**SYLLABUS**

**M.Sc. (Applied Mathematics & Computing) (Part I)**

**Session 2014-2015**

**First Semester**

**List of Papers**

Paper-I AMC 101: MATHEMATICAL ANALYSIS

Paper-II AMC 102: TOPOLOGY I

Paper-III AMC 103: ALGEBRA-I

Paper-IV AMC 104: DIFFERENTIAL GEOMETRY

Paper-V AMC 105 (A): FUNDAMENTAL OF COMPUTER SCIENCE and C-Programming

AMC- 105(B): SOFTWARE LABORTARY (C- Programming)

**Second Semester**

**List of Papers**

Paper-I AMC-201: DIFFERENTIAL EQUATIONS

Paper-II AMC-202: FUNCTIONAL ANALYSIS

Paper-III AMC-203: ALGEBRA-II (RINGS AND MODULES)

Paper-IV AMC-204: COMPLEX ANALYSIS

Paper-V AMC-205(A) : OBJECT ORIENTED PROGRAMMING USING C++

AMC-205(B): SOFTWARE LABORTARY-II (C ++ Programming)

**AMC-101: MATHEMATICAL ANALYSIS**

L T P University Exam: 75

5 1 0 Internal Assessment: 25

Time Allowed: 3 hours Total: 100

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of five sections: A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus. Sections C will consist of one compulsory question having ten short answer covering the entire syllabus uniformly. The weightage of section A and B will be 30% and that of section C will be 40%.

**INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt five questions in all selecting two question from each sections A and B and compulsory question of section C.

SECTION-A

Functional of several variables: Linear transformations, Derivatives in an open subset of **Rn** , Chain Rule, Partial derivatives, Interchange of the order of differentiation, Derivatives of higher orders, Taylor’s theorem, Inverse function theorem, Implicit function theorem. Algebras, σ- algebra, their properties, General measurable spaces, measure spaces, properties of measure, Complete measure, Lebesgue outer measure and its properties, measurable sets and Lebesque measure, A non measurable set.

##### SECTION-B

Measurable function w.r.t. general measure. Borel and Lebesgue measurability. Integration of non-negative measurable functions, Fatou’s lemma, Monotone convergence theorem, Lebesgue convergence theorem, The general integral, Integration of series, Riemann and lebesgue integrals. Differentiation; Vitalis Lemma, The Dini derivatives, Functions of bounded variation, Differentiation of an Integral, Absolute Continuity, Convex Fucntions and Jensen’s inequality.

### Book Recommended

1. H.L. Royden: Real analysis, Macmillan Pub. co. Inc. 4th Edition, New York, 1993. Chapters 3, 4, 5 and Sections 1 to 4 of Chapter 11.
2. Walter Rudin: Principles of Mathematical Analysis, 3rd edition, McGrawHill, Kogakusha, 1976, International student edition. Chapter 9 (Excluding Sections 9.30 to 9.43)

**AMC-102: TOPOLOGY I**

L T P University Exam: 75

5 1 0 Internal Assessment: 25

Time Allowed: 3 hours Total: 100

**INSTRUCTIONS FOR THE PAPER-SETTER**

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**INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt five questions in all selecting two question from each sections A and B and compulsory question of section C.

**SECTION A**

Cardinals: Equipotent sets, Countable and Uncountable sets, Cardinal Numbers and their Arithmetic, Bernstein’s Theorem and the Continumm Hypothesis.

Topological Spaces: Definition and examples, Euclidean spaces as topological spaces, Basis for a given topology, Topologizing of Sets; Sub-basis, Equivalent Basis.

Elementary Concepts: Closure, Interior, Frontier and Dense Sets, Topologizing with pre-assigned elementary operations. Relativization, Subspaces.

Maps and Product Spaces: Continuous Maps, Restriction of Domain and Range, Characterization of Continuity, Continuity at a point, Piecewise definition of Maps and Neighborhood finite families. Open Maps and Closed Maps, Homeomorphisms and Embeddings.

###### SECTION B

Cartesian Product Topology, Elementary Concepts in Product Spaces, Continuity of Maps in Product Spaces and Slices in Cartesian Products.

Connectedness: Connectedness and its characterizations, Continuous image of connected sets, Connectedness of Product Spaces, Applications to Euclidean spaces. Components, Local Connectedness and Components, Product of Locally Connected Spaces. Path Connectedness.

Compactness and Countability: Compactness and Countable Compactness, Local Compactness, One-point Compactification, T­0, T1, and T2 spaces, T2 spaces and Sequences and Hausdorfness of One-Point Compactification.

Axioms of Countablity and Separability, Equivalence of Second axiom, Separable and Lindelof in Metric Spaces. Equivalence of Compact and Countably Compact Sets in Metric Spaces.

###### Books Recommended

1. W.J. Pervin Foundations of General Topology, Ch. 2 (Sections 2.1, 2.2), Section 4.2, and Ch 5 (Sec 5.1 to 5.3).
2. James Dugundji : TOPOLOGY. Relevant Portions from Ch.III (excluding Sec 6 and Sec 10) , Ch IV; (Sections 1-3) and ChV

#### AMC-103: ALGEBRA - I

L T P University Exam: 75

5 1 0 Internal Assessment: 25

Time Allowed: 3 hours Total: 100

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of five sections: A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus. Sections C will consist of one compulsory question having ten short answer covering the entire syllabus uniformly. The weightage of section A and B will be 30% and that of section C will be 40%.

**INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt five questions in all selecting two question from each sections A and B and compulsory question of section C.

**SECTION-A**

Review of groups, subgroups, cosets, normal subgroups, quotient groups, homomorphisms and isomorphism theorems.Normal and subnormal series, Solvable groups, Nilpotent groups, Composition Series, Jordan-Holder theorem for groups. Group action, Stabilizer, orbit, Review of class equation, permutation groups, cyclic decomposition, Alternating group An, Simplicity of An.

SECTION-B

Structure theory of groups, Fundamental theorem of finitely generated abelian groups, Invariants of a finite abelian group, Sylow’s theorems, Groups of order p2, pq. Review of rings and homorphism of rings, Ideals, Algebra of Ideals, Maximal and prime ideals, ideal in Quotient rings, Field of Quotients of integral Domain.

**Books Recommended**

1. Bhattacharya, Jain & Nagpaul : Basic Abstract Algebra, Second Edition (Ch. 6, 7, 8, 10)
2. Surjeet Singh, Qzai Zimeeruddin : Modern Algebra
3. I.N. Herstein : Topics in Algebra, Second Edition

#### AMC-104: DIFFERENTIAL GEOMETRY

L T P University Exam: 75

5 1 0 Internal Assessment: 25

Time Allowed: 3 hours Total: 100

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of five sections: A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus. Sections C will consist of one compulsory question having ten short answer covering the entire syllabus uniformly. The weightage of section A and B will be 30% and that of section C will be 40%.

**INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt five questions in all selecting two question from each sections A and B and compulsory question of section C.

**SECTION-A**

A simple arc, Curves and their parametric representation, are length and natural parameter, contact of curves, Tangent to a curve, osculating plane, Frenet trihedron, Curvature and Torsion, Serret Frenet formulae, fundamental theorem for spaces curves, helices, contact between curves and surfaces. Evolute and involute, Bertrand Curves, spherical indicatrix, implicit equation of the surface, Tangent plane, the first fundamental form of a surface, length of tangent vector and angle between two tangent vectors, area of a surface.

**SECTION-B**

The second fundamental form, Gaussian map and Gaussian curvature, Gauss and Weingarten formulae, Codazzi equation and Gauss theorem, curvature of a curve on a surface, geodesic curvature. Geodesics, Canonical equations of geodesic, Normal properties of geodesics. Normal Curvature, principal curvature, Mean Curvature, principal directions, lines of curvature, Rodrigue formula, asymptotic Lines, conjugate directions, envelopes, developable surfaces associated with spaces curves, minimal surfaces, ruled surfaces.

**Books Recommended**

1. A. Goetz: Introduction to differential geometry.

2. T.J. Willmore :An introduction to differential geometry.

**AMC-105(A) : FUNDAMENTALS OF COMPUTER SCIENCE AND C-Programming**

L T P University Exam: 60

4 1 0 Internal Assessment: 15

Time Allowed: 3 hours Total: 75

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of five sections: A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus. Sections C will consist of one compulsory question having ten short answer covering the entire syllabus uniformly. The weightage of section A and B will be 30% and that of section C will be 40%.

**INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt five questions in all selecting two question from each sections A and B and compulsory question of section C.

**SECTION -A**

**Computer’s General Concepts:** Historical Evolution of Computer, Characterization of Computers, types of Computers, the Computer generations, CPU, Primary memory, Secondary storage devices, Input devices, Output devices, software – System software, Application software, Binary arithmetic for integer and fractional numbers.

**Computer Languages**: Machine Language, assembly language, high level language, 4GL, assembler, compiler and interpreter, Linkers, Loaders, Debuggers.

**Operating System Concepts:** Role of an operating System, Function of operating Systems, Types of operating systems, Booting procedure and its types.

**Networking:** Basics, types of networks (LAN, WAN, MAN), topologies, Transmission media.

**Internet:** Internet and its applications, Working knowledge of Search engines and use of electronic mail, Virus, Threats, Hacking, Prevention Mechanism: Anti Viruses, Firewalls.

**E-commerce:** meaning, advantages and application of e-commerce.

**SECTION-B**

**Programming Tools:** Problem Identification, Analysis, Flowcharts, Decision tables, Pseudo codes and algorithms, Program coding, Program Testing and execution, Modular Programming, Top-down and Bottom-up Approaches.

**C Programming:** Need of programming languages. C character set, Identifiers and keywords, Data types, Declarations, Statement and symbolic constants, Input-output statements, Preprocessor commands, Operators, expressions and library functions, Control statements: Conditional, Unconditional, Bi-directional, Multi-directional and loop control structures,

**Functions**: Declaration, Definition, Call, passing arguments, call by value, call by reference, Recursion, Use of library functions; Storage classes: automatic, external and static variables.

**Arrays**: Defining and processing arrays, Passing array to a function, Using multidimensional arrays, Solving matrices problem using arrays; Strings: Declaration, Operations on strings. Introduction to Pointers, Structure and union.

**Books Recommended**

1. Norton Peter, Introduction to Computers, Tata McGraw Hill (2005).
2. Computers Today: Suresh K. Basandra, Galgotia, 1998.
3. Kerninghan B.W. and Ritchie D.M., The C programming language, PHI (1989)
4. Kanetkar Yashawant, Let us C, BPB (2007).
5. Rajaraman V., Fundamentals of Computers, PHI (2004).
6. Shelly G.B., Cashman T.J., Vermaat M.E., Introduction to computers, Cengage India Pvt Ltd (2008).

**AMC-105(B): SOFTWARE LABORATORY-I (C-Programming)**

L T P University Exam: 15

0 0 4 Internal Assessment: 10

Time Allowed: 3 hours Total: 25

This laboratory course will mainly comprise of exercises on what is learnt under the paper," Fundamentals of Computer Science and C-Programming".

**AMC 201: DIFFERENTIAL EQUATIONS**

L T P University Exam: 75

5 1 0 Internal Assessment: 25

Time Allowed: 3 hours Total: 100

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of five sections: A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus. Sections C will consist of one compulsory question having ten short answer covering the entire syllabus uniformly. The weightage of section A and B will be 30% and that of section C will be 40%.

**INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt five questions in all selecting two question from each sections A and B and compulsory question of section C.

**SECTION- A**

Existence of solution of ODE of first order, initial value problem, Ascoli’s Lemma, Gronwall’s inequality, Cauchy Peano Existence Theorem, Uniqueness of Solutions. Method of successive approximations, Existence and Uniqueness Theorem.

System of differential equations, nth order differential equation, Existence and Uniqueness of solutions, dependence of solutions on initial conditions and parameters.

**SECTION- B**

Linear system of equations (homogeneous & non homogeneous). Superposition principle, Fundamental set of solutions, Fundamental Matrix, Wronskian, Abel Liouville formula, Reduction of order, Adjoint systems and self adjoint systems of second order, Floquet Theory.

Linear 2nd order equations, preliminaries, Sturm’s separation theorem, Sturm’s fundamental comparison theorem, Sturm Liouville boundary value problem, Characteristic values & Characteristic functions, Orthogonality of Characteristic functions, Expansion of a function in a series of orthonormal functions.

**Books Recommended**

1. E. Coddington & N. Levinson, Theory of Ordinary Differential Equations, Tata Mc-Graw Hill, India

2. S.L. Ross, Differential Equations, 3rd edition, John Wiley & sons (Asia).

3. D.A. Sanchez, Ordinary Differential Equations & Stability Theory, Freeman & company.

4. A.C. King, J. Billingham, S.R. Otto, Differential Equations, Linear, Nonlinear, Ordinary, Partial, Cambridge University Press.

# AMC-202: FUNCTIONAL ANALYSIS

L T P University Exam: 75

5 1 0 Internal Assessment: 25

Time Allowed: 3 hours Total: 100

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of five sections: A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus. Sections C will consist of one compulsory question having ten short answer covering the entire syllabus uniformly. The weightage of section A and B will be 30% and that of section C will be 40%.

**INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt five questions in all selecting two question from each sections A and B and compulsory question of section C.

## SECTION-A

Normed Linear spaces, Banach spaces, Examples of Banach spaces and subspaces. Continuity of Linear maps, Equivalent norms. Normed spaces of bounded linear maps. Bounded Linear functional. Hahn-Banach theorem in Linear Spaces and its applications.

Hahn-Banach theorem in normed linear spaces and its applications.Uniform boundedness principle, Open mapping theorem, Projections on Banach spaces, Closed graph theorem.

SECTION-B

The conjugate of an operator. Dual spaces of lp and C [a,b], Reflexivity. Hilbert spaces, examples, Orthogonality, Orthonormal sets, Bessel's inequality, Parseval's theorem. The conjugate space of a Hilbert spaces. Adjoint operators, Self-adjoint operators, Normal and unitary operators. Projection operators. Spectrum of an operator, Spectral Theorem, Banach Fixed Point Theorem, Brower's Fixed Point Theorem. Schauder Fixed Point Theorem, Picards Theorem. Applications of Fixed point theorem in differential equations and integral equations.

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Books Recommended

1. G.F.Simmons : Introduction to Toplogy and modern Analysis, Chapters IX, X , XII

and appendix one.

**Reference Books**

1. George Bachman & Lawrence Narici: Functional Analysis.

2. E. Kreyszig, Introductory Functional Analysis with applications

3. Abul Hasan Siddiqi , Applied Functional Analysis. Marcel Dekker.

**AMC 203: ALGEBRA-II (RINGS AND MODULES)**

L T P University Exam: 75

5 1 0 Internal Assessment: 25

Time Allowed: 3 hours Total: 100

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of five sections: A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus. Sections C will consist of one compulsory question having ten short answer covering the entire syllabus uniformly. The weightage of section A and B will be 30% and that of section C will be 40%.

**INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt five questions in all selecting two question from each sections A and B and compulsory question of section C.

**SECTION-A**

Unique Factorization Domains, Principal Ideal Domains, Euclidean Domains, Polynomial Rings over UFD, Rings of Fractions. (RR1: Ch. 11 and Section 1 of Chapter 12).

Modules: Definition and Examples, Submodules, Direct sum of submodules, Free modules, Difference between modules and vector spaces, Quotient modules, Homomorphism, Simple modules, Modules over PID. (RR2: Chapter 5)

**SECTION - B**

Modules with chain conditions: Artinian Modules, Noetherian Modules, composition series of a module, Length of a module, Hilbert Basis Theorem (RR2: Chapter 6).

Cohen Theorem, Radical Ideal, Nil Radical, Jacobson Radical, Radical of an Artinian ring. (RR2: Chapter 6)

**Books Recommended**

1. Bhattacharya, Jain and Nagpaul: Basic Abstract Algebra, Second Edition.

2. Musili C., Introduction to Rings and Modules, Second Revised Edition.

**AMC 204: COMPLEX ANALYSIS**

L T P University Exam: 75

5 1 0 Internal Assessment: 25

Time Allowed: 3 hours Total: 100

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of five sections: A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus. Sections C will consist of one compulsory question having ten short answer covering the entire syllabus uniformly. The weightage of section A and B will be 30% and that of section C will be 40%.

**INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt five questions in all selecting two question from each sections A and B and compulsory question of section C.

**SECTION-A**

Function of complex variable, Analytic function, Cauchy-Riemann equations, Harmonic function and Harmonic conjugates, Branches of multivalued functions with reference to arg z, logz and , Conformal Mapping.

Complex Integration, Cauchy’s theorem, Cauchy Goursat theorem Cauchy integral formula, Morera’s theorem, Liouville's theorem, Fundamental theorem of Algebra, Maximum Modulus Principle. Schwarz lemma.

**SECTION-B**

Taylor’s theorem. Laurent series in an annulus. Singularities, Meromorphic function. Cauchy’s theorem on residues. Application to evaluation of definite integrals.

Principle of analytic continuation, General definition of an analytic function. Analytic continuation by power series method, Natural boundary, Harmonic functions on a disc, Schwarz Reflection principle, Mittag-Leffler’s theorem (only in case when the set of isolated singularities admits the point at infinity alone as an accumulation point).

**Books Recommended**

1. L.V.Ahlfors, Complex Analysis, 3rd edition.

2. E.T.Copson, An introduction to Theory of Functions of a Complex Variable

3 H.S. Kasana, Complex Variables, Prentice Hall of India

4. Herb Silverman, Complex Variables, Houghton Mifflin Company Boston

###### AMC-205(A): Object Oriented Programming Using C++

L T P University Exam: 60

4 1 0 Internal Assessment: 15

Time Allowed: 3 hours Total: 75

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of five sections: A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus. Sections C will consist of one compulsory question having ten short answer covering the entire syllabus uniformly. The weightage of section A and B will be 30% and that of section C will be 40%.

**INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt five questions in all selecting two question from each sections A and B and compulsory question of section C.

**SECTION –A**

**Programming Paradigms:** Introduction to the object oriented approach towards programming by discussing Traditional, Structured Programming methodology, its shortcomings, Advantages of OOPS (Object Oriented Programming Style), Traditional Vs OOPS Software Life Cycle.

**Objects & Classes:** Object Definition, Instance, Encapsulation, Data Hiding, Abstraction, Inheritance, Messages, Method, Polymorphism, Classes, Candidate & Abstract Classes, Defining member functions, Members access control, Use of scope resolution, Nesting of member functions, Memory allocation for objects, Static data members, Static member functions, Array of objects, Friend functions and friend classes.

**Constructors and Destructors**: Types of constructors- default, parameterized and copy constructors, Dynamic constructors, Multiple constructors in a class, Destructors for destroying objects, Rules for constructors and destructors. Dynamic initialization of objects, new and delete operator.

**Operator Overloading and Type Conversions**: Overloading unary, binary operators, Operator overloading using friend functions, Rules for overloading operators.

**SECTION-B**

**Inheritance:** General concepts of Inheritance, Types of derivation-public, private, protected. Types of inheritance: Single, Multilevel, Multiple, Hybrid inheritance, Polymorphism with pointers, pointer to objects, this pointer, pointer to derived class,Virtual functions, Pure Virtualfunctions.

**Files and Streams**: Streams, Stream classes for console operations, Unformatted I/O operations, Formatted console I/O operations, Managing output with manipulators, File Streams, opening, reading, writing to file. File pointers and their manipulators, Exception handling, Basics of Exception handling, C++ versus java

**BOOKS RECOMMENDED**

1. Deitel and Deitel, C++ How to Program, Pearson Education (2004).
2. Balaguruswamy E., Objected Oriented Programming with C++, Tata McGraw Hill (2008).
3. Schildt Herbert, The complete Reference C++, Tata McGraw Hill (2003).
4. Designing Object Oriented Software Rebacca Wirfs - Brock Brian Wilerson, PHI.
5. Object Oriented Programming in Turbo C++, Robert Lafore, Galgotia Publication.
6. Designing Object Oriented Applications using C++ & Booch Method, Robert C. Martin.

**AMC-205(B): SOFTWARE LABORATORY-II (C++ PROGRAMMING)**

L T P University Exam: 15

0 0 4 Internal Assessment: 10

Time Allowed: 3 hours Total: 25

This laboratory course will mainly comprise of exercises on what is learnt under the paper," Object Oriented Programming Using C++".