# *DEPARTMENT OF MATHEMATICS*

# *COURSE MODULE IN SEM-III*
# *FOR*
# *MATHEMATICS (HONOURS) COURSE*

**Under Choice Based Credit System (CBCS)**
**Effective from 2017-2018**

## Course: BMH3CC05

### Theory of Real Functions & Introduction to Metric Space (Marks: 75)

**Total Lecture Hours: 60**

**Module-1:** Limits of functions (ϵ-δ approach), Sequential criterion for limits, divergence criteria. Limit Theorems, one sided limits, infinite limits and limits at infinity. **10L**

**Module-2:** Continuous functions, Sequential criterion for continuity and discontinuity. Algebra of continuous functions. Continuous functions on an interval, Intermediate value theorem, Location of roots theorem, preservation of intervals theorem. **10L**

**Module-3:** Uniform Continuity, non-uniform continuity criteria, Theorems on uniform continuity. **05L**

**Module-4:** Differentiability of a function at a point and in an interval, Caratheodory's theorems, Algebra of differentiable functions. Relative extrema, interior extremum, Rolle's theorem. Mean value theorem, Intermediate value property of derivatives, Darboux's theorem. **10L**

**Module-5:** Application of Mean value theorem to inequalities and approximation of polynomials, application of differential calculus: Curvature. **05L**

**Module-6:** Cauchy's mean value theorem. Taylor's theorem with Lagrange's form of remainder, Taylor's theorem with Cauchy's form of remainder, Application of Taylor's theorem to convex functions, relative extrema. **05L**

**Module-7:** Taylor's series and Maclaurin's series expensions of exponential and trigonometric functions, $\ln(1+x)$ , $\frac{1}{ax+b}$ $and$ $(1+x)^n$ . Application of Taylor's theorem to inequalities. **05L**

**Module-8:** Metric spaces: Definition and Examples. Open and closed balls, neighbourhood of a point. **04L**

**Module-9:** Open set, interior of a set. Limit point of a set, closed set, Diameter of a set, subspaces, Dense sets, Separable spaces. **06L**

## Course: BMH3CC06

### Group theory – I (Marks : 75)

**Total Lecture Hours: 60**

**Module – 1 :** Symmetries of a square, Dihedral group, definition and examples of groups including permutation group and quaternion groups (through matrices), elementary properties of groups **10L**

**Module -2 :** Subgroups and examples of subgroups, centralizer, normalizer, center of a group, product of two subgroups **05 L**

**Module-3 :** Properties of cyclic group, classification of subgroup of cyclic group, cycle notation for permutations, properties of permutations, even and odd permutations, alternating groups. **12L**

**Module -4 :** Properties of cosets, Lagrange's theorem, and consequences including Fermat's little theorem. **08L**

**Module -5 :** External direct product of a finite number of groups, normal subgroups, Factor groups, Cauchy's theorem for finite abelian group. **10L**

**Module-6 :** Group homomorphisms, properties of homomorphisms, Caley's theorem . **09L**

**Module -7 :** Properties of isomorphism, First, Second and Third isomorphism theorems. **06L**

## Course: BMH3CC07

### Numerical Methods and Numerical Methods Lab

## (Theory : 50 & Practical : 25)

**Total Lecture Hours: 60(Theory – 40, Practical - 20)**

**Numerical Theory : 40L**

**Module - 1 :** Algorithms, Convergence, Errors : Relative, Absolute, Round off, Truncation. **02L**

**Module**-2 : Transcendental and Polynomial equations: Bisection method, Newton's method, Secant method, Regula-Falsi method, fixed point iteration, Newton-Raphson method. Rate of convergence of these methods. **06L**

**Module**-3 : System of linear algebraic equations, Gaussian elimination and Gauss-Jordon method, Gauss-Jacobi's method, Gauss-Seidel method and their convergence analysis, L-U decomposition. 08 L

**Module**-4 : Interpolation : Lagrange and Newton's methods, error bounds, finite difference operators, Gregory forward and backward difference interpolations, **05L**

**Module**-5 : Numerical differentiation : methods best on interpolation, methods based on finite differences. **04L**

**Module**-6 : Numerical Integrations : Newton's cote formula, Trapezoidal Rule, Simpson's 1/3 role, Simpson's 3/8 rule, Weddle's rules, Boole's rule, Mid-point rule, Composite Trapezoidal rule , Composite Simpson's 1/3 rule,, Gauss-quadrature formula, 08L

**Module**-7 : The algebraic eigenvalue problem : Power method. **02L**

**Module-** 8 : Ordinary differential equations : The methods of successive approximations , Euler's method and modified Euler's method, Runge-Kutta method of order two and fourth. **05L**

**Numerical Practical : 20L**

**Module-** 1 : Solutions of transcendental and algebraic equation by

Newton-Raphson and Regula-Falsi method **04L**

**Module –** 2: Solutions of system of linear equations by Gaussian elimination and Gauss-Seidel method. **06L**

**Module –** 3: Lagrange Interpolation **02L**

**Module –** 4: Numerical integration by Trapezoidal and Simpson's 1/3 Rule. **04L**

**Module –** 4: Solutions of ordinary differential equations by Runge-Kutta method **04L**

## Course: BMH3SEC11

## Logic and Sets ( Marks : 50)

### Total Lecture Hours : 40

**Module-1:** Introduction, propositions, truth table, negation, conjunction and disjunction. Implications, biconditional propositions, converse, contra positive and inverse propositions and precedence of logical operators. **10L**

**Module-2:** Propositional equivalence: Logical equivalences. Predicates and quantifiers: Introduction, Quantifiers, Binding variables and Negations. **08L**

**Module-3:** Sets, subsets, set operations and the laws of set theory and Venn diagrams, Examples of finite and infinite sets. Finite sets and counting principle. Empty set, properties of empty set. Standard set operations. Classes of sets.

Power set of a set. **07L**

**Module-4:** Difference and Symmetric difference of two sets. Set identities, Generalized union and intersections. **05L**

**Module-5:** Relation: Product set. Composition of relations, Types of relations, Partitions, Equivalence Relations with example of congruence modulo relation. Partial ordering relations, n- ary relations. 1**0L**

# *DEPARTMENT OF MATHEMATICS*

# *COURSE MODULE IN SEM-II*
# *FOR*
# *MATHEMATICS (GENERAL) COURSE*

## Under Choice Based Credit System (CBCS)
## Effective from 2017-2018

## Course :BMG3CC1C
## Real Analysis (Marks : 75)
**Total lecture hours: 60**

**Module-1**
Finite and infinite sets, examples of countable and uncountable sets. Real line, bounded sets, suprema and infima. **05L**

**Module-2**
**C**ompleteness property of R, Archimedean property of R, intervals. Concept of cluster points and statement of Bolzano-Weierstrass theorem. **10L**

**Module-3**
Real Sequence, Bounded sequence, Cauchy convergence criterion for sequences. **06L**

**Module-4**
Cauchy's theorem on limits, order preservation and squeeze theorem, monotone sequences and their convergence (monotone convergence theorem without proof). **09L**

**Module-5**
Infinite series. Cauchy convergence criterion for series, positive term series, geometric series, comparison test, convergence of p-series, Root test, Ratio test. **10L**

**Module-6**
Alternating series, Leibnitz's test(Tests of Convergence without proof). Definition and examples of absolute and conditional convergence. **05L**

**Module-7**
Sequences and series of functions, Pointwise and uniform convergence. $M_n$-test, M-test. **08L**

**Module-8**
Statements of the results about uniform convergence and integrability and differentiability of functions, Power series and radius of convergence. **07L**

# Course: BMG3SEC11

## Logic and Sets ( Marks : 50)

### Total Lecture Hours : 40

**Module-1:** Introduction, propositions, truth table, negation, conjunction and disjunction. Implications, biconditional propositions, converse, contra positive and inverse propositions and precedence of logical operators. **10L**

**Module-2:** Propositional equivalence: Logical equivalences. Predicates and quantifiers: Introduction, Quantifiers, Binding variables and Negations. **08L**

**Module-3:** Sets, subsets, set operations and the laws of set theory and Venn diagrams, Examples of finite and infinite sets. Finite sets and counting principle. Empty set, properties of empty set. Standard set operations. Classes of sets. Power set of a set. **07L**

**Module-4:** Difference and Symmetric difference of two sets. Set identities, Generalized union and intersections. **05L**

**Module-5:** Relation: Product set. Composition of relations, Types of relations, Partitions, Equivalence Relations with example of congruence modulo relation. Partial ordering relations, n- ary relations. 1**0L**