SEMESTER SYSTEM OF P. G. MATHEMATICS

P. G. SEMESTER EXAMINATION REGULATIONS

CHAPTER – I

REGULATION OF GENERAL ACADEMIC MATTERS

1.1 The Departments shall follow Semester System of teaching and Examination based on continuous evaluation internally as well as externally subject to moderation of question papers. The system of evaluations of the students shall be based on Course Credit System.

1.1.1 Academic Year

The Academic Year of the department shall ordinarily be from JUNE to MAY. It may however, be modified by the Staff Council from time to time.

1.1.2 Semester

The academic year shall have two semesters, each of which shall be of 6 months duration.

1.2 Minimum working days in a Semester

A Semester shall have a minimum of 90 working/instructional days excluding examination days/Sundays/Holidays etc. The minimum number of classes in a semester shall not fall short of the number of classes as mentioned below.

1. One Credit hour courses = 10 classes minimum
2. Two Credit hour courses = 20 classes minimum
3. Three Credit hour courses = 30 classes minimum
4. Four Credit hour courses = 40 classes minimum
5. Five Credit hour courses = 50 classes minimum

1.3 ***Credit hours***

One credit shall signify the quantum of teaching imparted corresponding to one hour of theory class and two hours of laboratory/project work and two hours of seminar per week during a semester in respect of a particular course. Each teaching hour of theory class will be of 60 minutes and practical classes/project work will be of 120 minutes duration and seminar will be of 120 minutes duration. For field study outside headquarters, one working day will be considered as two teaching hours. However, the field study should not exceed 30 days (including Sundays) in one semester.

The P. G. Syllabus may be so designed that the total of credit hours for all four semesters shall be 80 spread equally over all semesters as far as practicable, tutorials and proctorials shall be treated as non-credit components.

1.4 ***Course***

A course is a Unit of instruction under any discipline carrying a specific number of credit hours describing its weightage. Those courses, which a student must take as compulsory requirement, are, called Core Courses. Those courses, which a student opts out of a list of specialized courses offered by the department, are called Elective Courses.

Choice Based Credit System (CBCS) is introduced at the P. G. Semester-I level uniformly in all the subjects to be taught in paper-103. The students of P. G. Arts stream can not opt for the CBCS course of Science stream. The details of the CBCS courses offered by different P. G. Departments are given in Annexure-II.

1.4.1 ***Grade***

The grade awarded to a student in any particular course shall be based on his/her performance in all the tests conducted during a semester and shall be awarded at the end of the semester. The grade in each course is expressed in numerical value in 10.00 scale. The marks of a student shall be converted to10.00 scale and the points scored thereby shall be called the "Grade Point" in the course. Respective "Grade Point Average" (GPA) and "Overall Grade Point Average" (OGPA) shall be awarded at the end of each semester and all semester respectively. A 3.0 Grade Point is required for passing in individual paper and 4.0 GPA to pass any semester examination. The G. P. shall be rounded to one decimal point and GPA to two decimal points.

1.4.2 Grade Point Average (G.P.A.)

Grade Point Average (G.P.A.) of a semester shall be calculated as:

$$\text{GPA} = \frac{\text{Summation of } \{(\text{Credits in each course}) \times (\text{Grade point in that course})\}}{\text{Total No. of Credits in that Semester}}$$

Where the summation is taken over all courses in a given semester, G.P.A. shall be rounded up to 2 decimal points.

1.4.3 O.G.P.A. (Overall Grade Point Average)

It is the average of accumulated grade points of a student, worked out by dividing the cumulative total of grade points by the cumulative total of credit hours of all the courses covered and completed by a student during all the Semesters. For the first semester of the programme the GPA and OGPA shall be the same.

$$\text{OGPA} = \frac{\text{Summation of } \{(\text{Credits in each semester}) \times (\text{Total Credits in that semester})\}}{\text{Total No. of Credits in that Semester}}$$

Where the summation is taken over all semesters in a given programme. OGPA shall be rounded up to e decimal points. For merit lists, in case of equality, the OGPA shall be calculated beyond two decimal places if necessary.

1.4.4 Conversion of grades to marks and classification of results under course credit system

The OGPA can be converted to percentage of marks in the following manner:

Percentage of Marks = (OGPA) ×10

A student after successful completion of all the semesters, Degree shall be awarded in the following manner:

O.G.P.A. ≥ 6.0 : FIRST CLASS
O.G.P.A. ≥ 5.0 - < 6.0 : SECOND CLASS
O.G.P.A. 4.0 - < 5.0 : THIRD CLASS
O.G.P.A. < 4.0 : FAIL

1.5 ***Academic Calendar***

The Examination Section and the academic section shall finalise the schedule of semester registration and other academic activities at the start of academic session. The Academic Calendar shall be prepared by the Academic Committee of the University in consultation with examination section.

The broad format for academic calendar for P. G. with regard to admission, registration and commencement of classes shall be as follows:

Admission and Registration and
Commencement of Classes for 1st Semester JULY
1st Semester Examination DECEMBER
Commencement of Classes 2nd Semester JANUARY-MAY
2nd Semester Examination JUNE

SEMESTER SYSTEM OF P. G. MATHEMATICS

Commencement of 3rd Semester Classes	JULY-NOVEMBER
3rd Semester Examination	DECEMBER
Commencement of 4th Semester Classes	JANUARY-APRIL
4th Semester Examination	APRIL & MAY
Final Results to be published in the month of	JUNE

1.5.1 Requirement of award of degree

The minimum credit hour requirement for the Master Degree shall be 80 (eighty) credits and the residence required for Master Degree shall be continuous four semesters from the first date of registration and the maximum time allowed to complete the Master Degree shall be 8 (eight) semesters.

1.6 Requirement for attendance

A candidate shall be required to attend 75% lectures, tutorials and practical classes separately during the semester (For late admitted students' attendance to be calculated from the date of admission). Condonation may be granted by the staff council only to the extent of 15% in exceptional cases. (Illness, accident, mishap in the family, deputation by University/Department). When a candidate has been deputed by the University to represent the University/state for any activity, the lectures delivered during his/her absence for the purpose shall not be counted towards the calculation of attendance provided the student submits a certificate to that effect from the appropriate authority.

1.7 ***Registration in a semester***

A student has to register his/her name at the beginning of every semester in the prescribed form, for the course he/she wants to take in that semester. Examination Section (General) shall notify the registration dates and the list of registered students for the semester shall be given to the Head of the Department within two weeks of the commencement of the Semester.

CHAPTER – II
REGULATIONS ON EXAMINATION MATTERS

2.1 Mid Term Examination

In each Semester there shall be one Mid Term Assessment examination of 60 minutes duration. The Mid Term examination shall be conducted by COE like that of End Term examination. The answer scripts shall be evaluated by the external and internal examiners and the marks along with answer scripts shall be retained in COE.

2.2 Semester Examination

After the end of each semester there shall be an examination of each theory paper of 2 hours duration and of each practical paper of 4 hours duration, which shall be called Term End / "Semester Examination". The maximum marks for each theory paper shall be 50 out of which 40 marks for term end and 10 marks for Mid Term. The maximum marks for each practical/ semester/ project/ dissertation/ review examination shall be 50 for Arts and Commerce and 100 marks for Science. The classes shall remain suspended ten days (including Sundays and holidays, if any) before the date of commencement of semester test for preparation by the students.

2.3 Results of Examinations

The results shall be declared ordinarily within four weeks of completion of the examinations. A students who seeks re-addition of his/her marks in a course shall be allowed to do so by submitting an application to Registrar along with a required fees in the fee counter of the University. All such cases/complaints if any shall be disposed of by the Examination Section in a prefixed day and necessary corrections if any shall be reflected in the mark/grade sheet. The candidates shall have to appear in all the Units of a semester examination to be eligible to be a declared 'pass' provided he/she secures minimum pass marks/grade.

2.4 Promotion to the next semester

A student shall be admitted to the next semester only when he/she appears in all the papers of the concerned semester examination. However, a student failing to appear semester examination in some or of all papers due to some reasons as mentioned in 2.5 may be admitted to the next semester. Such a student shall produce sufficient proof in favour of his/her reason for not being able to appear in some or all papers of the Semester Examination on the next academic session in the corresponding semesters.

2.5 ***Absence from Examination***

If a student is unable to appear a semester examination in some or all papers the Registrar shall consider his/her case for admission into the next higher semester only the following cases:

(a) When he/she is hospitalized.

(b) When he/she is not be able to appear in the examination due to serious illness or death of parents, brothers, sisters, spouse or children.

(c) When he/she met an accident of serious nature.

(d) When the department/University or any official directive deputes him/her

2.6 ***Procedure for Repeat/Improvement***

A student who wants to sit for the semester examination of first and/or second semester in the subsequent academic session (for repeat or improvement) he/she shall have to apply to the Registrar in plain paper before fifteen days of the commencement of the said examination. If allowed by the Registrar, he/she shall deposit the required fees for each paper with centre charge and produce the proof to the teacher in-charge examination with permission letter from the Registrar.

In a semester to appear improvement examination the candidates must have passed the semester examination. A candidate can appear repeat examination of papers in which he/she has failed or not appeared for reasons mentioned in 2.5.

The Master Degree student seeking to appear/improvement examination in any course(s) shall get 3 chances for 1^{st} and 2^{nd} semester within 8 semesters.

Candidates appearing in repeat/improvement examination shall not be considered in the merit list and it shall be reflected in the Provisional Certificate cum Mark sheet (PCM) but not in the final degree certificate.

2.7 Award of Degree Certificate, Grade/Mark sheet

A Degree certificate under the official seal of the university and signed by the Vice-Chancellor shall be presented at the Convocation or in absentia to each of the successful students of particular degree. The Controller of Examinations shall issue the mark/grade sheet of each semester to the candidates in the sheet of each semester to the candidates in the prescribed format by depositing the required fees for marks/Grade Sheet to be deposited in the University counter.

2.8 **Guideline for filling up of Forms for PG Classes (IMP/ Repeat)**

A student shall repeat all the theory and practical papers in which he/she failed in the semester examination within a period of eight semesters from the date of first registration. Such students shall have to apply to the Head of the Department/Registrar in plain paper during the filling up of form for the ensuing semester examination. If allowed, he/she shall deposit the fees as prescribed by the University

If a candidate secures less than 3.0 Grade point in a paper(s) and less than 4.0 Grade point average in a Semester examination he/she has to appear all the papers in that Semester.

If a candidate secures less than 3.0 Grade Point in a paper(s) and a minimum 4.0 Grade point average in a semester examination, he/she has to appear only the paper(s) in which he/she secured less than 3.0 Grade point.

A candidate is eligible to sit for improvement in a paper(s) only when he/she has passed the semester examination concerned. Further, he/she can improve in a maximum of EIGHT paper(s) in the entire course. The Master Degree students seeking to take improvement examination in any course(s) shall get chances within 8 semesters from the year of admission to the course. The candidates taking this advantage (improvement) will be examined on the basis of current syllabus and the higher marks shall be retained during computation of result.

2.9 If a candidate fails to appear in any paper of the said examination and marked ABSENT his/her results will be declared only when he/she clears that paper/those papers.

2.10 ***Disciplines in the Examination***

(A) Late Comers: A student arriving in the examination hall/room fifteen minutes after the commencement of the examination shall not be ordinarily allowed to sit for the examination. No examinee shall be allowed to go out of the examination hall within one hour of commencement of examination. The invigilators shall keep a record of temporary absence of students from the examination hall/room during the examination.

(B) Adoption of unfair means in the Examination:

Possession of unauthorized materials and using it, copying from scripts of other students or from any other source, showing his/her answer script to others during the examination, creating disturbance or acting in a manner so as to cause inconvenience to other students in the examination hall or near about shall be treated as adoption of unfair means or malpractice.

Sd/-
REGISTRAR

SEMESTER SYSTEM OF P. G. MATHEMATICS

P. G. Mathematics Science/ Arts

Paper	Subject	Mark	Credit
SEMESTER - I			
Paper – 101	Algebra	20+80	4
Paper - 102	Ordinary Differential Equation	20+80	4
Paper - 103	Real Analysis	20+80	4
Paper - 104	Programming in C	20+80	4
Paper - 105	Practical	100	4
	Total	**500**	**20**
SEMESTER - II			
Paper - 201	Graph Theory	20+80	4
Paper – 202	Topology	20+80	4
Paper – 203	Numerical Analysis	20+80	4
Paper - 204	Programming with C++ - I	20+80	4
Paper - 205	Practical	100	4
DSE PAPER (any one)			
Paper - 206 A	Mathematical Method	20+80	4
Paper - 206 B	Differential Geometry	20+80	4
Paper - 206 C	Advance Calculus	20+80	4
		600	**24**
SEMESTER - III			
Paper - 301	Operation Research - I	20+80	4
Paper- 302	Functional Analysis	20+80	4
Paper - 303	Complex Analysis	20+80	4
Paper - 304	Programming with C++ - II	20+80	4
Paper - 305	Practical	100	4
IDSE Papers**			
Paper - 306 A	Operation Research	20+80	4
Paper - 306 B	Elements of Number Theory	20+80	4
Paper - 306 C	Elements of Computer Programming	20+80	4
		600	**24**
SEMESTER - IV			
Paper - 401	Operation Research - II	20+80	4
Paper - 402	Partial Differential Equations	20+80	4
Paper - 403	Operation Theory	20+80	4
Paper - 404	Number Theory	20+80	4
Paper - 405	Practical/Project	100	4
		500	**20**
	Grand Total	**2200**	**88**

SEMESTER SYSTEM OF P. G. MATHEMATICS

SEMESTER – I

Paper - 101: ALGEBRA

Full Marks : 100 (20 Mid Term + 80 End Term)

Unit - I

Ideals and Quotient rings, The Field of Quotients of an Integral Domain, Euclidean rings.

Unit - II

Polynomial Rings, Roots of Polynomials over the Rational Field, Polynomial Rings, Over Commutative Rings.

Unit - III

Fields, Extension Fields. Roots of Polynomials, More about Roots.

Unit- IV

The Elements of Galois Theory. Solvability by Radicals.

Book Prescribed:

Topics in Algebra: I. N. Herstein, Chapter- 3 (Sec. 4 to 11), 5 (5.1, 5.3, 5.5, 5.6 and 5.7 only).

Paper - 102: ORDINARY DIFFERENTIAL EQUATION

Full Marks : 100 (20 Mid Term + 80 End Term)

Unit- I

System of Linear Differential Equations: - System of first order equations, Existence and Uniqueness theorems, Fundamental Matrix, Homogeneous and Non Homogeneous linear sys- tems with constant Co-efficient, Linear system with periodic Co-efficient.

Unit- II

Existence and Uniqueness of Solutions: - Successive approximation Picard's Theorem, Non Uniqueness of solutions, Continuation and dependence on Initial conditions, Existence of so- lutions in the large, Existence and uniqueness of solution of systems.

Unit- III

Oscillations of second Order Equations :- Fundamental Results, Sturm's Comparison theorem of Hille wiener Oscillations of $x'' + a(t)x = 0$.

Unit- IV

Boundary Value Problems :- Introduction ; Strum Liouville's Problem Green's func- tions, Picard's throrem.

The course is covered by Chapter 2 (Quick Review) 4,5,6,7 of "Ordinary Differential Equa- tions and stability theory" by S. G. Deo and V. Raghavendra TATA Mc Graw Hill Ltd.

Books for Reference: - 1. G. Birkhoff and G. C. Rota-Ordinary Differential Equations-John Wiley and Sons, N.Y., 1989.

2. Coddington and Levinson, Theory of Ordinary Differential Equations, Krieger Pub Co (June 1984)

3. Tyn-Myint-U Ordinary Differential Equations, Elsevier North-Holland, 1987.

4. L. Elsgolts -Differential Equations and calculus of Variation, Mir Publication, 1980

Paper - 103: REAL ANALYSIS

Full Marks : 100 (20 Mid Term + 80 End Term)

Unit - I

Measure on the real line.

Unit - II

Integration of functions of a real variable

Unit - III

Differentiation.

Unit - IV

Abstract measure space.

Book Prescribed:

Measure theory and Integration: G. De. Barra. Wiley Eastern Ltd.,
Chapter – 1 (1.5 - 1.7), II, III, IV, V.

Reference Books:

1. Real and Abstract Analysis: E. Hewitt and K. Stromberg. Springer International Student Edition, Narosa Publishing House.
2. Real and Complex Analysis: W. Rudin, Tata Mc Graw Hill.

Paper - 104: PROGRAMMING IN C

Full Marks : 100 (20 Mid Term + 80 End Term)

Unit - I

Overview of C, Constants, Variables, Data types, Operators and Expressions, Managing I/O operators.

Unit - II: Decision making and Branching, Looping, Arrays, Character, Strings.

Unit - III: User defined Functions,

Unit- IV: Structure and Union, Pointers.

Book Prescribed:

Programming in ANSI C: E. Balagurusamy.

Reference Books:

1. Let us C: Y. Kanetkar.
2. Mastering in C: Venugopal.
3. Computer Programming in C: V. Rajaraman.

Paper - 105: PRACTICAL - PROGRAMMING IN C

Full Marks 100

SEMESTER- II

Paper - 201: GRAPH THEORY

Full Marks : 100 (20 Mid Term + 80 End Term)

Unit - I: Introduction, Paths and Circuits,

Unit -II: Trees

Unit - III: Fundamental circuits, Cut sets and Cut Vertices.

Unit - IV: Planar and Dual graphs.

Book Prescribed:

Graph Theory with applications to Engg. and Computer Science: N. Deo (Prentice Hall of India Ltd.), Chapter - I, II, III, IV, V.

Reference Books:

1. Graph Theory: F. Harary.
2. Graph Theory and Application: Bondy and Murty (Mac Millan).

Paper - 202: TOPOLOGY

Full Marks : 100 (20 Mid Term + 80 End Term)

Unit - I

Topological Spaces and Continuous Functions.

Unit - II

Connectedness and Compactness.

Unit - III

Countability and Separation Axioms,

Unit - IV

The Tychonoff Theorem, Complete Metric Space, Compactness on Metric Spaces.

Book Prescribed:

Topology A first Course: J. R. Munkers (Prentice Hall of India Ltd.), Chapter - II (excluding 2.11), III (excluding 3.8), IV (excluding 4.5), V (5.1 only), VII (7.1 and 7.3 only).

Paper - 203: NUMERICAL ANALYSIS

Full Marks : 100 (20 Mid Term + 80 End Term)

Unit-I

Errors: Root finding for non-linear equations: Bisection method, Iteration methods based on first degree equations(Secant method, Regula-Falsi method, Newton Raphson method), Iteration methods based on second degree equation(Muller method, Chebysev method), Rate of convergence , Iteration methods.

Unit-II

Interpolations: Lagrange and Newton interpolations, Finite differences, Interpolating polynomials using finite differences, Hermite interpolation, Piecewise and Spline interpolation.

Unit-III

Differentiation: Methods based on Interpolation, Methods based on Finite Differentials, Methods based on undetermined coefficients, optimum choice of step length, Interpolation method. Integration: Methods based on Interpolation(Trapezoidal rule , Simpson' s rule), Method based on undetermined coefficiencts(Gausses Legendre Integration method, Lobatto integration method , Radon integration method, Gauss-chebysev Integration method(without derivation), Gauss-Laguerre Integration method (without derivation) , Gauss-Hermite Integration methods(without derivation), Composite integration methods.

Unit-IV

Numerical Solution of system of linear equations: Direct methods, Gauss Elimination methods, Gauss-Jordan Elimination method, Triangularization method, Cholesky method, Iteration methods(Jacobi iteration method, Gauss-siedel iteration method, Iterative method for A^{-1}) Eigen value problems(Jacobi method for symmetric matrices) Givers Method for symmetric matrices, Rutishauser method for arbitrary matrices). Numerical solution of ordinary differential equation: Euler Method, Backward Euler method, Mid-point method, Single Step methods(Tayler series method, Range-kutta method(Second order, Fourth order method)

Books for Reference:- 1 M.K. Jain , S.R.K Iyengar, R.K. Jain: Numerical Methods for Scientific and Engineering Computation , Willey Eastern Ltd. New Delhi (1995)
Unit-I : Chapt-I 1.3 ; Chapt-II 2.1,2.2,2.3,2.4,2.5,2.6.;
Unit-II: Chapt-IV 4.1,4.2,4.3,4.4,4.5,4.6,4.8,4.9,4.10;
Unit-III: Chapt-V 5.1,5.2,5.3,5.4,5.6,5.7,5.8,5.9;
Unit-IV: Chapt-III- 3.1,3.2,3.4,3.5;Chapt-VI 6.1,6.2,6.3;

Paper - 204: PROGRAMMING WITH C++ - I

Full Marks : 100 (20 Mid Term + 80 End Term)

Unit - I: Principles of object oriented programming - Object oriented programming paradigm, Basic concept of OOP, benefits of OOP, applications of OOP.
Structure of a C++ program - creating a source file, compiling and linking a C++ program.

Unit - II: Tokens, Expression and Control structures - Key words, Identifiers, Data types. User defined data types, Derived data types, Symbolic constant, Variables, Operators in C++.

Unit - III : Function in C++, Function prototyping, Call by reference, Inline function, Default argument, Function overloading. Classes and Objects Defining class and member function.

Unit - IV: Structures of a C++ program with class, nesting of member, memory allocation for objects, static data member, static member function, Friend function, pointers to data member.

Book Prescribed:

Object Oriented Programming with C++: E. Balagurusamy, (Chapter 1 to 5).

Reference Books:

1. Object Oriented Programming Turbo C++: Robert Lafore.
2. Mastering in C++: Venugopal.

Paper - 205: PRACTICAL PROGRAMMING WITH C++ - I

Full Mark - 100

Paper - 206 A: MATHEMATICAL METHOD

Full Marks : 100 (20 Mid Term + 80 End Term)

Unit - I : Laplace Transforms.

Unit - II : Fourier Series

Unit III: Fourier Integrals.

Unit -IV: Calculus of Variation: Variation & its Properties, Euler equation.

Books Prescribed:

1. Advanced Engineering Mathematics: Erwin Kreyszig Wiley, Eastern Ltd., 5th edition, Chapters - 5 and 10.

2. Calculus of Variations with Application: A. S. Gupta, PHI, Chapter – (Art 1, 2 only).

Paper - 206 B: DIFFERENTIAL GEOMETRY

Full Marks : 100 (20 Mid Term + 80 End Term)

Unit - I: The Theory of Space Curve

Unit - II: The Metric: Local Intrinsic Properties of a Surface

Unit III: The Second Fundamental Form: Local Intrinsic Properties of a Surface

Unit -IV: Differential Geometry of Surfaces in the Large.

Books Prescribed:

1. An Introduction to Differential Geometry by T. J. Willmore, Oxford University Press
   Ch: 1 (1.1 to 1.9), 2(2.1 to 2.12), 3(3.1 to 3.10), 4(4.1 to 4.9)

Paper - 206 C: ADVANCED CALCULUS

Full Marks : 100 (20 Mid Term + 80 End Term)

Unit - I: Derivatives for Function on R^n - Differentiation of Composite functions and Taylor's Theorem

Unit-II: Transformation, Linear function and Transformations, Differentials of Transformation, Inverse Transformations.

Unit-III: Implicit Function Theorems, Functional dependence, set Functions and Transformation of Multiple Integrals.

Unit -IV: Curve and Arc-Length, Surfaces and surface Area, Integrals over Curves and Surfaces, Differential Forms, Theorem of Green, Gauss and Stokes, Exact forms and Closed forms

Books Prescribed:

Advance calculus by R.C Beck, 3rd edition, Mc Graw Hill Publication Chapter-3 (3.3 to 3.8), 7 (7.2 to 7.7), 8 (8.2 to 8.6), 9 (9.2, 9.4, 9.5)

SEMESTER – III

Paper 301: OPERATION RESEARCH - I

Full Marks : 100 (20 Mid Term + 80 End Term)

Unit - I: Convex sets and function, Linear Programming.

Unit - II: Duality in Linear Programming,

Unit- III: Transportation Problem.

Unit - IV: Assignment Problems, Revised Simplex Method.

Book Prescribed:

Operations Research: S. D. Sharma.

Reference Books:

1. Linear Programming and Application: S. I. Gass.
2. Non-Linear Programming: C. Hadley.
3. Operation Research: Kanti Swarup

Paper - 302: FUNCTIONAL ANALYSIS

Full Marks : 100 (20 Mid Term + 80 End Term)

Unit - I

Review of Metric spaces, Lp - spaces, Inequalities in Lp - spaces, Completeness of Lp, Normed linear spaces, Inner product spaces, examples, properties of Normed linear spaces and inner product spaces, Continuity of linear maps.

Unit -II

Hilbert spaces, Examples, orthonormal sets, Gram-Schist orthonormalizations, orthonormal polynomials, bessel's inequality, Riesz-Fisher Theorem, Orthonormal basis, Fourier Expansion, Parseval's formula, Projection theorem, Riesz Representation Theorem.

Unit - III

Banach Spaces, Hahn Banach Theorem, Baire's category theorem, Open mapping Theorem,

Closed graph theorem, Uniform boundedness Principle, duals and transpose dual of $Lp[a, b]$ and C [a,b], Reflexivity.

Unit - IV

Bounded Linear Operators on Banach Spaces, Banach algegra, defination, Examples, Spectrum of a bounded operator, Resolvent Set, Compact operators on Banach spaces, spectrum of a Compact operator, Elementary ideas on integral equations, Unbounded Operators and fixed point theorems.

Books Prescribed:-

1. Kreyszig-Functional Analysis -John Wiley, 1978.
2. Limaye -Functional Analysis, 3rd Ed, 2014.
3. Goffman and Pedrick A first Course in Functional Analysis- Prentice Hall (1 June 1965)
4. Bachmen and Narici, Functional Analysis, Dover Publications Inc.; 2nd edition edition (28 March 2003).

Paper - 303: COMPLEX ANALYSIS

Full Marks : 100 (20 Mid Term + 80 End Term)

Unit-I: Complex numbers: The algebra of complex numbers, the geometric representation of complex numbers.
Complex Functions: Introduction to the concept of analytic functions, elementary theory of power series, exponential and trigonometric function.

Unit-II : Analytical functions a mapping: Conformality, linear transformation, elementary conformal mapping. Complex Integration,

Unit -III: Fundamental theorems, Cauchy integral formula. Local properties of analytic functions,

Unit - IV: the integral forms of Cauchys' Theorem. Cauchy's Residue Theorem, Contour Integration

Books Prescribed:

1. Complex Analysis: L. V. Ahlfros, Mc Graw Hill, Kogakusha Ltd., Chapter - I, II, III (excluding 3.1), IV.
2. Function of one Complex Variable: J. B. Conway Narosa Publisher House, Chapter - 4.

Paper - 304: PROGRAMMING IN C++ - II

Full Marks : 100 (20 Mid Term + 80 End Term)

Unit - I

Constructors and destructors – Default constructors and parameterized constructor, copy constructor, dynamic constructor, constructor with default arguments, dynamic initialization of objects, constructors overloading, destructors and its function.

Unit - II

Operator overloading and type conversation - Defining operators overloading, overloading unary and binary operators, overloading binary operators using friend function, manipulation of strings using operators, rule for overloading operators, type conversions.

Unit - III

Inheritance: Extending classes - Defining derived classes, single inheritance, making a private member inheritable, multiple inheritance, Hierarchical inheritance, Hybrid inheritance,

Unit - IV

Virtual base class, Abstract classes, constructors in derived classes, Nesting of classes. Pointers, Virtual functions and polymorphisms - pointers to objects, this pointer, pointers to derive data classes, virtual functions, pure virtual function.

Book Prescribed:

Object Oriented Programming with C++: E. Balagurusamy, (Chapter 6 to 9).

Reference Books:

1. Object Oriented Programming in Turbo C++: Robert Lafore.
2. Mastering in C++: Venugopal.

Paper - 305: PRACTICAL
PROGRAMMING WITH C++ - II
Full Mark - 100

Paper - 306 A: OPERATION RESEARCH

Full Marks : 100 (20 Mid Term + 80 End Term)

Unit - I: Convex sets and function, Linear Programming.

Unit - II: Duality in Linear Programming,

Unit - III: Transportation Problem.

Unit - IV : Assignment Problems.

Book Prescribed:

1. Operations Research: Kanti Swarup.

Reference Books:

2. Linear Programming and Application: S. I. Gass.
3. Non-Linear Programming: C. Hadley.
4. Operation Research: S.D Sharma

Paper - 306 B: ELEMENTS OF NUMBER THEORY

Full Marks : 100 (20 Mid Term + 80 End Term)

Unit - I: Divisibility and Distribution of Primes

Unit - II: The Theory of Congruences and Fermat's Theorem

Unit - III: Number- Theoretic Functions and Euler's Generalization of Fermat's Theoram

Unit - IV : The Quadratic Reciprocity Law.

Book Prescribed:

Elementary number theory by David M. Burton, Tata Mc.HGraw Hill Edn. Pvt.Ltd.
Chapter-2 (2.2 to 2.4), 3(3.1, 3.2), 4(4.2, 4.4), 5(5.2, 5.3), 6(6.1 to 6.3), 7(7.2, 7.3), 9(9.1 to 9.4)

Reference Books:

1. Linear Programming and Application: S. I. Gass.
2. Non-Linear Programming: C. Hadley.
3. Operation Research: Kanti Swarup.

Paper 306 C: ELEMENTS OF COMPUTER PROGRAMMING

Full Marks : 100 (20 Mid Term + 80 End Term)

Unit - I

Binary system, Octal and Hexadecimal systems. Conversion to and from Decimal systems. Codes, Bits, Bytes and Words. Memory of a computer, Arithmetic and Logical operations on numbers. Precisions, AND, OR, XOR, NOT and Shift operators, Basic logic gates and Truth Tables.

Unit - II

Boolean Algebra, Normal Forms, Representation of unsigned integers, Signed integer, Real, Double precisions numbers, Long integers.

Unit - III

1. Algorithm and Flow chart for solving the following Numerical Analysis problems.
2. Solution of algebraic an transcendental equation of one variable by Bisection, Regula-Falsi and Newton-Raphson methods.
3. Solution of system of linear equations by Gaussian elimination and Gauss-Jordan (direct), Gauss Seidel (iterative) methods.
4. Newton's (forward and backward), Lagrange's interpolation methods.

Unit IV:

1. Numerical integration by Trapezoidal rule, Simpson's rules, Gaussian quadrature formula.
2. Numerical solution of ordinary differential equations by Euler and Runga-Kutta methods.

Reference Books:

1. Structured Computer Organization: Andrew S. Tanenbaum (PHI).
2. Computer Oriented Statistical & Numerical Methods: E. Balagurusamy (MacMillan India Limited).
3. Discrete Mathematics: M. K. Gupta (Krishna's).
4. C Language and Numerical Methods: C. Xavier (New Age).
5. Discrete Mathematics – K. Rosen

SEMESTER – IV

Paper - 401: OPERATION RESEARCH - II

Full Marks : 100 (20 Mid Term + 80 End Term)

Unit - I: Upper Bounding Technique, Integer Programming Problems, Branch & Bounds. Gomary Method.

Unit - II: Dynamic Programming,

Unit- III: Game Theory

Unit - IV: K. T. Conditions, Quadratic Programming.

Book Prescribed:

Operations Research: S.D. Sharma.

Reference Books:

1. Linear Programming: S. I. Gass.
2. Non-Linear and Dynamic Programming: G. Hadley.
3. Operation Research: Kanti Swarup

Paper - 402: PARTIAL DIFFERENTIAL EQUATIONS

Full Marks : 100 (20 Mid Term + 80 End Term)

Unit-I

Meaning of Partial differential equation, Classification of first order Partial differential equa- tions, Semi-linear and quasi-linear equations, Pfaffian differential equations, Lagrange's method, Compatible systems, Charpit's method, Jacobi's method,

Unit-II

Integral surfaces passing through a given curve, Cauchy problem, method of characteristics for quasi-linear and non linear partial differential equation, Monge cone, characteristic strip. First order non-liner equations in two independent variables ,Complete integral.

Unit-III

Linear Second order partial Differential Equations : Origin of second order p.d.e's, Classifica- tion of Second order Partial Differential Equations., One dimensional Wave equation, Vibration of an infinite string, origin of the equation, D'Alembert's solution, Vibrations of a semi finite string, Vibrations of a string of finite length, existence and uniqueness of solution, Riemann method,

Unit-IV

Laplace equation , Boundary value problems, Maximum and minimum principles, Uniqueness and continuity theorems, Dirichilet problem for a circle, Dirichlet problem for a circular an- nulus, Neumann problem for a circle, Theory of Green's function for Laplace equation, Heat equation, Heat conduction problem for an infinite rod, Heat conduction in a finite rod, existence and uniqueness of the solution, Classification in higher dimension, Kelvin's inversion theorem , Equipotential surfaces.

Books for Reference:-

1. Phoolan Prasad and Renuka Ravindran Partial Differential Equations, New Age Interna- tional, 1985.
2. F. John - Partial Differential Equations, Springer-Verlag, New York, 1978.
3. Tyn-Myint-U - Partial Differential Equations North Holland Publication, New York, 1987. 4 Amarnath- An elementary course in partial differential equation, Alpha Science International, 2003.

Paper - 403: OPERATOR THEORY

Full Marks : 100 (20 Mid Term + 80 End Term)

Unit - I: Banach Algebra: Introduction, Complex homomorphism, Basic properties of spectra.

Unit - II: Commutative Banach Algebra: Ideals, and homomorphism, Geifand transform, Involution

Unit-III: Bounded operators in a Hillbert Space: Basic facts, Bounded operators, Fuglede-Putnam – Rosenblum Theorem, Resolution of the identity.

Unit - IV: The Spectral Theorem, Eigen – values of normal operators, Positive operators and square roots

Books Recommended:

1. Functional Analysis – Walter Rudin- Tata Mcgraw Hill {Ch – 10 (10.1 – 10.20), Ch-11 (11.1 – 11.20), Ch-12 (12.1 – 12.36)}

Reference Books:

1. Basic Operator Theory: Gohberg and Goldberg.
2. Principle of Functional Analysis: M. Schecter.
3. Theory of Linear Operator, Vol. I, II, Pitman Publishing House: Akhietzer and Glazeman.
4. Linear Operator, Vol. I, II, III: Donford and Schwarz.
5. Linear Operator on Hilbort Speces, Speringer: Weildman.

Paper - 404: NUMBER THEORY

Full Marks : 100 (20 Mid Term + 80 End Term)

Unit - I: Arithmetical function and Dirichlet multiplication.

Unit - II: Congruences & Dirichlet theorem on primes in arithmetic progression,

Unit - III: Periodic arithmetical functions & Gauss sums.

Unit - IV :Quadratic residues and Quadratic reciprocity law.

Book Prescribed:

Introduction to Analytic Number Theory: T. M. Apostol (Springer, International students End) Narosa Publ. House. Chapter – 2(2.1 to 2.14, 2.16, 2.17), 5 (5.1 - 5.8), 7(7.2 to 7.9), 8(8.1 to 8.12), 9 (9.1-9.10)

Reference Books:

1. An Introduction to the Theory of Numbers: Hardy and Wright.
2. Introduction to Analytic Number Theory: K. Chandrashekaram.
3. Arithmetical Functions: K. Chandrashekaram.

Paper - 405 (PROJECT + VIVA-VOCE)
MARKS - (50 +50)