Report on The Two Days Workshop on NET, GATE, NBHM & TFIR syllabus" held on & from 25th August, 2021 to 26th August 2021

Organized by The Dept. Of Mathematics

Mugberia Gangadhar Mahavidyalaya

Date: 18.12.2020

N O T I C E

This is to hereby notify all the students that the Dept. of Mathematics, Mugberia Gangadhar Mahavidyalaya is going to organize a "The Five Days Workshop on NET, GATE, NBHM & TFIR syllabus" which will be held on & from 4th January to 8th January, 2021 . All the students and researchers are requested to be present in the said workshop.

18.12.2020

Dr. Swapan Kumar Misra

Principal

Mugberia Gangadhar Mahavidyalaya

Principal

Mugberia Gangadhar Mahavidyalaya

Mr. Goutam Kumar Mandal, Contractual Teacher in Mathematics(Coordinator)

Dr. Kalipada Maity, HOD, Associate Prof.(Jt. Coordinator)

Speaker : Dr. Kalipada Maity, Associate Professor & HOD, dept of Mathematics.

Topic : **Syllabus of GATE, CSIR NET and reference books**

a. GATE syllabus in Mathematics

Calculus: Functions of two or more variables, continuity, directional derivatives, partial derivatives, total derivative, maxima and minima, saddle point, method of Lagrange's multipliers; Double and Triple integrals and their applications to area, volume and surface area; Vector Calculus: gradient, divergence and curl, Line integrals and Surface integrals, Green's theorem, Stokes' theorem, and Gauss divergence theorem.

Linear Algebra: Finite dimensional vector spaces over real or complex fields; Linear transformations and their matrix representations, rank and nullity; systems of linear equations, characteristic polynomial, eigenvalues and eigenvectors, diagonalization, minimal polynomial, Cayley-Hamilton Theorem, Finite dimensional inner product spaces, Gram-Schmidt orthonormalization process, symmetric, skew-symmetric, Hermitian, skew-Hermitian, normal, orthogonal and unitary matrices; diagonalization by a unitary matrix, Jordan canonical form; bilinear and quadratic forms.

Real Analysis: Metric spaces, connectedness, compactness, completeness; Sequences and series of functions, uniform convergence, Ascoli-Arzela theorem; Weierstrass approximation theorem; contraction

mapping principle, Power series; Differentiation of functions of several variables, Inverse and Implicit function theorems; Lebesgue measure on the real line, measurable functions; Lebesgue integral, Fatou's lemma, monotone convergence theorem, dominated convergence theorem.

Complex Analysis: Functions of a complex variable: continuity, differentiability, analytic functions, harmonic functions; Complex integration: Cauchy's integral theorem and formula; Liouville's theorem, maximum modulus principle, Morera's theorem; zeros and singularities; Power series, radius of convergence, Taylor's series and Laurent's series; Residue theorem and applications for evaluating real integrals; Rouche's theorem, Argument principle, Schwarz lemma; Conformal mappings, Mobius transformations.

Ordinary Differential Equations: First order ordinary differential equations, existence and uniqueness theorems for initial value problems, linear ordinary differential equations of higher order with constant coefficients; Second order linear ordinary differential equations with variable coefficients; Cauchy-Euler equation, method of Laplace transforms for solving ordinary differential equations, series solutions (power series, Frobenius method); Legendre and Bessel functions and their orthogonal properties; Systems of linear first order ordinary differential equations, Sturm's oscillation and separation theorems, Sturm-Liouville eigenvalue problems, Planar autonomous systems of ordinary differential equations: Stability of stationary points for linear systems with constant coefficients, Linearized stability, Lyapunov functions.

Algebra: Groups, subgroups, normal subgroups, quotient groups, homomorphisms, automorphisms; cyclic groups, permutation groups, Group action, Sylow's theorems and their applications; Rings, ideals, prime and maximal ideals, quotient rings, unique factorization domains,

Principle ideal domains, Euclidean domains, polynomial rings, Eisenstein's irreducibility criterion; Fields, finite fields, field extensions, algebraic extensions, algebraically closed fields.

Functional Analysis: Normed linear spaces, Banach spaces, Hahn-Banach theorem, open mapping and closed graph theorems, principle of uniform boundedness; Inner-product spaces, Hilbert spaces, orthonormal bases, projection theorem, Riesz representation theorem, spectral theorem for compact self-adjoint operators.

Numerical Analysis: Systems of linear equations: Direct methods (Gaussian elimination, LU decomposition, Cholesky factorization), Iterative methods (Gauss-Seidel and Jacobi) and their convergence for diagonally dominant coefficient matrices; Numerical solutions of nonlinear equations: bisection method, secant method, Newton-Raphson method, fixed point iteration; Interpolation: Lagrange and Newton forms of interpolating polynomial, Error in polynomial interpolation of a function; Numerical differentiation and error, Numerical integration: Trapezoidal and Simpson rules, Newton-Cotes integration formulas, composite rules, mathematical errors involved in numerical integration formulae; Numerical solution of initial value problems for ordinary differential equations: Methods of Euler, Runge-Kutta method of order 2.

Partial Differential Equations: Method of characteristics for first order linear and quasilinear partial differential equations; Second order partial differential equations in two independent variables: classification and canonical forms, method of separation of variables for Laplace equation in Cartesian and polar coordinates, heat and wave equations in one space variable; Wave equation: Cauchy problem and d'Alembert formula, domains of dependence and influence, nonhomogeneous wave equation;

Heat equation: Cauchy problem; Laplace and Fourier transform methods.

Topology: Basic concepts of topology, bases, subbases, subspace topology, order topology, product topology, quotient topology, metric topology, connectedness, compactness, countability and separation axioms, Urysohn's Lemma.

Linear Programming: Linear programming models, convex sets, extreme points; Basic feasible solution, graphical method, simplex method, two phase methods, revised simplex method ; Infeasible and unbounded linear programming models, alternate optima; Duality theory, weak duality and strong duality; Balanced and unbalanced transportation problems, Initial basic feasible solution of balanced transportation problems (least cost method, north-west corner rule, Vogel's approximation method); Optimal solution, modified distribution method; Solving assignment problems, Hungarian method.

Reference Books:

1. Linear Algebra and its applications, Gilbert Strang.
2. Real Analysis, Royden H.L., Fitzpatrick P. M
3. Introduction to Real analysis, Donald R. Sherbert Robert G. Bartle
4. Foundations of complex analysis, S. Ponnusamy
5. Topics in Algebra, I. N. Herstein
6. An Introduction to Ordinary Differential Equations, Earl A. Coddington

b. CSIR-NET Syllabus in Mathematics

CSIR-UGC National Eligibility Test (NET) for Junior Research Fellowship and Lecturer-ship COMMON SYLLABUS FOR PART 'B' AND 'C' MATHEMATICAL SCIENCES

UNIT – 1

Analysis: Elementary set theory, finite, countable and uncountable sets, Real number system as a complete ordered field, Archimedean property, supremum, infimum. Sequences and series, convergence, limsup, liminf. Bolzano Weierstrass theorem, Heine Borel theorem. Continuity, uniform continuity, differentiability, mean value theorem. Sequences and series of functions, uniform convergence. Riemann sums and Riemann integral, Improper Integrals. Monotonic functions, types of discontinuity, functions of bounded variation, Lebesgue measure, Lebesgue integral. Functions of several variables, directional derivative, partial derivative, derivative as a linear transformation, inverse and implicit function theorems. Metric spaces, compactness, connectedness. Normed linear Spaces. Spaces of continuous functions as examples.

Linear Algebra: Vector spaces, subspaces, linear dependence, basis, dimension, algebra of linear transformations. Algebra of matrices, rank and determinant of matrices, linear equations. Eigenvalues and eigenvectors, Cayley-Hamilton theorem. Matrix representation of linear transformations. Change of basis, canonical forms, diagonal forms, triangular forms, Jordan forms. Inner product spaces, orthonormal basis. Quadratic forms, reduction and classification of quadratic forms

UNIT – 2

Complex Analysis: Algebra of complex numbers, the complex plane, polynomials, power series, transcendental functions such as exponential,

trigonometric and hyperbolic functions. Analytic functions, Cauchy-Riemann equations. Contour integral, Cauchy's theorem, Cauchy's integral formula, Liouville's theorem, Maximum modulus principle, Schwarz lemma, Open mapping theorem. Taylor series, Laurent series, calculus of residues. Conformal mappings, Mobius transformations.

Algebra: Permutations, combinations, pigeon-hole principle, inclusion-exclusion principle, derangements. Fundamental theorem of arithmetic, divisibility in Z, congruences, Chinese Remainder Theorem, Euler's Ø-function, primitive roots. Groups, subgroups, normal subgroups, quotient groups, homomorphisms, cyclic groups, permutation groups, Cayley's theorem, class equations, Sylowtheorems. Rings, ideals, prime and maximal ideals, quotient rings, unique factorization domain, principal ideal domain, Euclidean domain. Polynomial rings and irreducibility criteria. Fields, finite fields, field extensions, Galois Theory. Topology: basis, dense sets, subspace and product topology, separation axioms, connectedness and compactness.

UNIT – 3

Ordinary Differential Equations (ODEs): Existence and uniqueness of solutions of initial value problems for first order ordinary differential equations, singular solutions of first order ODEs, system of first order ODEs. General theory of homogenous and non-homogeneous linear ODEs, variation of parameters, Sturm-Liouville boundary value problem, Green's function.

Partial Differential Equations (PDEs): Lagrange and Charpit methods for solving first order PDEs, Cauchy problem for first order PDEs. Classification of second order PDEs, General solution of higher order PDEs with constant coefficients, Method of separation of variables for Laplace, Heat and Wave equations.

Numerical Analysis : Numerical solutions of algebraic equations, Method of iteration and Newton-Raphson method, Rate of convergence, Solution of systems of linear algebraic equations using Gauss elimination and Gauss-Seidel methods, Finite differences, Lagrange, Hermite and spline interpolation, Numerical differentiation and integration, Numerical solutions of ODEs using Picard, Euler, modified Euler and Runge-Kutta methods.

Calculus of Variations: Variation of a functional, Euler-Lagrange equation, Necessary and sufficient conditions for extrema. Variational methods for boundary value problems in ordinary and partial differential equations.

Linear Integral Equations: Linear integral equation of the first and second kind of Fredholm and Volterra type, Solutions with separable kernels. Characteristic numbers and eigenfunctions, resolvent kernel.

Classical Mechanics: Generalized coordinates, Lagrange's equations, Hamilton's canonical equations, Hamilton's principle and principle of least action, Two-dimensional motion of rigid bodies, Euler's dynamical equations for the motion of a rigid body about an axis, theory of small oscillations.

UNIT – 4

Descriptive statistics, exploratory data analysis Sample space, discrete probability, independent events, Bayes theorem. Random variables and distribution functions (univariate and multivariate); expectation and moments. Independent random variables, marginal and conditional distributions. Characteristic functions. Probability inequalities (Tchebyshef, Markov, Jensen). Modes of convergence, weak and strong laws of large numbers, Central Limit theorems (i.i.d. case). Markov chains with finite and countable state space, classification of states, limiting behaviour of n-step transition probabilities, stationary

distribution, Poisson and birth-and-death processes. Standard discrete and continuous univariate distributions. sampling distributions, standard errors and asymptotic distributions, distribution of order statistics and range. Methods of estimation, properties of estimators, confidence intervals. Tests of hypotheses: most powerful and uniformly most powerful tests, likelihood ratio tests. Analysis of discrete data and chi-square test of goodness of fit. Large sample tests. Simple nonparametric tests for one and two sample problems, rank correlation and test for independence. Elementary Bayesian inference. Gauss-Markov models, estimability of parameters, best linear unbiased estimators, confidence intervals, tests for linear hypotheses. Analysis of variance and covariance. Fixed, random and mixed effects models. Simple and multiple linear regression. Elementary regression diagnostics. Logistic regression. Multivariate normal distribution, Wishart distribution and their properties. Distribution of quadratic forms. Inference for parameters, partial and multiple correlation coefficients and related tests. Data reduction techniques: Principle component analysis, Discriminant analysis, Cluster analysis, Canonical correlation. Simple random sampling, stratified sampling and systematic sampling. Probability proportional to size sampling. Ratio and regression methods. Completely randomized designs, randomized block designs and Latin-square designs. Connectedness and orthogonality of block designs, BIBD. 2K factorial experiments: confounding and construction. Hazard function and failure rates, censoring and life testing, series and parallel systems. Linear programming problem, simplex methods, duality. Elementary queuing and inventory models. Steady-state solutions of Markovian queuing models: M/M/1, M/M/1 with limited waiting space, M/M/C, M/M/C with limited waiting space, M/G/1. All students are expected to answer questions from Unit I. Students in mathematics are expected to answer additional question from Unit II and III. Students with in statistics are expected to answer additional question from Unit IV.

Reference books:

1. Linear Algebra and its applications, Gilbert Strang.
2. Real Analysis, Royden H.L., Fitzpatrick P. M
3. Introduction to Real analysis, Donald R. Sherbert Robert G. Bartle
4. Foundations of complex analysis, S. Ponnusamy
5. Topics in Algebra, I. N. Herstein
6. An Introduction to Ordinary Differential Equations, Earl A. Coddington
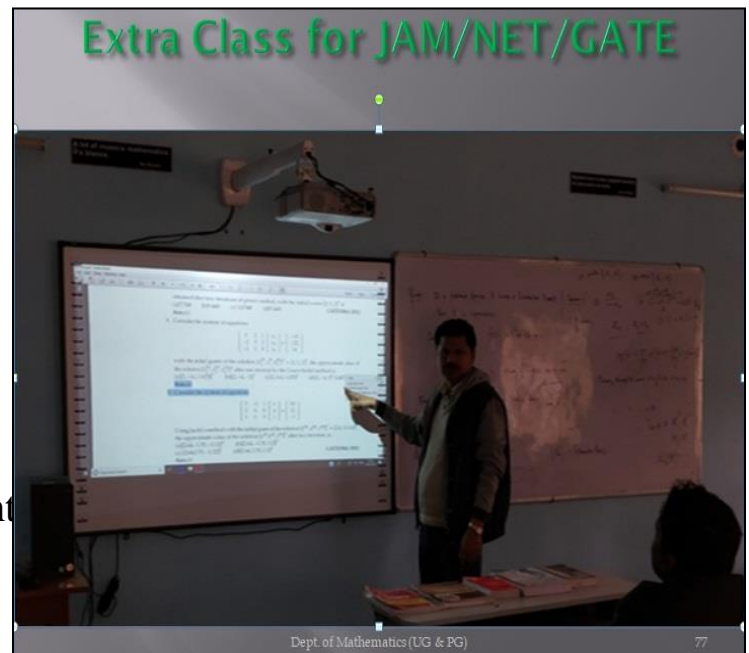
Speaker: Dr Manoranjan De, Assistant Professor, dept of mathematics

Topic : Syllabus of NBHM & TFIR and reference books

   a. **NBHM Syllabus in Mathematics**

Section A: Algebra: Polynomial's, Abstract algebra, Binary operations, Sets theory, Matrix Theory, Rings and Fields, Groups Algebra.

Section B: Analysis Real Analysis: Sequence and limits, Series, Matric Spaces, Functional Analysis Maxima and minima Continues functionDefining a function Differential function Complex Analysis Poles and Residues Polar coordinates.

Section C: Geometric : Algebraic geometry Cartesian coordinates Polar coordinates Plane algebraic curves Cubic curves Lines Circles 3d Shapes Ellipse Elliptical curves etc.

Reference books:

1. Linear Algebra and its applications, Gilbert Strang.
2. Real Analysis, Royden H.L., Fitzpatrick P. M
3. Introduction to Real analysis, Donald R. Sherbert Robert G. Bartle
4. Foundations of complex analysis, S. Ponnusamy
5. Topics in Algebra, I. N. Herstein
6. An Introduction to Ordinary Differential Equations, Earl A. Coddington

b. TIFR Syllabus in Mathematics

Algebra: Definitions and examples of groups (finite and infinite, commutative and non-commutative), cyclic groups, subgroups, homomorphisms, quotients. Group actions and Sylow theorems. Definitions and examples of rings and fields. Integers, polynomial rings and their basic properties. Basic facts about vector spaces, matrices, determinants, ranks of linear transformations,

characteristic and minimal polynomials, symmetric matrices. Inner products, positive definiteness.

Analysis: Basic facts about real and complex numbers, convergence of sequences and series of real and complex numbers, continuity, differentiability and Riemann integration of real valued functions defined on an interval (finite or infinite), elementary functions (polynomial functions, rational functions, exponential and log, trigonometric functions), sequences and series of functions and their different types of convergence.

Geometry/Topology: Elementary geometric properties of common shapes and figures in 2 and 3 dimensional Euclidean spaces (e.g. triangles, circles, discs, spheres, etc.). Plane analytic geometry (= coordinate geometry) and trigonometry. Definition and basic properties of metric spaces, examples of subset Euclidean spaces (of any dimension), connectedness, compactness. Convergence in metric spaces, continuity of functions between metric spaces.

General: Pigeon-hole principle (box principle), induction, elementary properties of divisibility, elementary combinatorics (permutations and combinations, binomial coefficients), elementary reasoning with graphs, elementary probability theory.
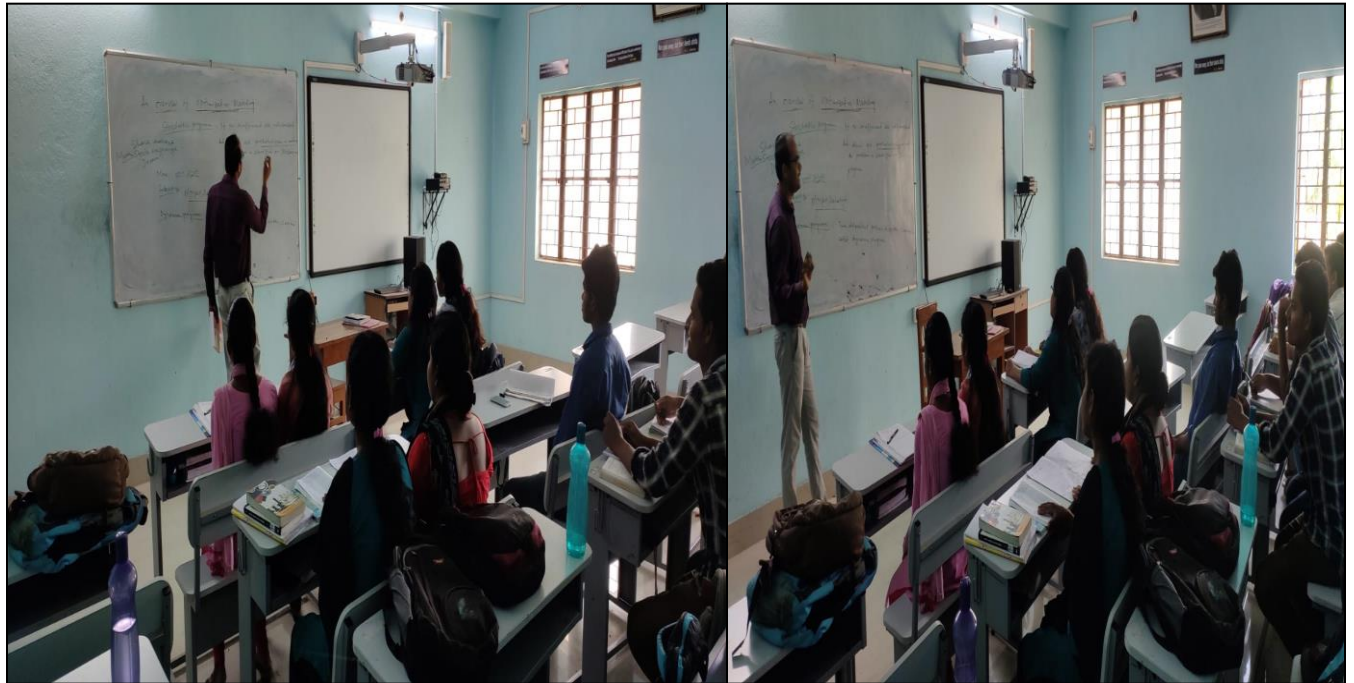
Reference books :

1. Linear Algebra and its applications, Gilbert Strang.
2. Real Analysis, Royden H.L., Fitzpatrick P. M
3. Introduction to Real analysis, Donald R. Sherbert Robert G. Bartle

4. Foundations of complex analysis, S. Ponnusamy
5. Topics in Algebra, I. N. Herstein
6. An Introduction to Ordinary Differential Equations, Earl A. Coddington

Registration

S.N.	Student Name	UG/PG
1	Somsankar Mandal	UG
2	Suman Das	UG
3	Amiyendra Maiti	UG
4	Soumyadeep Bej	UG
5	Jatindranath Samanta	UG
6	Sudipta Mondal	UG
7	Ranajit Mandal	UG
8	Atanu Maity	UG
9	Bachaspati Mondal	UG
10	Shubhajit Giri	UG
11	Surajit Maity	UG
12	Ayan Pradhan	UG
13	Rajkumar Karan	UG
14	Soumitra Das	UG
15	Bidisha Sasmal	UG
16	Sonali Mandal	UG
17	Sudeshna Maity	UG

18	Annesha Khatua	UG
19	Paramita Maity	UG
20	Megha Rani Sahoo	UG
21	Gaurangi Pal	UG
22	Subhadip Mahapatra	UG
23	Amit Patra	UG

Dated   04.09.2021

Signature of The Principal

Dr Swapan Kumar Misra

Principal

Mugberia Gangadhar Mahavidyalaya