugate classes, Centre and Normalizer, conjugate elements, Class equation, Theorem I If order of group $G = p^n$, then $Z(G) \neq \{e\}$; Theorem II: If $O(G) = p^2$, then group is Abelian; Cauchy's Theorem for Abelian Group, Sylow's theorems, Composition series. Jordan Holder Theorem for finite groups.

Unit-3

Ring Theory: Ideals, Maximal Ideals and quotient rings, Homomorphism of rings, Fundamental theorem of Homomorphism, Integral domain, field, quotient field, prime field, Direct product of rings, Polynomial rings, divisibility of polynomial, value of Polynomial, irreducibility of Polynomial, Remainder theorem.

Unit-4

Vector spaces: subspaces, linear dependence and independence, bases, dimension, direct sums, dimensions of a direct sum, quotient spaces

Books:

1- Topics in Algebra by I. N. Herstein.
2- A Course of Algebra, Fraleigh
3- Abstract Algebra by G. C. Chadha et.al.
4- Modern Algebra by R. S. Agarwal
5- Modern Algebra by A.R. Vashistha

SYLLABUS FOR NEP

Paper 2

REAL ANALYSIS

B030702T

Credits: 05

Max. Marks: 100

Evaluation: Continuous Internal Assessment – 25 marks

Semester End Examination – 75 Marks

Course Title: Real Analysis

Course Type: Core paper

Course Level: PG

Unit-1

Archimedean property, Completeness property of real numbers, Metric spaces, compactness. Connectedness, (with emphasis on R^n), Continuity and uniform continuity. Monotonic functions, Functions of bounded variation, Absolutely continuous functions. Derivatives of functions and Taylor's theorem.

Unit-2

Functions of several variables, derivatives in an open subset of R^n, Derivatives of higher order, partial derivatives, Taylor's theorem., Lagrange's Multiplier method, Inverse function theorem, Implicit function theorem.

Unit-3

Riemann integral and its properties, charaterization of Riemann integrable functions. Improper integrals, Sequences and series of functions, uniform convergence and its relation to continuity, differentiation and integration. Point wise convergence, Fejer's theorem, Weierstrass approximation theorem.

Unit-4

Measure Theory: Measurable sets; Lebesque Measure and its properties, Measurable functions and their properties, Integration and Convergence theorem.

Text/ References:

1- T. Apostol, Mathematical Analysis, 2nd ed., Narosa Publishers, 2002.
2- K. Ross, Elementary Analysis: The Theory of calculus, Springer Int. Edition, 2004.
3- W. Rudin, Principles of Mathematical Analysis, 3rd ed., McGraw-Hill, 1983.
4- P.R. Halmos, Measure Theory, Graduate Text in Mathematics, Springer-Verlag, 1979.
5- Inder K. Rana, An Introduction to Measure and Integration (2nd ed.), Narosa Publishing House, New Delhi, 2004.
6- H.L. Royden, Real Analysis, 3rd ed., Macmillan, 1988.

Paper 3

ORDINARY DIFFERENTIAL EQUATIONS

B0307037

Credits: 05 **Max. Marks: 100**

Evaluation: Continuous Internal Assessment – 25 marks

Semester End Examination – 75 Marks

Course Title: Ordinary Differential Equations

Course Type: Core paper

Course Level: PG

Unit-1

Non-linear ordinary differential equations of particular forms, Riccati's equation - General solution and the solution when one, two or three particular solutions are known.

Unit-2

Total Differential equations, Forms and solutions, necessary and sufficient conditions, Geometrical Meaning Equation containing three and four variables, total differential equations of second degree.

Unit-3

Series Solution: Radius of convergence, method of differentiation, Cauchy-Euler equation, Solution near a regular point (Method of Forbenius) for different cases, Particular integral and the point at infinity.

Unit-4

Existence and uniqueness of solutions to first order equations: Introduction, Exact Differential Equations, successive approximation, Lipchitz's condition, convergence of successive approximation, Non local existence of solutions, Approximations to solutions and uniqueness of solutions, Existence and Uniqueness of solutions to systems.

Books:

1- Ordinary Differential Equations : Garret Birkhoff and Gian-Carlo Rota

2- Ordinary Differential Equations: D. Somusundaram.

3- An introduction to ordinary Differential Equations: Earl A. Coddington.

Not to be republished © NEP

Paper 4

COMPLEX ANALYSIS

B030704T

Credits: 05 **Max. Marks: 100**

Evaluation: Continuous Internal Assessment – 25 marks

Semester End Examination – 75 Marks

Course Title: Complex Analysis

Course Type: Core paper

Course Level: PG

Unit-1

Conformal Mapping: Introduction, conformal transformation, sufficient condition for $w = f(z)$ to represent a conformal mapping, necessary condition for $W = f(z)$ to represent a conformal mapping, superficial transformations, some special transformations power, special power, the inverse mapping, the mapping $w = e^z$; the mapping $w = \log z$, the mapping $w = z^n$.

Unit-2

Calculus of Residues: Cauchy Residue theorem, evaluation of the real definite integral, case of poles on real axis, evaluation of the integral when the integrand involves multiple valued functions, uses of rectangular contours, summation of infinite series.

Unit-3

Analytic Continuation: Determination of a given function , analytic in a domain by a function elements, extension of a function by power series with a finite non-zero radius of convergence, analytical continuation of a function, analytic continuation to a point, complete analytic function, natural boundary, continuation by power series.

Unit- 4

Entire function, factorization of integral functions - Weierstrass's theorem, Weierstrass's factorization theorem, Picard's theorem, Jensen's Inequality, Jensen's formula, Jensen's theorem, Poisson- Jensen's formula, growth of an entire function, maximum modulus of an entire function, order of an integral function, Hadamard's three circle principle, convex function- the three circle theorem as a convexity theorem

Text /References:

1- J.B. Conway, Functions of One Complex Variable, 2nd ed., Narosa, New Delhi.
2- L.V. Ahlfors, Complex Analysis, McGraw-Hill book Company.
3- T.W. Gamelin, Comple Analysis, Springer International Edition, 2001.
4- M. J. Ablowitz and A. S. Fokas, Complex variables: Introduction and Applications, Foundation Books
5- B. Chaudhary, The Elements of Complex Analysis, Wiley Eastern
6- Shanti Narayan, Theory of Functions of a complex variable, S. Chand & Co.

Paper 5

INTRODUCTORY STATISTICAL METHOD B0307057

Credits: 04 **Max. Marks: 100**

Evaluation: Continuous Internal Assessment – 25 marks

Semester End Examination – 75 Marks.

Course Title: Introductory Statistical Method

Course Type: Minor paper

Course Level: PG

Unit-1

Measures of central tendency, Frequency distribution, Graphical representation of frequency distribution, Properties of measures of central tendencies, Probability and examples of probability, Conditional probability, Discrete probability distributions (Binomial and Poisson), Continuous probability distributions (Normal).

Unit-2

Dispersion, Various measures of dispersion, Minimal property of mean deviation, Root mean square deviation, Variance and standard deviation. Moments about mean, origin, and any point, Skewness, Kurtosis, Pearson's β and γ- coefficients, Method of least squares, Curve fitting, Fitting of straight lines, Fitting of second degree curve, Fitting of a polynomial of k-th degree, Change of origin, Selection of type of curve to be fitted, Exponential curves.

Unit-3

Correlation and Regression Analysis: Significance of measuring correlation, Types of correlation, Methods of measuring correlation, Regression analysis, Lines of regression.

Unit-4

Sampling and Hypothesis Testing: Census and sampling method, Merits and limitations of sampling, Sampling and non-sampling errors, Reliability of samples, Standard error of estimate, t-test for single mean and difference of means, F-test, z-test, Chi-square test.

Recommended books:

1- Miller, Irwin and Miller, Marylees (2006): John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.

2- Goon A. M., Gupta M. K. and Dasgupta B. (2005): Fundamentals of Statistics, Vol. I, 8th Ed., World Press, Kolkata.

3- Gupta, S. C. and Kapoor, V. K. (2007): Fundamentals of Mathematical Statistics, 11th Edn., (Reprint), Sultan Chand and Sons.

4- Mood, A. M. Graybill, F. A. and Boes, D. C. (2007): Introduction to the Theory of statistics, 3rdEdn., (Reprint), Tata McGraw-Hill Pub. Co. Ltd.

5- Hogg, R.V. and Tanis, E. A. (2009): A Brief Course in Mathematical Statistics. Pearson Education.

M.Sc. Second Semester

Mathematics

Paper 1

INVENTORY AND QUEUING MODELS

B030801T

Credits: 04 **Max Marks: 100**

Evaluation: Continuous Internal Assessment - 25 marks
Semester End Examination - 75 marks

Course Title: Inventory and Queuing Models
Course Code: C1
Course Type: Core paper
Course Level: PG

Unit-1

Inventory Models: Deterministic Inventory Models without and with shortage, production models without and with shortage, EOQ problems with price break, Probabilistic Inventory Models

Unit-2

Markov Chain definition and example, Transition Probabilities, Transition Matrix, Higher Transition probabilities, Chapman- Kolmogorov equations, Generalization of Independent Bernoulli trials, Classification of State and Chains, Stability of Markov Chain, Markov process with continuous State Space

Unit-3

Markov Process with discrete state space, Poisson Process and related distribution, Generalization of Poisson Process, Birth- Death Process, Continuous time Marko Chain, Erlang Process, Renewal Process, Renewal Process in continuous time, Renewal Theory, Wald's equations, Renewal Theorem, Markov Renewal Equation, Semi Markov Process

Unit-4

Queueing System-general concept, Steady State solutions, M/M/1, M/M/c, M/M/1:N, M/M/c:N, M/Ek/1Markov Models, M/G/1non Markovian Model

Recommended books:

1- Stochastic Process : J Medhi
2- Operations Research: Kantiswroop et.el.
3- Fundamental o · Queueing Theory: Gross and Harris
4- Queueing System(Vol. 1) : L Kleinrock

Paper 2

FLUID MECHANICS

B030802T

Credits: 04 **Max Marks: 100**

Evaluation: Continuous Internal Assessment - 25 marks
Semester End Examination - 75 marks

Course Title: Fluid Mechanics
Course Code: C2
Course Type: Core paper
Course Level: PG

Unit-1

(a) **Kinematics:** Lagrangina and Eulerian methods, Steady and Unsteady flows, Uniform and Non uniform flows, Stream lines, Path lines and streak lines, Equation of continuity (Certesian, polar & cylindrical coordinates), Equivlence of the two forms of Equation of continuity, velocity potential, Irrotational & Rotational flows, Boundary Surface.

(b) **Conservation of Momentum:** Euler's of motion, Equation of motion of motion of an unviscid fluid, Bernoulli's equation, Conservative field of force, Integration of Euler's equation, Impulsive motion of a fluid, Energy Equation, Application of Bernoulli's theorem.

Unit-2

(a) **Irrotational Motion:** General motion of a fluid element, Vorticity, Flow and Circulation, Stoke's theorem, Kelvin's circulation theory

(b) **Motion in two dimensions:** Stream function & its physical interpretation complex potential and complex velocity, Two dimensional source, Sink and doublet (Strength and complex potential) Image of source and doublet with regard to a plane & circle the circle theorem, Application to fluid dynamics.

Unit-3

(a) **Viscous fluid flow:** Stress analysis, Symmetry of stress tensor, stress in a fluid at rest and in motion, Transformation of stress components, Principal stresses and principal directions, strain analysis, Rate of strain quadric, Navier stokes equation, of motion of viscous fluid, Equation of energy, Dissipation of energy, Vorticity and circulations &

NEP LIBRARY

viscous fluid, Diffasion of vorticity, the equations of state, Reynolds number.

Unit-4

Exact solutions of the Navier stoke's Equation: Laminar flow between parallel plates, Plane Couette flow, Plane poiseuille flow, flow between parallel plates (Temp. distribution) Hagen Poiseuille flow through a circular pipe, Steady flow between co-axial circular pipes, Lamianr flow between concentric rotating cylinders, Temperature distribution, Steady motion of a flat plane. Flow due to an oscillating flat plate. Pulsatile flow between parallel surfaces, Solution of the Navier stokes equation at low Reynolds number, flow past a sphere & circular cylinder.

Laminar boundary layer flow: Two dimensional boundary layer equation for flow over a plane wall, Boundary layer flow along a flat plate, Properties of boundary layer equation, momentum integral equation for boundary layer, Momentum and Energy integral equation for the boundary layer, Application of the momentum integral equation to boundary layer: von karma'n Bhonausen method.

Recommended books:

1. Fluid Dynamics by M. Ray
2. Fluid Dynamics by R.K. Gupta
3. Fluid Dynamics by G.K. Batcheler
4. Fluid Dynamics by M.D. Raisinghania
5. Fluid Dynamics by R.K. Rathy

SYLLABUS FOR

Paper 3

COMPUTATIONAL NUMERICAL METHODS B0308O3T

Credits: 04 **Max Marks: 100**

Evaluation: Continuous Internal Assessment - 25 marks
Semester End Examination - 75 marks

Course Title: Computational Numerical Methods
Course Code: C3
Course Type: Core paper
Course Level: PG

Unit-1

Error Analysis: Solution of algebraic and transcendental equations in one variable by secant, Regula-Falsi method, Newton-Raphson's Method, Iterative method.

Unit-2

Matrix inversion by the escalator method, Iterative method; Jacobi's method, Gauss-seidel method.

Unit-3

Simple step and multi-step methods of numerical Solution of Ordinary differential equations, Picard method, Taylor series method, Euler's method, Euler's modified method, Runge-Kutta methods, Milne's methods.

Unit-4

Interpolation (Linear, Hermite, cubic spline), Algebraic-eigen values and vectors : Iterative method for finding eigen values and eigen vectors, Jocobi's method; complex eigen values.

Reference/ Text Books:

1- Numerical Methods : R.K. Jain, S.R.K. Iyengar and M.K. Jain
2- Numerical Methods using MATLAB: Mathews and Finle
3- Applied Numerical Anaysis: Gerald and Wh ealtey

Approved by BOS for NEP

Dehra

Paper 4

(Optional Paper- a)

FUZZY MATHEMATICS

B030804T

Credits: 04

Max Marks: 100

Evaluation: Continuous Internal Assessment - 25 marks
Semester End Examination - 75 marks

Course Title: Fuzzy Mathematics
Course Code: C4 (a)
Course Type: Elective Paper
Course Level: PG

Unit-1

Crisp sets, Fuzzy sets and their basic concepts, operations on fuzzy sets, Fuzzy arithmetic, Fuzzy relations, Fuzzy relation equations based on sup - i composition and on Inf - wi composition.

Unit-2

Possibility theory, Fuzzy measure, Evidence theory, possibility theory, Fuzzy sets and possibility theory

Unit-3

Fuzzy logic, Classical logic, Multivalued logic, Fuzzy propositions, Fuzzy quantifiers, inference from conditional fuzzy propositions

Unit-4

Uncertainty based information: Information and Uncertainty, Non specificity of Crisp sets, Non specificity of Fuzzy sets, Fuzziness of Fuzzy sets, Fuzzy sets in Business management, Psychology, Foods and nutrition with good number of case studies.

References:

1- Fuzzy sets and fuzzy logic, theory and applications- George J. Klir, Yuan Prentice Hall 2006.
2- Analysis and management of uncertainty: Theory and application: Ayyub, B.M., L.N. Kana. North Holland, Newyork 1992.
3- Fuzzy data Analysis: Bandler, W. and W. Nather, Kluwer 1996.
4- Fuzzy Mathematical Techniques with Applications: Addison Wesley, 1985

AS PER NEP

Paper 4

(Optional Paper- b)

HISTORY & DEVELOPMENT OF INDIAN MATHEMATICS B030805T

Credits: 04 **Max Marks: 100**

Evaluation: Continuous Internal Assessment - 25 marks
Semester End Examination - 75 marks

Course Title: History & Development of Indian Mathematics
Course Code: C4 (b)
Course Type: Elective Paper
Course Level: PG

Unit-1

Indian contributions to decimal system and place value, The mathematical sophistication of the Harappan culture, The Vedic period and the sulva geometry.

Unit-2

Contribution of the Jainas, Chandas Sutras of Pingala and binary arithmetic, The Baksali Manuscript, Aryabhata I, Varahamihir, Brahmagupta, Bhaskara I.

Unit-3

Sridharacharya, Mahaveeracharya, Shripati, Aryabhata II, Bhaskaracharya II, Contributions of Kerala school as Madhava, Nilkantha.

Unit-4

Srinivasa Ramanujan, Swami Bharati Krishna Tirthaji, Prasanta Chandra Mahalanobis, Prof. Harishchandra.

SYLLABUS FOR NEP

Recommended books:

1. B. B. Datta and A. N. Singh, History of Hindu Mathematics, 2 Volumes, Bharatiya Kala Prakashan, Delhi,2001.
2. C. N. Srinivasiengar, The history of Ancient Indian mathematics, World Press, 1988.

Paper 4

(Optional Paper- c)

WAVELET ANALYSIS

B0308O6T

Credits: 04

Max Marks: 100

Evaluation: Continuous Internal Assessment - 25 marks
Semester End Examination - 75 marks

Course Title: Wavelet Analysis
Course Code: C4 (c)
Course Type: Elective Paper
Course Level: PG

Unit-1

Fourier transforms, Inverse Fourier transforms, Basic properties of Fourier and inverse Fourier transforms, Convolution and delta function, Fourier transform of square integrable functions, Poisson's summation formula.

Unit-2

Construction of wavelets on Z_N, Haar wavelets on Z, Shannon wavelet, The Gabor transform, Heisenberg uncertainty principle, Description of $L^2(Z)$, $L^2[-\pi,\pi]$ and $L^2(R)$ Parseval's relation.

Unit-3

Multi resolution analysis, MRA wavelets, Scaling functions with finite two scale relations, Direct sum decomposition of $L^2(R)$, Linear phase filtering, Low-pass filters and scaling functions, Compactly supported wavelets, Wavelets and their duals.

Unit-4

Franklin wavelets on R, Orthogonal wavelets and wavelet packets, Example of orthogonal wavelets, Identification of wavelet packets, Construction of compactly supported orthogonal wavelets, Orthogonal wavelet packets, Orthogonal decomposition of wavelet series.

Recommended books:

1. C. K. Chui, An Introduction to Wavelets, Academic Press, 1992.
2. I. Daubechies, Ten Lectures on Wavelets, CB5-NSF Regional Conference in Applied Mathematics, 61, SIAM, 1992.
3. M. W. Frazier, An Introduction to Wavelets through Linear Algebra, Springer-Verlag, 1999.
4. E. Hernandez and G. Weiss, A First Course on Wavelets, CRC Press, 1996.

Paper 4

(Optional Paper- d)

RIEMANNIAN GEOMETRY AND TENSOR ANALYSIS

B030807T

Credits: 04 **Max Marks: 100**

Evaluation: Continuous Internal Assessment - 25 marks
Semester End Examination - 75 marks

Course Title: Riemannian Geometry and Tensor Analysis
Course Code: C4 (d)
Course Type: Elective Paper
Course Level: PG

Unit-1
Geodesics, Differential equation of a geodesic, Single differential equation of a geodesic, Geodesic on a surface of revolution, Geodesic curvature and orison, Gauss-Bonnet Theorem.

Unit-2
Tensor Ariatysis-Kroneeker delta. Contac variant and Covariant tensors, Symmetric tensors, Quotient Jaw of tensors, Relative tensor. Riemannian space. Metric tensor, indicator, Permutation symbols and Permuafon tensors.

Unit-3
Christoffel symbols and their properties. Covariant differentiation of tensors. Ricci's theorem, Intrinsic derivative, Geodesics, Differential equation of geodesic, Geodesic coordinates, Field of parallel vectors.

Unit-4
Reimann-Christoffel tensor and its properties, Covariant curvature tensor, Einstein space, Bianchi's identity, Einstein Tensor, Flaw pace, Isotropic point, Schwarz's theorem.

Reference/ Text Books:

1- L. P. Eisenhart "Riemannian Geometry" Princeton University Press
2- J.C. H. Gorretsen "Lectures on Tensor Calculus and differential Geometry"
3- H. Lass "Vector and Tensor Analysis" McGraw Hill, N.Y.
4- S. Mishra "A course in Tensors with application to Riemannian Geometry' Pothishala Publication.

Paper 5

Practical

COMPUTER PROGRAMMING WITH C/C++ B030808P

Credits: 04 **Max Marks:100**

Evaluation: Continuous Internal Assessment – 25 marks

Semester End Examination – 75 Marks

Course Title: Computer Programming with c/c++
Course Code: C5
Course Type: Practical
Course Level: PG

Problems of Numerical Methods & Operations Research through 'C' and "C++". Numerical Integration, Solution of ODE, Solution of System of Linear Equations, Solutions of LPP, Solution of Inventory Problems

PG SYLLABUS FOR NEP

M.Sc. Third Semester

Mathematics

Paper 1

TOPOLOGY

B030901T

Credits: 05

Max Marks:100

Evaluation: Continuous Internal Assessment – 25 marks

Semester End Examination – 75 Marks

Course Title: Topology
Course Code: C1
Course Type: Core Paper
Course Level: PG

Unit-1

Definitions and examples of topological spaces, closed sets, closure of a set, dense subsets, Kuratowski closure axioms, neighborhood of a point, interior, exterior, frontier (Boundary), accumulation (limit) point and derived sets, basis for topology, order topology, subspace topology.

Unit-2

Continuous mapping and Homeomorphism, Nets, filters, compact spaces, Compact subspaces of the real line.

Unit-3

Separation axioms (T0, T1, T2, T3, T4), regular spaces, normal spaces, Compact and locally compact spaces, Continuity and Compactness.

Unit-4

Countability axioms, Product and Quotient spaces, Connected and Locally Connected spaces, Continuity and Connectedness.

Recommended books:

1- J.L. Kelly: "General Topology" von Nostrand Reinhold Co. (Affiliated East West Press)
2- J. R. Munkres: "Topology; A First Course'', Prentice Hall
3- K.P. Gupta: "Topology" Pragati Prakashan

ONLY AS PER NEP

Paper 2

OPERATIONS RESEARCH

B030902T

Credits: 05

Max Marks:100

Evaluation: Continuous Internal Assessment – 25 marks

Semester End Examination – 75 Marks

Course Title: Operations Research
Course Code: C2
Course Type: Core Paper
Course Level: PG

Unit-1

Introduction: Nature and Scope of operations research, Linear Programming: Mathematical formulation of the 'problem, Graphical Solution methods

Unit-2

The Simplex Method: Fundamental properties of solution, Simplex algorithm, Artificial variables, Two phase Simplex Method, Big M method, Unrestricted variables, problems of degeneracy, Principle of duality in simplex method, Formation of dual with mixed type of constraints, Dual Simplex Method. Integer Programming.

Unit-3

Non-Linear programming : Mathematical Formulation, Constrained Optimization, Khun Tucker Conditions of optimality, Quadratic Programming, Beale Method, Wolfe method.

Unit-4

Assignment and transportation problems and algorithm, optimal solution, Replacement problem and Sequencing problem, Game Theory: Two persons zero sum games, The maxmin and minimax principles, Games without saddle points, Dominance Property, Graphical Solution of two persons game.

Books and References:

1- Kanti Swarup, "Operations Research", Sultan Chand & sons
2- N.P Loomba "linear Programming"
3- H.A. Taha "Operations Research: An introduction".
4- Kasana and Kumar "Introduction to operations research" Springer

Paper 3

ADVANCED FLUID MECHANICS

B030903T

Credits: 05

Max Marks:100

Evaluation: Continuous Internal Assessment – 25 marks

Semester End Examination – 75 Marks

Course Title: Advanced Fluid Mechanics
Course Code: C3
Course Type: Core Paper
Course Level: PG

Unit-1

Three dimensional irrotational flow, Asymmetric flow, Strokes Stream function, Asymmetric potential flow, Liquid streaming past a stationary sphere, Uniform motion of a sphere in a liquid at rest at infinity, Concentric sphere (problem of initial motion).

Unit-2

Vortex motion, Vortex filament, Complex potential, Image of vortex, Complex potential due to vortex doublet, Spiral vortex, Rankine combined vortex, Rectilinear vortex with elliptic cross-section, Routh's theorem, Motion of any vortex, Kirchhoff vortex theorem.

Unit-3

Newton's Law of viscosity, Newtonian and non-Newtonian fluids, Definition of stress, strain and their relations, Relation between stresses and rate of strain, Navier-Stoke's equation, Dissipation of energy, Diffusion of vorticity, Laminar flow of Viscous incompressible fluids.

Fluid pressure: Equation of pressure, Condition of equilibrium, Lines of force, Homogeneous and heterogeneous fluids, Elastic fluids, Surface of equal pressure and density, Rotating fluids.

Unit-4

Fluid pressure on plane surface: Centre of pressure, Resultant pressure on curved surfaces.

Gas Laws: Height of station by Barometer, Mixture of gases, Internal energy, Adiabatic expansion, Work done in compressing a gas, Convective equilibrium.

Recommended books:

1- W.H. Besant and A.S. Ramsey, A Treatise on Hydrodynamics, CBS publishers and Distributors, Delhi, 1988.
2- R.K. Rathy, An introduction to fluid Dynamics, Oxford and IBH Publishing Company, New Delhi; 1976.
3- F. Charlton, A Text Book of Fluid Dynamics, CBC, 1985.
4- S.W. Yuan, Foundations of Fluid Dynamics, Prentice – Hall of India, 1988.
5- B. D. Sharma, Hydro-statics, Kedar Nath Ram Nath Publication.

Paper 4

(Optional Paper-a)

FINANCIAL MATHEMATICS

B030904T

Credits: 05 **Max Marks:100**

Evaluation: Continuous Internal Assessment – 25 marks

Semester End Examination – 75 Marks

Course Title: Financial Mathematics
Course Code: C4 (a)
Course Type: Elective Paper
Course Level: PG

Unit-1

Review of probability, finite probability space, Derivatives security, interest rates, other financial instruments.

Unit-2

Arbitrage and pricing, risk less issue, yield curves, mean terms matching and immunization, interest rate models, Dependent annual rates of return

Unit-3

Random walk and Markov process, stochastic calculus, option pricing, Portfolio optimization, Fokker-plank equation, distribution and green functions

Unit-4

Feynman-kac formula options, dividends revisited, Exotic options, bond pricing, transaction costs, time series, stochastic processes, Neural nets.

Text books/References:

1- Financial Mathematics-Richard Brass, Springer (2003)
2- Mathematics of financial derivatives-Wilmott & Howison, Springer (2005)
3- Hand book of stochastic methods-Gardiner, Wiely (2000)

Draft Syllabus for NEP

Paper 4

(Optional Paper-b)

COMPUTATIONAL FLUID DYNAMICS

B030905T

Credits: 05 **Max Marks:100**

Evaluation: Continuous Internal Assessment – 25 marks

Semester End Examination – 75 Marks

Course Title: Computational Fluid Dynamics
Course Code: C4 (b)
Course Type: Elective Paper
Course Level: PG

Unit-1

Incompressible plane flows, Stream function and vorticity equations, Conservative form and normalizing systems, Method for solving vorticity transport equation

Unit-2

Basic finite difference forms, Conservative property, Convergence and stability analysis, Explicit and implicit methods, Finite difference method for partial differential equation

Unit-3

Stream function equation and boundary conditions, Schemes for advective diffusion equation

Unit-4

Solution for primitive variables, Finite element Method for Computational Fluid Dynamics

Text and References:

1- C.A. J. Fletcher, Computational Techniques for Fluid Dynamics, Volume 1 & 2, Springer Verlag, 1992.
2- C.Y Chow, Introduction to Computational Fluid Dynamics, John Wiley, 1979
3- Holt, Numerical Methods in Fluid Mechanics, Springer Verlag, 1977
4- H.J. Wirz and J.J. Smolderen, Numerical Methods in Fluid Dynamics, Hemisphere, 1978.
5- D.A. Anderson, J.C. Tannehill and R.H. Pletcher, Computational Fluid Dynamics and Heat Transfer, McGraw Hill. 1984.

LAPUSE FOR NEP

Paper 4

(Optional Paper-c)

BIO-MATHEMATICS

B030906T

Credits: 05 **Max Marks:100**

Evaluation: Continuous Internal Assessment – 25 marks

Semester End Examination – 75 Marks

Course Title: Bio-Mathematics
Course Code: C4 (c)
Course Type: Elective Paper
Course Level: PG

Unit-1

Epidemic models: Deterministic models without removal, general deterministic model with removal, general deterministic model with removal and immigration, control of an epidemic.

Unit-2

Mathematical models in Pharmacokinetics: basic equations and their solutions, solutions for special cases, determination of transfer coefficients and compartment volumes, mathematical techniques used in compartment analysis, stochastic compartment models.

Unit-3

Models for blood flows some basic concepts for fluid dynamics, basic concepts about blood, cardiovascular system and blood flows, steady non-Newtonian fluid flow in circular tubes, Newtonian pulsatile flows in rigid and elastic tubes, blood flow through artery with mild stenosis, peristaltic flow in tubes and channels, Models for air flow in lungs, Diffusion and Diffusion-reaction models, the diffusion equations, oxygen diffusion living tissues.

Unit-4

Non-linear populations growth models, models in genetics, basic model for inheritance, models for genetic improvement: selection and mutation applications in ecological and environmental subject areas, urban waste, water management, planning.

Books:

1- Mathematical Modelling: J N Kapoor
2- Mathematical Modelling in Biology Medicine: J.N. Kapoor
3- Mathematical Biology: J.D. Murty
4- Ecology and Resource Management : K.E.F. Watt

Paper 4

(Optional Paper-d)

INTEGRAL EQUATIONS & BOUNDARY VALUE PROBLEMS

B0309077

Credits: 04 **Max Marks:100**

Evaluation: Continuous Internal Assessment – 25 marks

Semester End Examination – 75 Marks

Course Title: Integral Equations & Boundary Value Problems
Course Code: C4 (d)
Course Type: Core Paper
Course Level: PG

Unit-1

Definition of integral equations, Types of integral equations, Kernel, Fredholm and Volterra integral equations, Verification of solution of integral equations, Conversion of integral equation to differential equation and vice-versa, Initial value problem & Volterra integral equation, Boundary value problem and Fredholm integral equation.

Unit-2

Solution of Fredholm integral equation by method of successive approximation, Resolvent kernel, Solution of Volterra integral equation by method of successive approximation and by method of successive substitution, Fredholm determinant, Convergence of Fredholm series.

Unit-3

Solution of integral equations by method of Laplace transform, Convolution type kernel, Solution of integral equation by Fourier transform method, Singular integral equation, Cauchy and Hilbert type kernel, Solution of singular integral equation having kernel of h(s)- h(t) type.

Unit-4

Boundary value problems, Initial value problems, Green's function, Construction of Green's function from given boundary value problem, Applications of Green's function, Modified Green's function, Dirac Delta function.

Recommended books:

1. Linear integral equations theory & techniques, R.P. Kanwal Academic Press New York 1971.
2. Linear integral equation & boundary value problem by M. D. Rai Singhania, S. Chand & Co. 2005.
3. Integral Equation by Shanti Swaroop, Krishna Prakashan, 1989.
4. A first course in integral equation, A M Wazwar, Saint Xavier Univ. USA Dec 1997.

M.Sc. Fourth Semester

Mathematics

Paper 1

FUNCTIONAL ANALYSIS

B031001T

Credits: 04 **Max Marks:100**

Evaluation: Continuous Internal Assessment – 25 marks

Semester End Examination – 75 Marks

Course Title: Functional Analysis
Course Code: C1
Course Type: Core Paper
Course Level: PG

Unit-1

Normed Linear spaces, Quotient space of normed linear spaces and its completeness, Banach spaces and examples, Bounded linear transformations, Normed linear space of bounded linear transformations.

Unit-2

Equivalent norms, Basic properties of finite dimensional normed linear spaces and compactness, Reisz Lemma, Open mapping theorem, Closed graph theorem, Uniform boundness theorem.

Unit-3

Continuous linear Functional, Hahn-Banach theorem and its consequences, Embedding and reflexivity of normed linear spaces, Dual spaces with examples, Boundedness and Continuity of Linear operators.

Unit-4

Inner product spaces, Hilbert space and its properties, Orthgonality in Hilbert spaces, Phythagorean theorem, Projection theorem, Orthonormal sets, Bessel's inequality, Complete orthonormal sets, Paseval's identity.

Reference/ Text Books:

1- G. F. Simmons: "introduction to Topology and Modern Analysis"
2- B. K. Lahiri: "Functional Analysis"
3- J. B. Conway: "Functional Analysis"

SYLLABUS FOR NEP

PAPER 2

SPACE DYNAMICS

B031002T

Credits: 04 **Max Marks:100**

Evaluation: Continuous Internal Assessment – 25 marks

Semester End Examination – 75 Marks

Course Title: Space Dynamics
Course Code: C2
Course Type: Core Paper
Course Level: PG

SYLLABUS FOR NEP

Unit-1

D' Alembert's principle, The general equations of motion of a rigid body, Motion of centre of inertia and motion relative to centre of inertia, Motion about a fixed axis.

Unit- 2

The compound pendulum, Centre of percussion, Motion of a rigid body in two dimensions under finite and impulsive forces.

Unit-3

Motion in three dimensions with reference to Euler's dynamical and geometrical equations, Motion under no forces, Motion under impulsive forces, Conservation of momentum (linear and angular).

Unit-4

Lagrange's equations for holonomous dynamical system, Energy equation for conservative field, Small oscillations, Motion of a top, Hemilton's equations of motion, Hamilton's principle and principle of least action.

Books:

1- IE. A. Milne, Vectorial Mechanics, Methuen & Co. Ltd., London, 1965
2- A. S. Ramsay. Dynamics Part II, CBS Publishers and Distributors, Delhi, 1985
3- H. Goldstein, Classical Mechanics, Addison Wisley Pub. Co. London, 1969
4- I. A. Pars, A treatise on Analytical Dynamics, Heinemann, London, 1968

Paper 3

(Optional Paper-a)

CALCULUS OF VARIATIONS

B031003T

Credits: 04

Max Marks:100

Evaluation: Continuous Internal Assessment – 25 marks

Semester End Examination – 75 Marks

Course Title: Calculus of Variations
Course Code: C3 (a)
Course Type: Elective Paper
Course Level: PG

Unit I

Evolution of calculus of variations and contribution of Bernoulli, Functional, Euler's equation of extrema for functionals involving first order derivative, Functional dependent on more than one dependent variables, Functional dependent on two independent variables: Euler Ostrogradsky equation, Generalised Eular's Ostrogradsky Equation, Functional dependent on higher order derivative: Euler Poisson's equation.

Unit-2

Weierstrass function, sufficient condition of extrema, Legendre condition, Isoperimetric problem, Local maxima, Invariance of Euler's equation under coordinate transformation, Problems based on Legendre condition.

Unit-3

Moving boundary value problem, condition of extrema, Transversality condition, Variational problem with movable boundary for a functional dependent on two functions, Two sided variation, Reflection & refraction of extremals, Diffraction of light rays.

Unit-4

Field extremal, Jacobi condition, Second variation, Canonical equations, Applications of calculus of variations in Lagrarge's equation, Application of calculus of variations in the Hamilton's equation, Hamiltons variational principle.

Recommended books:

1. Calculus of Variations with Applications, AS Gupta, Printice Hall of India,1997.
2. Calculus of Variations, I.M. Gelfand and S.V. Fomin, Dover Publication, 2000.
3. Calculus of Variations, Mukesh Singh, Krishna Publications, 2015.

Paper 3

(Optional Paper-b)

CODING THEORY

B031004T

Credits: 04 **Max Marks:100**

Evaluation: Continuous Internal Assessment – 25 marks

Semester End Examination – 75 Marks

Course Title: Coding Theory
Course Code: C3 (b)
Course Type: Elective Paper
Course Level: PG

Unit-1
Polynomial rings over fields, Extension of fields, Computation in Gf(q), Root fields of polynomials, Vector space over finite fields.

Unit-2
Binary group codes, Hamming codes, Linear block codes, The structure of cyclic codes, Quadratic residue codes, Reed Mueller codes, Simplex codes.

Unit-3
Nonlinear codes, Golay, Hadamard, Justeen, Kerdock, Nordstorm-Robinson codes, First and Second order Reed-Mueller codes, t-designs, steiner systems, Weight distribution of codes.

Unit-4
Generalized BCH codes, self dual codes and invariant theory, Covering radius problem, Convolutional codes.

Books and References:

1- Coding Theory, Cryptography and Related Areas by J Buchmann, T Hoholdt, H Stichtenoth.
2- Error-correcting codes, Self-checking circuits and applications by Waker v, J. North-Holland, New Yorlk 1978
3- Algebra und codes by Wan Zh. Wissenschaftsverlag, Peking, 1980.
4- Codes and Kryptograrphy, Welsh, D.k, VCH, Weinheim 1991.
5- Coding Theorems of information theory by Wolfowitz, J., Springer, Berlin, 1978.
6- Principles of communication engineering by Wozen.cn1ft, M., Jae.obs, I. John Wiley, New York.
7- Sequential Decoding by Wozencraft, M., Reiffen, B, MJ.T. Press, Cambridge/Mass.
8- Codes for error control and synchronization by Wiggert, D. Artech, Boston/Mass. 1988.

Paper 3

(Optional Paper-c)

SPECIAL FUNCTIONS

B031005T

Credits: 04

Max Marks:100

Evaluation: Continuous Internal Assessment – 25 marks

Semester End Examination – 75 Marks

Course Title: Special Functions
Course Code: C3 (c)
Course Type: Elective Paper
Course Level: PG

Unit-1

Differential equations with three regular singularities, Hyper geometric differential equations, Gauss' hyper geometric functions, Elementary properties-contiguous relation, integral representation linear and quadratic transformation and summation formulae, Analytic continuation, Barnes' contour integral representation, Confluent hyper geometric function and its elementary properties.

Unit-2

Generalised hypergeometric function and its elementary properties, linear and quadratic transformations, summation formulae, Hermite, Laguerre, Jacobi and Ultraspherical polynomials, Definition and elementary properties.

Unit-3

Asymptotic Series: Definition, elementary properties-term by term differentiation, integration, theorem of uniqueness, Watson's lemma, asymptotic expansions of 1F1, zF1, Orthogonal polynomial Definition their zeros expansion in term of orthogonal polynomials, three term recurrence relation, Christoffel-Darboux formula, Bessel's inequality, Characterization –Appell-Sheffes and o-type characterization of polynomial sets.

Unit-4

Weierstrass Elliptic Functions, Jacobi's first and second equations, zeros and poles of elliptic functions, Weierstrass' functions p(z) and o(z), pseudo periodicity of f(z), Differential equation, addition theorem for p(z), Algebraic relation between two elliptic functions, expansion for elliptic functions in term of o(z) and p(z), Evaluation of elliptic integrals.

References/Books

1- Special Functions E. ID. Rainville, Mac Millan
2- Theory of complex variables ET., Copson Wiley
3- Resonance of Ramanujan Mathematics volume I, II, 111, R.P. Agarwal, Narosa Publication.
4- Theory of Hypergeometric functions and applications, Gasper and Rehman

Paper 3
(Optional Paper-d)
FRACTIONAL CALCULUS

B0310067

Credits: 04

Max Marks:100

Evaluation: Continuous Internal Assessment – 25 marks

Semester End Examination – 75 Marks

Course Title: Fractional Calculus
Course Code: C3 (d)
Course Type: Elective Paper
Course Level: PG

Unit-1

Some Special functions of fractional calculus: (i) Gama function (ii) Wright function (iii) Mittag leffler function (iv) Miller ross function, Graunwald-Letnikow (GL) fractional derivative, GL fractional derivative of $(t-a)^{\beta}$

Unit-2

The Riemann-Liouville fractional integral; fractional integral of some functions namely binomial functions, exponential, hyperbolic and trigonometric functions, Bessel's function, Leibnitz formula for fractional integral and integral of fractional derivative.

Unit-3

Riemann- Liouville fractional derivative Leibnitz formula for fractional derivative. Laplace and Fourier transform of fractional derivative. Mellin transform of fractional derivative.

Unit-4

Definition weyl fractional derivative, definition of Caputo fractional derivative, Leibnitz formula for weyl and Caputo fractional derivative, Laplace transform of Caputo fractional derivative, Difference between Caputo and R.L. fractional derivative

Refference:

1- Miller K.S & Ron B.: An Introduction to the fractional differential equations, John Wiley and sons, 1993.
2- Samko SG, Kilbas A.A, Marichev O.I. fractional Integral and derivative, Forden and Breach science publishers, 1987.
3- Kilbas A.A., Srivastava H.M. Trujilllo J.J. Theory and Application of fractional differential equation else view 2006.
4- Oldham & Spanier : The fractional calculus Academic peer fine, 1974.
5- Ricardo, Dina, Delfin & Tornes : The variable order fractional calculus of variation Springer 2019.
6- Podlerbany fractional differential equation Academic peer Ine. 1999.
7- Das S. functional fractional calculus Springer 2011.

29

PAPER 3

(Optional Paper-e)

MATHEMATICAL MODELLING

B0310071

Credits: 05

Max Marks:100

Evaluation: Continuous Internal Assessment – 25 marks

Semester End Examination – 75 Marks

Course Title: Mathematical Modelling
Course Code: C3 (e)
Course Type: Elective Paper
Course Level: PG

Unit-1

Role of Mathematics in Problem solving, Problem definition, case studies, System characterization- Basic Concept, Degree of Detail, Static vs Dynamics, Deterministic vs Stochastic.

Unit-2

General Introduction to models, model classification, Mathematical model-Empirical vs Theoretical models, Analog and Simulation Model, Mathematical Modeling Process, Validation criteria, Mathematical formulation - Classification of Mathematical Formulation, Static formulation, Difference equation formulation, ODE and PDE formulation, Random Variable and Stochastic Process, Static formulation, Discrete/continuous state/time formulation.

Unit-3

Analysis of Mathematical Formulation- types of Analysis, Types of computers, Nature of Computed solutions, Dimensional Analysis and scaling, Analysis of all types of formulation, Analysis of Stochastic Process, Analysis of Discrete/continuous state/time formulation.

Unit-4

Parameter estimation- Deterministic-Stochastic model parameter estimation, Design of Experiments- Static-Dynamic system with parameter estimation, Validation- Fundamental Difficulty, Approaches to Validation, Validation of Deterministic- Stochastic models, Selecting among alternate models, Pitfalls of modeling.

Books:

1- Mathematical Modelling-D N P Murthy , N W Page and E Y Rodin
2- Mathematical Modelling- Mark M Meerschreart

SYLLABUS UNDER NEP

PAPER 4
(Optional Paper-a)
DISCRETE MATHEMATICAL STRUCTURES

B0310087

Credits: 04 **Max Marks:100**

Evaluation: Continuous Internal Assessment – 25 marks

Semester End Examination – 75 Marks

Course Title: Discrete Mathematical Structures
Course Code: C4 (a)
Course Type: Elective Paper
Course Level: PG

Unit-1

Lattices: Lattices as Partially Ordered Sets, Their Properties, Lattices as algebraic Systems, Sublattices, Direct Product and homomorphism, Some Special lattices e.g. Complete, Complemented and Distributive Lattices, isomorphic Lattices, Join Irreducible elements, Atoms.

Unit-2

Boolean Algebra: As Lattices, Various Boolean identities, The switching Algebra Example, Sub Algebras, Direct Production and Homomorphism, Boolean Forms and their Equivalence, Minterm Boolean forms, Sum of Products Canonical Forms, Minimization of Boolean Functions, Application of Switching Theory, The Karnuagh Map Method.

Unit-3

Graph Theory: Definition of undirected, Multigraphs, Subgraphs, Paths, Circuits, cycles, Induced Subgraphs, degree of vertex, Connectivity, Planar graphs, Euler's theorem, Directed graphs, Warshall's Algorithm of shortest paths, Reular and Bipartite Graphs, Kuratowski's Theorem

Unit-4

Trees, Spanning Trees, Cut Sets, Fundamental Cut sets and Cycles, Minima Spanning Trees and Kruskal's Algorithm, Matrix representation of graphs, Euler's Theorem on the existence of Eulerian paths and circuits, Directed Graphs, indegree and outdegree of vertex, Directed trees, Search trees, Tree Traversals.

References/Text

1- C.L Liu: Elements of Discrete Mathematics, McGraw-Hill Book co.
2- Seymour Lipschutz M. Lipson: Discrete Mathematics, Tata McGraw hill Edition.
3- J Bondy, Murthy U.S.R.: Graph theory with applications John Wiley, 1996.
4- N. Dev: Graph theory and applications Prentice Hall India 2005.

Only for Reference

PAPER 4

(Optional Paper-b)

CRYPTOGRAPHY

B0310091

Credits: 04

Max Marks:100

Evaluation: Continuous Internal Assessment – 25 marks

Semester End Examination – 75 Marks

Course Title: Cryptography
Course Code: C4 (b)
Course Type: Elective Paper
Course Level: PG

Unit-1

Definition of a cryptosystem, Symmetric cipher model, Classical encryption techniques-Substitution and transposition ciphers, Caesar cipher, Play fair cipher, Block cipher Principles, Shannon theory of diffusion and confusion, Data encryption standard (DES).

Unit-2

Polynomial and modular arithmetic, Introduction to finite field of the form GF(p) and GF(2n), Fermat theorem and Euler's theorem (statement only), Chinese remainder theorem; Discrete logarithm.

Unit-3

Advanced Encryption Standard (AES), Stream ciphers, Introduction to public key cryptography, One-way functions, The discrete logarithm problem, Diffie-Hellman key exchange algorithm, RSA algorithm and security of RSA, The ElGamal public key cryptosystem, Introduction to elliptic curve cryptography.

Unit-4

Information/Computer Security: Basic security objectives, security attacks, security services, Network security model, Cryptographic hash functions, Secure hash algorithm, SHA-3, Digital signature, El-Gamal signature, Digital signature standards, Digital signature algorithm.

Recommended books:

1- William Stallings, Cryptography and Network Security, Principles and Practice, 5th ed., Pearson Education, 2012.
2- Douglas R. Stinson, Cryptography: Theory and Practice, CRC Press, 3rd ed., 2005.
3- J.A. Buchmann, Introduction to Cryptography, 2nd ed., Springer 2003.
4- W. Trappe and L.C. Washington, Introduction to Cryptography with Coding Theory, Pearson, 2006.
5- J. Hoffstein, J. Pipher, and J. H. Silverman, An Introduction to Mathematical Cryptography, 2nd ed., Springer, 2014.

32

PAPER 4
(Optional Paper-c)
VADIC GANITA

B0310107

Credits: 04

Max Marks:100

Evaluation: Continuous Internal Assessment – 25 marks

Semester End Examination – 75 Marks

Course Title: Vadic Ganita
Course Code: C4 (c)
Course Type: Elective Paper
Course Level: PG

Unit-1

History of Vedic Ganita, Why Vedic Ganita, Silent features of Vedic Ganita, Vedic Ganita formulas, 16 sutras, 13 sub sutras, Terms and operations, High speed addition by using the concept of computing the whole and from left to right, Superfast subtraction by Nikhilamsutram from basis 100, 1,000, 10,000.

Unit-2

Multiplication by Urdhavtrighbhyam sutram, Multiplication by vinculum sutram, Multiplication by Nikhilam sutram, Fast multiplication by 11, Multiplication of numbers consisting of all 9s, Multiplication of numbers nearest to the base 10 and multiplication of numbers with sub base 50,500,5000.

Unit-3

Meaning of Ekadhiken sutram and its applications in finding squaring of numbers ending in 5, squares by Anurupeyana sutram, Square by Yavdunam thava dunikritya vargamcha yojyet sutram, Squaring by Dwandvayoga sutram, Squaring numbers nearest 50, Square roots of perfect square, General method of square roots, Cubes by Anurupeyana sutram.

Unit-4

Decimal and fractions, Division by Nikhilam Sutram, Division of 1/19, 1/29 by Ekadhikenpurven sutram, Division by Paravartya sutram, Division by Anurupeyana sutram, Division of polynomials, Factors of general second-degree equation by Lopsthapanabhyam sutram.

Recommended books:

1. Vedic Mathematics, published by Motilal Banarasi Das 1965. ISBN 81-2 08-0163-6.
2. Vedic Ganita: Vihangam Drishti-1, Shiksha Sanskriti Utthan Nyasa, New Delhi

PAPER 4

(Optional Paper-d)

COSMOLOGY

B031011T

Credits: 04

Max Marks:100

Evaluation: Continuous Internal Assessment – 25 marks

Semester End Examination – 75 Marks

Course Title: Cosmology
Course Code: C4 (d)
Course Type: Elective Paper
Course Level: PG

Unit-1
Mach's principle, Einstein modified field equations with cosmological term, Static cosmological model of Einstein and De-Sitter, Their derivation, Properties and comparison with the actual universe.

Unit-2
Hubble's law, Cosmological principles, Weyl's postulate. Derivation of Robertson-Walker metric, Hubble and deacceleration parameters, Redshifts, Redshift versus distance relation, Angular size versus redshift relation and source counts in Robertson-Walker space-time.

Unit-3
Friedmann models, Fundamental equation of dynamical cosmology, Critical density, Closed and open Universe, Age of the Universe, Matter dominated era of the Universe, Einstein- De- Sitter model, Particle and even horizons.

Unit-4
Eddington-Lamaitre models with l-term, Perfect Cosmological principle, Steady state Cosmology.

Recommended books:

1- R. C. Tolman, Relativity, Thermodynamics and Cosmology, Clarendon Press, Oxford, 1934.
2- S. Weinberg, Gravitation and Cosmology, John Wiley, 1972.
3- J. V. Narlikar, Introduction to Cosmology, Cambridge University Press, 1998.
4- J. N. Islam, An Introduction to Mathematical Cosmology, Cambridge University Press, 1999.
5- J. A. Peacock, Cosmological Physics, Cambridge University Press, 1999.

SYLLABUS FOR M.Sc

PAPER 4

(Optional Paper-e)

THEORY OF RELATIVITY

B031012T

Credits: 04

Max Marks:100

Evaluation: Continuous Internal Assessment – 25 marks

Semester End Examination – 75 Marks

Course Title: Theory of Relativity
Course Code: C4 (d)
Course Type: Elective Paper
Course Level: PG

Unit-1

Historical background and postulates of special relativity, Relativity of simultaneity, Lorentz transformation and its consequences, Relativistic addition of velocities.

Unit-2

Doppler effect, Space-time diagrams, Time-order and Space-time separation of events, Null cone, The twin-paradox.

Unit-3

Relativistic mass and momentum, The equivalence of mass and energy, The relativistic force law and dynamics of a single particle, Energy momentum tensor of incoherent matter.

Unit-4

Principle of equivalence, Principle of general covariance, Criteria for gravitational field equations, Einstein field equations, Gravity as a geometric Phenomenon. The energy momentum tensor, Inclusion of forces in the field equations and their classical limits.

Recommended books:

1- Rindler W. Special Relativity, 1966.

2- Resnick, R., Introduction to special relativity, Wiley-Eastern, 1990.

3- Special Theory of Relativity, Anshan Publishers-2009.

SYLLABUS FOR NEP

PAPER 5
(PRACTICAL)
COMPUTER PROGRAMMING WITH MATLAB

B031013P

- Problems of Operations Research through 'MATLAB'
- Problems of Numerical Methods through 'MATLAB'

Note:

3- There will be a research project of 4 credit in each semester. The students shall submit the research projects done in the 1st and 2nd semester in the form of a Dissertation at the end of 2nd semester. The submitted dissertation will be evaluated by supervisor and an external examiner nominated by the University. The total marks for the dissertation will be 100. The evaluation of research project of semester 3 and 4 will be done at the end of 4th semester in the same way as done for the 1st and 2nd semester at the end of 2nd semester.

4- There will be a minor elective of 4 credit/100 marks from other faculty to be taken in 1st year (1st or 2nd semester, only once).

PG SYLLABUS FOR M.P.

Nehra