B.R.A.BIHAR UNIVERSITY, MUZAFFARPUR

COURSE OF STUDY

M.A/M.Sc, MATHEMATICS

SEMESTER- I, II, III & IV

CHOICE BASED CREDIT SYSTEM (CBCS)

(To be effective from 2018-2019)

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M.A/M.Sc (Mathematics)

SCHEME OF EXAMINATION

Passing of Examination and Promotion Rule

The Post Graduate Course in Mathematics shall be of two academic sessions comprising of FOUR SEMESTERS. Each academic session shall consist of two Semesters – I & III from July to December and Semester II & IV from January to June.

Each theory paper irrespective of their nature and credits hall be of 100 marks out of which the performance of a student in each paper will be assessed on the basis of Continuous Internal Assessment (CIA) of 30 marks and the End Semester Examination (ESE) consisting of 70 marks.

The components of CIA shall be

(a)	Two Mid Semester Written Tests of one hour duration each	15 Marks
(b)	Seminar/quiz	5 Marks
(c)	Assignment	5 Marks
(d)	Punctuality & Conduct	5 Marks
	Total	**30 Marks**

1. There shall be no supplementary examination in any of the Semester Course (I, II, III & IV).

2. A student who has appeared at the CIA and attended the required minimum percentage (75%) of the attendance in theory shall be permitted to appear in the End Semester Examination (ESE).

3. To be declared passed in ESE in any subject, a students must secure at least 45% marks in each paper separately.

A student has to secure minimum 45% marks in CIA of any paper. In case, a student fails to secure minimum 50% marks in CIA of any paper, he/she will be declared fail in that paper. Students shall have to reappear in that paper and in CIA examination also in the same semester of next academic session.

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If students fail to secure minimum 50% marks in CIA of any paper his result will be declared as fail in that paper. Students shall have to reappear in that paper in the same semester of next academic session.

A promoted candidate, if he has passed in CIA but fails in theory paper/papers, he/she shall retain his/her CIA award and will reappear in the theory paper only of the semester whenever available. However, if a candidate is declared fail in any End Semester Examination, shall retain nothing and will have to redo the course work of failed semester again and he has to appear again in CIA as-well-as in theory paper.

4. If a candidate passes in at least two paper in his/her First, Second and third End Semester Examination, he/she shall be promoted to next higher semester. But he/she will have to clear their backlog papers in the next end semester examination of that semester whenever it is available. Even if a student is promoted to fourth semester his final result will only be declared when he/she has cleared all their backlog papers.

5. Final result of M.Sc. will be published only after h;/she has cleared all the 16 paper securing minimum qualifying marks.

6. Student shall be awarded Grade Point (GP) at the end of each semester examination and Cumulative Grade Point (CGP) at the end of final End Semester Examination in 10 point scoring system.

Declaration of Result

The following grading system shall be used by teacher/Examination department

Letter Grade	Percentage Range	Number of Letter Grade	Description of Grade
O	90-100	10	Outstanding
A++	80-89	9	Excellent
A+	70-79	8	Very Good
A	60-69	7	Good
B+	50-59	6	Average
B	45-49	5	Pass
F	Less than 45	Less than 5	Fail

A student shall be declared to have passed and promoted to the next semester when he/she earns B or above grade in the semester examination covering continuous evaluation, mid-term and end term examination.

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Syllabus of M.A/M.Sc (Mathematics) Semester I

PAPER I (MAT CC 01)

Abstract Algebra

Abstract Algebra

Prerequisites: Introduction to Group, Elementary Properties of Group, Finite Group, and subgroup, Cyclic Group, Permutation Group, Properties of Permutations, rings, integral Domains, Characteristics of rings.

Unit 1 : Homomorphism; Group actions, Sylow theorems, Normal and subnormal series composition series of a group. Jordan-Holder Theorem, Solvable groups, commutatior subgroup of a group, Lilpotent groups.

Unit 2 : Ring homomorphism, isomorphism, quotient rings, ideals, Kernel of ring homomorphism, principal ideal ring and domain,prime and maximal ideal, Euclidean domaon.

Unit 3 : Extension fields , algebraic and transcendental extension, splitting field of Polynomial, separable and inseparable extension, normal extension, constructible real numbers.

Unit 4 : Cyclic Modules, simple Modules, semi-simple Modules, Schur's Lemma, Free Modules..

Unit 5 : Solution of equations by radicals, insolvability of equations of degree 5 by radicals.

References :

1. I. N. Herstein :- Topics in Algebra.
2. M.Artin :- Algebra
3. L. S Luther & I.B.S Passi :- Algebra Vols I & II Narosa Publication House
4. D.S. Dummit and R.M. Foote:- Abstract Algebra
5. N.S. Gopalakrishnan :- University Algebra

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PAPER II (MAT CC- 02)

Real Analysis

Real Analysis

Unit 1 : Sequences and series of functions, pointwise and uniform convergence, Cauchy criterion for uniform convergence, Weierstrass-M test, Abel's and Dirichlet's test for uniform convergence.

Unit 2 : Uniform convergence and differentiation, Weierstrass approximation theorem Power series, Uniqueness theorem for power series, Able's and Tauber's theorem.

Unit 3 : Definition and examples of Riemann-Stieltje's integral Property of integral, Integration and differentiation, the fundamental theorem of Calculus, Integration Of vector valued function, rectifiable curves.

Unit 4 : Functions of several variables, linear transformation, Derivatives in an open subset of R^n,chain rule,partial derivatives, interchange of order of differentiation, derivatives of higher orders, Taylor's theorem.

Unit 5 : Inverse function theorem, Implicit function theorem, Jacobians, Extremum Problems with constraints, Lagrange's multiplier methods, differentiation of Integrals, partition of unity, Differential forms, Stoke's theorem.

References :

1. W. Rudin :- Principles of Mathematical Analysis
2. T. M. Apostal :- Mathematical Analysis
3. I.P. Natanson :- Theory of function of Real Variable
4. H.L. Royden :- Real Analysis

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PAPER III (MAT CC-03)

Linear Algebra

Linear Algebra

Unit 1 : Finite dimensional vector spaces; Linear transformations and their matrix representations, rank; systems of linear equations, eigenvalues and eigenvectors, minimal polynomial. Cayley-Hamilton Theorem, diagonalization.

Unit 2 : Hermitian, Skew Hermitian and unitary matrices; Finite dimensional inner product space, Gram-Schmidt orthonormalization process, self-adjoint operatrs.

Unit 3 : Similarity of linear transformations, Invariant subspaces, reduction to triangular forms, Nilpotent transformations, Index of Nilpotency, invariants of a Nilpotent transformations, primary decomposition theorem, Joardan blocks and Jordan forms rational canonical form.

Unit 4 : Bilinear form, algebra of bilinear form Matrix of bilinear forms, degenerate and

Non-degenerate bilinear forms, Alternating bilinear forms

Unit 5 : Symmetric and Skew-symmetric bilinear forms, Quadratic form, law of Inertia, Sylvester's theorem, Hermitian forms.

References :

1. K.B.Datta:- Matrix and Linear Algebra
2. S. Lipschutz:- Linear Algebra, Schaum's outline series
3. Hoffman and Kunze:- Linear Algebra

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PAPER IV (MAT CC-04)

Discrete Mathematics

Discrete Mathematics

Set Theory:

Unit 1 : Elementary set theory. Finite, countable and uncountable sets, Real number system as a complete ordered field. Archimedean property, supremum, infimum. Schroeder-Bernstein's theorem, Zorn's lemma, Well-ordering theorem.

Lattice Theory

Unit 2 : Lattices as partially ordered sets and their properties, lattices as algebraic system, Sub lattices, direct products and Homomorphisms of Lattices some special lattices eg Complete lattices, complemented lattices and distributive lattices.

Boolean Algebra

Unit 3 : Boolean algebra as a complemented distributive lattice, Boolean rings,identification of Boolean algebra and Boolean rings, sub-algebra and generators.

Unit 4 : Boolean homomorphism and ring homomorphism ideals in a Boolean algebra and Dual ideals, Fundamental theorem of homomorphism and Stone's representation theorem for Boolean algebras and Boolean rings, simple application to eletrical network, solvability of Boolean equations and logical puzzles.

Combinatories

Unit 5 : Permutation and combinations, partitions, pigeonhole principle, inclusion-exclusion principle, generating functions, recurrence relations.

References :

1. K.H. Rosen :- Discrete Mathematics and its applications.
2. S.Lipschutz and M.Lipson:- Discrete Mathematics
3. C. L. Lin:- Elements of Discrete Mathematics.
4. E.Mendelson :- Boolean Algebra and Switching Circuits
5. Kolman, Bushi and Ross :- Discrete Mathematical Structure.

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Syllabus of M.A/M.Sc (Mathematics) Semester II

PAPER V (MAT CC 05)

General Advanced Mathematics

Integral Transforms:

Unit 1 : Laplace transform, Definition of t^n, e^{at}, Sinh(at)/Cosh(at) Sinat, Cos at, Convolution theorem, Application of Linear differential equations with constant coefficients. Fourier transform, Fourier Integral theorem, Fourier sine and cosine transforms.

Fuzzy Set Theory:

Unit II: Fuzzy Sets Versus Crisp sets, Basic definitions, types, properties and representations of Fuzzy sets, Convex Fuzzy sets, Basics operation on Fuzzy set, α- Cuts, Decompositions theorem, Complements, t- norm and t-conorms, Exten - sion principles and Simple applications of Fuzzy sets.

Graph Theory

Unit III : Definition of graphs, paths, circuits and subgraphs, induced subgraphs, degree of a vertex, connectivity, planar graphs and their properties, Trees and simple applications of graphs.

Number Theory

Unit IV : Divisibility Theory in the Integers: Division Algorithm, the Greatest Common Division. The Euclidean Algorithm, The Diophantine Equations $ax + by = c$, Fundamental Theorem of Arithmetic.

References:

1. Kolman, Bushi and Ross:- Discrete Mathematical Structure.
2. Pundir And Pundir:- Fuzzy Sets & their Application,
3. G.J.Klir & B. Yuan :- Fuzzy sets.
4. Graph Theory: F. Harare, Addison Wesley.
5. A. Baker, A concise introduction to the Theory of Numbers.

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PAPER VI (MAT CC 06)

Complex Analysis

Complex Analysis

Unit 1 : Algebra of complex numbers, the complex plane, polynomials, power series, transcendental functions such as exponential, trigonometric and hyperbolic functions. Analytic functions, Cauchy-Riemann equations.

Unit 2 : Contour integral, Cauchy's theorem, Cauchy's integral formula, Liouville's theorem.

Unit 3 : Taylor's theorem, Maximum modulus Principle, Schwarz's Lemma, Laurent Series, Isolated singularities, Meromorphic function, Mittag-Leffler's theorem The argument principle, Rouche's theorem, power series.

Unit 4 : Residues, Cauchy's residue theorem, Evaluation of integral, Branches of many valued functions with special reference to argz, logz and Z^n, Bilinear transformations, their properties and classifications, definition and examples of conformal mappings. Mobius Transformations.

References :

1. J.B. Conway :-Functions of one Complex Variables,
2. L.V. Ahlfors :- Complex Analysis

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PAPER VII (MAT CC-07)

Differential and Integral Equations

Differential and Integral Equations

Unit 1 : Initial Value problem and the equivalent integral equation, n order equation in d dimension as a first order system. Concepts of local existance, existance in the large and uniqueness of solution with examples.

Unit 2 : Integral Equations and their classifications. Eigen values and eigen functions. Fredholm Integral equations of Second Kind, Iterative Scheme and method of successive approximations.

Unit 3 : Ascoli- Arzela theorem, a theorem on convergence of solutions of a family of Initial value problems. Picard- Lindelof theorem, Peano's existance theorem Corollaries, Kamke's convergence theorem.

Unit 4 : Gronwall's inequality, maximal and minimal solution, Differential inequalities, Uniqueness theorem, Nagumo's and Osgood's criteria, successive approximations.

References :

1. P. Hartman :- Ordinary Differential Equation
2. S.G.Mikhlin :- Linear Integral Equations.
3. R.P.Kanwal :- Linear Integral Equations, Theory and Techniques.

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PAPER VIII (MAT CC-08)

Measure Theory

Measure Theory

Unit 1 : Lebesgue outer measure, Measurable sets Measuribility, Measurable functions, Borel and Lebesque measurability, non- measurable sets.

Unit 2 : Integration of non-negative functions, the general integral, Integration of series, Riemann and Lebesgue integrals.

Unit 3 : The Four Derivatives, function of bounded variation, Lebesgue differentiation Theorems, Differentiation and Integration.

Unit 4 : Measure and outer measure, extension of measures,uniqueness of extension, Completion of a measure, measurable spaces, Integration with respect to a measure.

Unit 5 : The L^p-spaces, convex functions, Jensen inequality Holder's and Minkowski's Inequalities, completeness of L^p-spaces, convergence in measure, Almost uniform Convergence.

References:

1. G.de Barra :- Measure Theory and Integration
2. P.K. Jain and V.P Gupta :- Lebesque Measure and Integration
3. I.K. Rana :- An Introduction to Measure and Integration
4. P.R. Halmos- Measure Theory.

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PAPER IX (MAT CC-09)

Topology

Unit 1 : Definition and examples of topological spaces, closed sets, dense subsets, Neighbourhood, interior, exterior, boundary and accumulation points. Derived Sets, Bases and subbases. Subspaces and Relative topology.

Unit 2 : Continuous functions and homeomorphism, characterisation of continuity in Terms of open sets, closed sets, basic open sets, sub- basic open sets and closure. First and second countable topological spaces Lindelof's theorem, separable Spaces, second countability and separability.

Unit 3 : Separation axioms T_0, T_1 *and* T_2 and their basicsproperties, compactness, Continuous function and compact sets, basic properties of compactness and Finite intersection property.

Unit 4 : Connectedness, continuous function and connected sets characterization of Connectedness in terms of a discrete two point space connectedness on real line.

Unit 5 : Regular and Normal spaces T3 and T4 spaces, characterisations and basic properties, Urysohn's lemma and Tietze extension Tehorems.

References:

1. G.F. Simmons :- Introduction to Topology and Modern Analysis
2. K.K.Jha :- Functional Analysis, Advanced General Topology
3. Futton:- Algebraic Topology First Course

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PAPER X (MAT CC-10)

Number Theory

Number Theory

Unit 1 : Divisibility, G.C.D. and L.C.M., Primes, Fermat numbers, congruences and residues, theorems of Euler, Format and Wilson, solutions of congruences, linear congruences, Chinese remainder theorem.

Unit 2 : Arithmetical functions $\varphi(n)$, $\mu(n)$ and $d(n)$ and $\sigma(n)$, Moebius inversion formula, congruences of higher degree, congruences of prime power modulli and prime modulus, power residue.

Unit 3 : Quadratic residue, Legendre symbols, lemma of Guass and reciprocity law, Jacobi symbols, Farey series, rational approximation, Hurwitz theorem, irrational numbers, irrationality of e and π, Representation of the real numbers by decimals.

Unit 4 : Finite continued fractions, simple continued fractions, infinite simple continued fractions, periodic continued fractions, approximation by convergence, best possible approximation, Pell's equations, Lagrange four sphere theorem.

References:

1. Theory of Numbers, G.H. Hardy and E M Wright, Oxford Science Publications, 2003.
2. Introduction to the Theory of Numbers, I Niven and H S Zuckerman, John Wiley & Sons, 1960.
3. Elementary Number Theory, D M Burton, Tata McGraw Hill Publishing House, 2006.
4. Higher Arithmetic, H. Davenport, Cambridge University Press, 1999.
5. Introduction to Analytic Number Theory, T.M. Apostal, Narosa Publishing House.

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Syllabus of M.A/M.Sc (Mathematics) Semester III

PAPER XI (MAT CC-11)

Functional Analysis

Functional Analysis

Unit 1 : Normed linear spaces, Banach spaces and examples, Quotient space of normed linear Spaces and its completeness, equivalent norms, Riesz Lemma, Basic properties of finite dimensional normed linear spaces and compactness.

Unit 2 : Weak convergence and bounded linear transformation, normed linear spaces of bounded linear transformations, dual spaces with examples, uniform boundness theorem and some of its consequences.

Unit 3 : Open mapping theorem and closed graph theorem, Hahn- Banach Theorem on real linear spaces, complex linear spaces and normed linear spaces, Reflexive spaces.

Unit 4 : Inner product spaces, Riesz lemma on Hilbert space, orthonormals sets and Parseval's identity, structure of Hilbert spaces, Projection theorem Riesz Representation Theorem.

Unit 5 : Adjoint of an operator on a Hilber space, Relfexivity of Hilbert spaces, Self-adjoint Operators, positive operator, Projection, Normal and unitary operators.

References

1. G.F.Simmons:- Introduction to Topology and Modern Analysis
2. K.K.Jha :– Functional Analysis, Advanced General Topology

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PAPER XII (MAT CC-12)

Fluid Dynamics

Fluid Mechanics

Unit 1 : Lagrangian and Eulerian methods, Equation of Continuity, Boundary Surfaces, Stream lines, Path lines and Streak lines, velocity potential, irrotational and rotational motions, vortex lines.

Unit 2 : Lagrange's and Euler's equations of motion, Bernoulli's theorem, equation of motion by flux method, equation referred to moving axis, implusive actions.

Unit 3 : Irrotational Motion in two dimension, stream function, complex velocity potential, sources, sinks, doublets and their images, conformal mapping, Milne-Thompson circle theorem.

Unit 4 : Two dimensional irrotational motion produced by motion of a circular, coaxial and elliptic cylinders in an infinite mass of liquid, kinetic energy of a 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, Stoke's stream function

Unit 5 : Vortex motion and its elementary properties, Kelvin's proof of permanence, Motion due to circular and rectilinear vertices.

References

1. F.Chorlton :- A text Book of Fluid Dynamics.
2. M.D. Raisinghania:- Fluid Dynamics

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PAPER XIII (MAT CC-13)

Classical Mechanics (Rigid Dynamics)

Unit 1 : Generalised Co-ordinates, Holonomic and Non Holonomic systems, Lagrange's equations of motion, energy equations for conservative fields.

Unit 2 : Hamilton's canonical equations, Rouths equations, Hamilton's Principle, Principle of Least Action.

Unit 3 : Small Oscillations, normal Co-ordinates, normal mode of vibration.

Unit 4 : Contact transformations, Lagrange brackets and Poisson brackets, the most general infinitesimal contact transformation, Hamilton-Jacobi equation.

Unit 5 : Motivating problem of Calculus of variation, Euler-Lagrange equation shortest distance, minimum surfaces of revolution, Brachistochrone problem..

References

1. A.S. Ramsey :- Dynamics Part II
2. S.L. Loney :- Dynamics of particle and rigid bodies

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PAPER XIV (MAT CC-14)

Optimization Techniques

Linear Programming

Unit 1 : Simplex method for unrestricted variable, Two phase method, Dual simplex method, Parametric Linear programming, Upper Bound technique, Interior point algorithm, Linear Goal programming.

Unit 2 : Integer programing, Branch and bound technique, Gomory's algorithm.

Non- Linear programming:

Unit 3 : One and multi-variable unconstrained optimization, Kuhn- Tucker condition for constrained optimization, Wolfe's and Beale's methods.

Unit 4 : Game theory, Two person- Zero sum games with mixed strategies, Graphical solution by expressing as a linear programming problem.

Unit 5 : Inventory theory, Different costs of inventory model, Deterministic Economic lot size model, EOQ with uniform demand and several productions of unequal length / production runs of equal length EOQ models- Shortages not allowed, shortages allowed.

References

1. H.A.Taha :- Operations Research- An Introduction
2. Kanti Swarup, P.K.Gupta and Man Mohan: Operations Research
3. P.K.Gupta and D.S. Hira :- Operations Research- An Introduction

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PAPER XV (MAT CC-15)

Differential Geometry

Unit 1 : Curves in R^3 spaces, parameters other than arc lengths, tangent principal normal, binormal and three fundamental planes, Curvature and torsion of space curves, Serret- Frenet formulae, Fundamental theorem on spaces curves, Helices, spherical. indicatrix, Involutes and Evolutes, Bertrand curves.

Unit 2 : Representation of surfaces, Curves on surfaces in R^3 spaces, tangent plane and Normal, Envelope, characteristic and edge of regression, developable surface of revolution, directions on a surface.

Unit 3 : Paramertric curves, angle between them, first order and second order magnitudes, principal directions and lines of curvature, Normal Curvature, Euler's theorem and Meunier's theorem. Theorem of Beltrami and Enneper, Gauss Characteristic equation, Mainardi-Codazzi equations.

Unit 4 : Conjugate directions, Isometric lines, asymptotic lines and Geodesics- their equations and properties, curvatrure and torsion, their structures on surfaces of revolution, Bonnet's theorem, Clairaut's theorem and Dupin's indicatrix.

References

1. C.E. Weatherburn:- Differential Geometry In Three Dimension
2. J.A. Thorpe :- Elementary Topics in Differential Geometry.
3. A.Gray: Differential Geometry of three dimensions, Cambridge University Press

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List of Elective Paper (MAT EC-01 & MAT EC-02)

1. **Fuzzy sets and their application**
2. **Mathematical Methods**
3. **Operational Research**
4. **Theory of Relativity**
5. **Galois Theory.**
6. **Advanced Topology**
7. **Banach Algebras**
8. **Commutative Algebra**
9. **Programming in C**

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1. Fuzzy set and their applications

Fuzzy Set Theory:

Unit 1 : Fuzzy Sets Versus Crisp sets, Basic definitions, types, properties and representations of Fuzzy sets, Convex Fuzzy sets, Basics operation on Fuzzy set, α- Cuts, Decompositions theorem, Complements, t- norm and t-conorms, Extension principles and Simple applications of Fuzzy sets.

Unit 2 : Fuzzy logics – An overview of classical logic, Multivalued logics, Fuzzy propositions, fuzzy quantifiers, Linguistic variable and hedges, inference from conditional fuzzy propositions the compositional rule of inference.

Unit 3 : Approximate Reasoning – An overview of fuzzy expert system, Fuzzy implication and their selection Multiconditional approximate reasoning the role of fuzzy relation equation.

Unit 4 : An introduction to Fuzzy control – Fuzzy controllers, Fuzzy rule base Fuzzy inference engine Fuzzification. Defuzzification and the various defuzzification method (The centre of maxima and the mean of maxima methods).

Unit 5 : Decision making in Fuzzy Environment – Individual decision making. Multiperson decision making, Multicriteria decision making, Multistage decision making, Fuzzy ranking methods, Fuzzy linear programming.

Unit 6 : Misc Application specially in social science, Biological Science and engineering reliability theory and mathematical statistics.

References :

1. G.J.Klir & B. Yuan :- Fuzzy sets and Fuzzy Logics.
2. H.J.Zimmermann, Fuzzy set theory and its Applications.
3. G.J.Klir and T.A.Folger:- Fuzzy Sets, Uncertainty and Information.
4. Pundir And Pundir:- Fuzzy Sets & their Application,

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2. Mathematical Methods

Unit 1 : Orthogonalisation, Bessel's Inequality, Mean error minimization,completeness relation, Weierstrass approximation theorem, polynomials of Legendre, Hermite and Bessel, generating function, orthogonality, recurrence relation and Rodrigue's formula

Unit 2 : Partial Differential Equation and properties, concept of well posed problems, Reduction of P.D.E in two independent variables to the canonical forms, classification in to elliptic, hyperbolic and parabolic equations, Laplace's equations in cartesian, cylindrical and spherical co-ordinates, Equipotential surfaces, Interior and exterior Dirichlet problem, the Maximum- Minimum property, solutions and Uniqueness, Dirichlet's problem for a circle, fundamental properties of Harmonic function.

Unit 3 : Wave equation in one dimension and two dimension, vibrations of struck and plucked string with fixed ends, homogeneous rectangular and circular membranes, eigen vibrations, D'Alembert's solution of one dimensional wave equation. One dime -nsional Diffusion equation & solution of initial value problem by integral transform .

Unit 4 : Tensors- Transformations of Co-ordinates, contravariant and covariant vectors Symmetric and skew-symmetric tensors, addition and multiplication of tensors, Contraction and composition of tensors, Quotient law.

Unit 5 : Reciprocal symmetric tensors of the second order, Christoffel's symbols, covariant derivative of a contravariant vector, Co-variant derivative of a covariant vector, covariant derivatives of tensors, curl of a vector, Divergence of a covariant vector, Laplacian of a scalar invariant.

References

1. I. N. Sneddon:- Elements of Partial Differential Equations
2. R. Courant and D. Hilbert:- Methods of Mathematical Physics Vol I & Vol II
3. C.E. Weatherburn : - Riemannian Geometry and Tensor calculus
4. Smirnov and Tychonoff : - Partial Differential Equations.

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3. Operations Research

Unit 1: Queuing Theory- Poisson probability law, Distribution of inter-arrival time, Distribution of time between successive arrivals, Differential difference equation of $M\ |M|1 : \infty|FIFO$, $M\ |M|1 : N|FIFO$, $M\ |M|C : \infty|FIFO$, $M\ |M|C : N|FIFO$,

Unit 2 : Information Theory: Description of communication system, Mathematical definition of information, Axiomatic approach to information, Measures of uncertainty, Entropy In two dimensions- property, conditional entropy.

Unit 3 : Channel capacity, Efficiency and redundancy, Encoding, Fano-encoding procedure, Necessary and sufficient condition, average length of encoded message.

Unit 4 : Replacement Model- introduction concepts of present value, replacement of items whose maintenance cost increase with time and value of money also changes, Replacement of items that fail completely, individual and group replacement policy.

Unit 5 : Sequencing – N jobs and 2 machines, N jobs and 3 machines, N jobs M machines.

References

1. H.A. Taha:- Operations Research – An Introduction
2. Kanti Swarup, P.K.Gupta and Man Mohan: Operations Research
3. P.K.Gupta and D.S. Hira:- Operations Research.

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4. Theory of Relativity

Unit 1 : General Theory of Relativity- Principle of equivalent and general covariance, Einstein field equations and its Newtonian approximation.

Unit 2 : Schwarz- Schild external solution and its isotropic form, Birkhoff theorem, planetary orbits and analogous of Kepler's laws in general relativity.

Unit 3 : Advance of perihelion of a planet, Bending of light rays in a gravitational field, Gravitational shift of spectral lines, Einstein theory.

Unit 4 : Energy Momentum of tensor of a perfect fluid, Schwarz- Schild internal solution, Energy Momentum tensor of a electromagnetic field, Einstein Maxwell equation, Reissner-Nordstrom Solution.

Unit 5 : Cosmology – Einstein modified field equation with cosmological term static cosmological models of Einstein and De-Sitter, their derivation properties and comparison with the actual universe.

References:

1. C.E. Weatherburn: An Introduction to Riemannian Geometry and the tensor calculus.
2. A.D.Eddington: The Mathematical theory of Relativity.
3. Goyal and Gupta:- Theory of Relativity
4. R.Adler, M.Bazin, M.Schiffer:- Introduction to General Relativity.
5. J.J.Synge:- Special theory of Relativity & General theory of Relativity.

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5. Galois Theory

Unit 1 : Rings, examples of ringd, ideals, prime and maximal ideals. Integral domains, Euclidean Domains, Principal Ideal Domains and Unique Factorizations Domains. Polynomial rings over UFD's.

Unit 2 : Fields, Characteristic and prime subfields, field extensions, finite, algebraic and finitely generated field extensions, algebraic closures..

Unit 3 : Spliting fields, normal extension, Multiple roots, Finite fields, separable Extension.

Unit 4 : Galois group, Fundamental Theorm of Galois Theory, Solvability by radicals, Galois theorem on solvability. Cyclic and abelian extensions. Classical ruler and Compass constructions.

References:

1. D.S. Dummit and R.M. Foote, Abstract Algebra
2. Joseph Rotman, Galois Theory
3. N.Jacobson, Basic Algebra I, IInd ed., Hindustan Publishing Co. 1984.
4. S.Lang, Algebral, III Edition, Addison Wesley, 2005.

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University Professor &
Head of the Deptt. of Mathematics
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6. Advance Topology

Unit 1 : Countably compactspaces, sequentially compact spaces, totally bounded metric spaces.

Unit 2 : Lebesgue's covering lemma, spaces of continuous functions, Arzela-Ascoli Theorem, Weierstrass's approximation theorem.

Unit 3 : Stone Weierstrass's theorem, metrizable spaces and meztrization theorems, uniform spaces, topology of uniform spaces.

Unit 4 : Uniform continuity, uniform metrizable topological spaces, metrizable uniform spaces.

Unit 5 : Some properties of completely regular spaces, the Stone-Chech compactification..

References:

1. S.Willard: General Topology, Addison – Wesley 1970.
2. S.W.Davis: Topology, TMH 2006.
3. K.K.Jha: Advanced General Topology, Nav Bharat Prakashan, Patna.
4. G.F.Simmons: An introduction to Topology and Modern analysis.

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Head of the Deptt. of Mathematics
B.R.A.B.U., Muzaffarpur

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7. Banach Algebras

Unit 1 : Elementary properties and Examples of Banach Algebras, Ideal quotients, the spectrum of an element, dependence of specturem on algebra, Abelian Banach Algebras.

Unit 2 : Elementary properties of C*-Algebras and examples, Abelian Algebras and functional calculus, positive elements.

Unit 3 : Ideals and quotients, representations of C*-Algebras and the Gelfand-Naimark construction.

Unit 4 : Spectral measures and representations of Abelian C*-Algebras, Special theorem.

Unit 5 : Topologies on B(H), the double commutant rem and Abelian Von-Neumann Algebras.

References:

1. J.B.Conway: A course in Functional Analysis, Springer 1990.
2. R.V.Kadison and J.R.Ringrose: Fundamentals of the theory of Operator Algebras, AMS 1997.
3. G.Murphy: C*-Algebras and Operator theory, Academic Press 1990.

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University Professor &
Head of the Deptt. of Mathematics
B.R.A.B.U., Muzaffarpur

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8. Commutative Algebra

Unit 1 : Ring and ring homomorphisms, ideals, quotient rings, Zero divisors, Nilpotent elements units, prime ideals and maximal ideals, Nil Radical and Jacobson Radical, Operations on ideals, extension and contraction.

Unit 2 : Modules and module homormorphisms, sub-modules, quotient modules. Operations on sub-modules, Direct sum and products, Finitely generated modules, exact sequences.

Unit 3 : Tensor product of modules, restriction and extension of scalars, exactness properties of tensor product, Algebras, Tensor product of algebras.

Unit 4 : Local properties, extended and contracted ideals in ring of fractions, primary decompositions, integral dependence, the going-up theorem, integrally closed integral domains, the going-down theorem, chain conditions.

Unit 5 : Primary decompositions in Noetherian ring, Artin rings, discrete valuation rings, Dedekind domains, Fractional ideals.

References:

1. M.F. Atiyah and I.G. Macdonald: Introduction to Commutative Algebra- Addison-Wesley.
2. H.Matsumura: Commutative ring theory, Camb. Univ. Press
3. N.S.Gopala Krishnan- Commutative algebra
4. S.Lang: Algebra, Springer
5. D.P.Patil, Patil, Storch: Introduction to Algebraic Geometry and Commutative Algebra, Anshan Publishers.

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9. Programming in C

Theory

1. Introduction to programming languages, C language and its features.
2. Understanding of Structure of Programme in C.
3. Basic data types, Library in C.
4. Operators and expression in C.
5. Functions used for input and output in C.
6. Conditional branching in C, use of If-then.
7. Looping in C, use of for loop, while loop, do-while loop, nested loops.
8. Algorithm and Flow Charts.

Practical

1. Some simple programmes use in C.
2. Leap – year.
3. Generate first n-primes
4. Roots of quadratic equations.
5. Convert a number to any given base.
6. Generate first n-perfect numbers.
7. Sine and Cosine by Taylors series.
8. Addition and multiplication of matrices
9. Transpose of a matrix.
10. Inverse of a matrix.

References:

1. Y.Kanitkar: Lets C.
2. Robert Lafore: C programming.
3. E.Balaguruswami: Programming in ANSI C.

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University Professor &
Head of the Deptt. of Mathematics
B.R.A.B.U., Muzaffarpur