

**DETAILED SYLLABUS FOR THE POST OF  
ASSISTANT PROFESSOR IN MATHEMATICS IN  
COLLEGIATE EDUCATION (TRAINING COLLEGES)**

*(Category Nos: 22/2020)*

**Module I - 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-rational forms, Jordan forms. Inner product spaces, orthonormal basis. Quadratic form.

**(8 Marks - 3 x 1 + 5 x 1)**

**Module II - Real Analysis:**

Sequences and series, convergence,  $\lim \sup$ ,  $\lim \inf$ . Bolzano Weierstrass theorem, Heine Borel theorem. Continuity, uniform continuity, differentiability, Rolle's theorem, Mean value theorem. Sequences and series of functions- uniform convergence. Riemann sums and Riemann integral, Improper Integrals. Double and triple integrals,

**Module III - Real Analysis(continued):**

Lebesgue measure, Lebesgue integral. directional derivative, partial derivative, Functions of several variables, inverse and implicit function theorems. Special functions- Beta and Gamma functions, Fourier series.

**(11 Marks - 3 x 2 + 5 x 1)**

**Module IV - Abstract Algebra:**

Groups, subgroups, normal subgroups, quotient groups, homomorphisms, isomorphisms, cyclic groups, permutation groups, Cayley's theorem, Direct products, Fundamental theorem for abelian groups, class equations, Sylow theorems.

**Module V - Abstract Algebra (continued):**

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.

**(11 Marks - 3 x 2 + 5 x 1)**

**Module VI - Topology:** Metric spaces, continuity, Topological spaces, Base, subbase, countability properties, Separation axioms, Compact space, one point compactification, locally compact space, connected spaces, pathwise connectedness, Quotient spaces, Product topology.

**(8 Marks - 3 x 1 + 5 x 1)**

### **Module VII - Complex Analysis:**

Complex numbers, polar form, properties of complex numbers, Analytic functions, Cauchy Reimann equations, Conformal Mappings, Mobius transformation, Power series, Zeros of analytic functions, Liouville's theorem, Complex integration, real integrals using complex integration, Cauchy's theorem and Cauchy's integral formula, Morera's theorem, open mapping theorem, Singularities and its classification, residues, Laurent series, Schwarz lemma, Maximum modulus principle, Argument principle.

**(8 Marks - 3 x 1 + 5 x 1)**

### **Module VIII - Functional Analysis:**

Normed Linear spaces, Continuity of linear maps, Banach spaces, Hahn Banach spaces, Open mapping theorem, closed graph theorem, uniform boundedness principle, Inner product spaces, Hilbert spaces Projections, Bounded operators, Normal, unitary and self adjoint operators.

**(8 Marks - 3 x 1 + 5 x 1)**

### **Module IX - Ordinary Differential & Partial Equations :**

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 homogeneous and non-homogeneous linear ODEs.

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

**(8 Marks - 3 x 1 + 5 x 1)**

### **Module X - Theory of Numbers:**

Fundamental theorem of arithmetic, divisibility in  $\mathbb{Z}$ , congruences, Chinese Remainder Theorem, Euler's  $\phi$ -function, Fermat's theorem, Wilson's theorem, Euler's theorem, primitive roots.

**(8 Marks - 3 x 1 + 5 x 1)**

### **Module I : Foundations of Modern Mathematics**

**(4 Marks – 2 x 2)**

1. Philosophical aspects about Mathematics- a priori and empirical knowledge, Analytical and synthetic knowledge. Euclidean Geometry and its criticisms - Euclid's procedure; Euclid's postulates; Euclid's axioms and definitions. Emergence of Non Euclidean geometry.

2. Psychological foundations of new approaches to teaching of Mathematics. Theories and educational implications of the work of Piaget, Bruner, Gagne, Vygotsky and Gardiner with special reference to teaching and learning of Mathematics.

### **Module II : Aims and Objectives of Mathematics Education**

**(5 Marks – 2 x 1 + 3 x 1)**

Mathematics Education-Nature and scope, Need and Significance; Historical development of Mathematics with special reference to the developments in the 20<sup>th</sup> century and 21<sup>st</sup> century; Aims and objectives of Mathematics education- Taxonomy of educational objectives - cognitive, affective and psychomotor-specific objectives in the instruction of Mathematics, Classification of objectives by Bloom, Wilson and Yager – revised Bloom's taxonomy.

### **Module III : Mathematics Curriculum**

**(9 Marks – 2 x 2 + 5 x 1)**

1. Meaning and scope of curriculum, changing curriculum patterns, curriculum as a course of study, as courses offered, planned experience and subject matter content. Need for changing Mathematics curriculum- social needs, developments in the discipline of Mathematical science; developments and innovations in pedagogy, need for coping up with international norms. Principles of curriculum construction and organisation, Approaches to curriculum organisation- topical and Spiral, Logical and Psychological, Correlational approaches.
2. **Approaches to Learning Mathematics:** Learner Centered Approach, Life centered /Environment based approach, Mastery Learning approach, Analytic-synthetic approach, Process Oriented approach, Inductive - deductive approach, Heuristic Approach. **Approaches to teaching Mathematics:** Behaviorist approach, constructivist approach, Process oriented approach, Competency based approach. Analysis of various Methods of Teaching Mathematics: Lecture, Inductive, Deductive, Analytic, Synthetic, Heuristic, Project, Problem solving, and Laboratory methods.
3. **Strategies for Teaching:** Concept attainment model, Inductive thinking model, Cognitive development model, Inquiry training model, Constructivist learning strategies and Reflective practices.

**Module IV : Educational Technology for Mathematics Education (6 Marks – 2 x 3)**

1. Programmed instruction: Linear and Branching; Development of programmed learning materials. Modular Instruction, Instructional modules, Web based lessons and Multimedia presentations. Teaching skills, Microteaching- advantages and limitations; link practice and macro teaching.
2. Identification of e-resources; e-content development, Blogging - Concept, format, steps for preparation of a Blog, Advantages with regard to Mathematics teaching and Learning. Concept of Techno Pedagogic Content Knowledge (TPCK).

**Module V : Assessment in Mathematics Learning**

**(6 Marks - 3 x 2)**

1. Evaluation of learning outcomes in Mathematics, Teacher made tests and standardized tests; construction and standardization of achievement test in Mathematics. Diagnostic testing and remedial instruction in Mathematics-Need and importance. Formative and Summative evaluation, Continuous and Comprehensive evaluation. Need for research in Mathematics education, Action research in Mathematics, Areas of research in mathematics education, Review research done in the area of Mathematics education.
2. Grading system- concept and spirit, types of grading-absolute grading, direct grading and relative grading, merits and demerits. Grade Point Average, Cumulative Grade Point Average, Weighted average and weighted score/point. Classification of learners according to their level of performance in grading system. Portfolio assessment and Evaluation based on Rubrics.

**NOTE: - It may be noted that apart from the topics detailed above, questions from other topics prescribed for the educational qualification of the post may also appear in the question paper. There is no undertaking that all the topics above may be covered in the question paper**