NILAMBAR-PITAMBER UNIVERSITY
MEDININAGAR

SYLLABUS FOR M.A./M.Sc. W.E.F. 2017-18

(UNDER CHOICE BASED CREDIT SYSTEM)

UNIVERSITY DEPARTMENT OF MATHEMATICS

NILAMBER-PITAMBER UNIVERSITY

MEDININAGAR, PALAMU

JHARKHAND

UNIVERSITY DEPARTMENT OF MATHETMATICS, N.P. UNIVERSITY
CBCS PATTER SYLLABUS W.E.F. 2016-17

Semester wise distribution of Curses, Credits, Lectures and Marks :

Semester I						
Course Code	**Title**	**Credits**	**Lectures/week Lecutres Tutorial**		**Max. Marks**	
					UNIV. EXAM	**Sessional**
FCMATH 101	Foundation Course	5	5 (L)	1 (T)	70	30
CCMATH 102	Real Analysis (Core Course 1)	5	5 (L)	1 (T)	70	30
CCMATH 103	Topology (Core Course 2)	5	5 (L)	1 (T)	70	30
CCMATH 104	Complex Analysis (Core Course 3)	5	5 (L)	1 (T)	70	30
Total		20	20	4		
Semester II						
ECMATH 201	Programming in C & MATLAB (Skill Enhancement Course I)	5	5 (L)	1 (T)	70	30
CCMATH 202	Ordinary Differential Equations (Core Course 4)	5	5 (L)	1 (T)	70	30
CCMATH 203	Differential Geometry and Tensor Analysis (Core Course 5)	5	5 (L)	1 (T)	70	30
CCMATH 204 (P)	Programming in C & MATLAB (Practical) (Core Course (P) 6)	5	10		70	30
Total		20				

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Semester III						
Course Code	**Title**	**Credits**	**Lectures/week Lecutres Tutorial**		**Max. Marks**	
					UNIV. EXAM	**Sessional**
CCMATH 301	Functional Analysis (Core Course 7)	5	5 (L)	1 (T)	70	30
CCMATH 302	PDE (Core Course 8)	5	5 (L)	1 (T)	70	30
ECMATH 303(A) 303 (B) 303 (C)	Any one of the following : A. Optimization Techniques B. Advance Discrete Mathematics C. Integral Transforms (Elective Course 2)	5	5 (L)	1 (T)	70	30
ECMATH 304(A) 304 (B) 304 (C)	Any one of the following : A. Fluid Dynamics B. Analytical Dynamics and Calculus of Variations C. Probability and Statistics (Elective Course 3)	5	5 (L)	1 (T)	70	30
Total		20				

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Semester III						
CCMATH 401	**Numerical Solution of ODE/PDE** **(Core Course 9)**	**5**	**5 (L)**	**1 (T)**	**70**	**30**
ECMATH 402(A) 402 (B) 402 (C)	Any one of the following : A. Mathematical Modeling B. Fourier and Wavelet Analysis C. Operations Research (Elective Course 4)	5	5 (L)	1 (T)	70	30
ECMATH 403(A) 403 (B) 403 (C)	Any one of the following : A. Mathematics of Finance and Insurance B. Hadamard Matrices and Combinatorial Designs C. Integral Equations (Elective Course 5)	5	5 (L)	1 (T)	70	30
MATH 404	Project	5	10		80 (Written)	20 (Viva)
Total		20				

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M.Sc./M.A. MATHEMATICS
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SEMESTER I

UNIVERSITY DEPARTMENT OF MATHETMATICS, N.P. UNIVERSITY
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Paper Code: FCMATH101
Foundation Course
Credits: 5, Full Marks: 70, Pass Marks: 28
Time: 3 hours

Nine questions will be set, out of which candidates are required to answer 5 questions. Q. No. 1 is compulsory, consisting of ten shorts answer type questions, each of 3 marks, covering entire syllabus of the paper uniformly. Rest four questions, each of 10 marks will be required to be answered, selecting one from each unit.

Unit I GROUP THEORY
Groups : Finite permutation groups S_n and A_n Normal and Subnormal series, Jordan-Holder theorem, Solvable groups, Nilpotent groups. Group action, orbit –stabilizer theorem, Sylow's theorems (proofs using group actions).

Unit IILINEAR ALGEBRA
Matrix of a linear transformation, Canonical Forms – Similarity of linear transformations, Invariant subspaces, Eigen values and Eigen vectors, Reduction to diagonal, triangular and Jordan forms, The primary decomposition theorem.

Unit III Number Theory
Fundamental Theorem of Arithmetic, Properties of prime numbers, Euclid's algorithm, HCF, LCM. Congruence, Linear Congruence, Chinese remainder theorem and applications, Euler's function, Fermat's little theorem, Wilson's theorem.

Unit IV Real Analysis
Sequence of real numbers, monotonic, bounded sequence, limit of the sequence, Cauchy's general principle of convergence for sequence. Infinite series of real numbers, Cauchy's general principal of convergence of series. Auxiliary series, Tests of convergence. Alternating Series, Leibnitz test, absolutely convergence series, Conditionally convergent series.

Text/ Reference Books:

1. D.S. Dummit, R.M. Foote, Abstract Algebra –John Wiley&Sons (2013)
2. J.N. Herstein. Topics in Algebra, Wiley Eastern Ltd. , New Delhi, 1975
3. K. Hoffman and R. Kunze (2nd edition), Linear Algebra, Prentice Hall of India, New Delhi (1997)
4. W Rudin, Principles of Mathematics Analsis, Mc-Graw Hill.
5. Hardy and Wright, An Introduction to Theory of Numbers, Oxford Univ. Press.

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CBCS PATTER SYLLABUS W.E.F. 2016-17

Paper Code: CCMATH102
Real Analysis Credits: 5, Full Marks: 70, Pass Marks: 28
Time: 3 hours

Nine questions will be set, out of which candidates are required to answer 5 questions. Q. No. 1 is compulsory, consisting of ten shorts answer type questions, each of 3 marks, covering entire syllabus of the paper uniformly. Rest four questions, each of 10 marks will be required to be answered, selecting one from each unit.

Unit I – UNIFORM CONVERGENCE
Sequences and series of functions, pointwise and uniform convergence. Cauchy criterion for uniform convergence, weierstrass M-test, Abel's and Dirichlet's test for uniform convergence, uniform convergence and continuity, preservation of differentiability and integrability theorems.

[2 QUESTIONS]

Unit II – FUNCTINS OF SEVERAL VARIABLES
Derivative of functions in an open subset of R^n into R^m as a linear transformation. Chain rule. Partial derivatives. Taylor's theorem. Inverse function theorem. Implicit function theorem, Jacobians.

[2 QUESTIONS]

Unit III - MEASURE
Motivation and Concept of Measure of a set, Outer measure, measurable sets, Lebesgue measures, A non-measureable set, measurable functions, Littlewood's three principles.

[2 QUESTIONS]

Unit IV – The Lebesgue integral
Lebesgue integral o a bounded function over a finite measure, The integral of a non-negative function, The general Lebesgue integral, Convergence theorems, Convergence in measure.

[2 QUESTIONS]

Text/ Reference Books:

1. Walter Rudin, Principles of Mathematical Analysis, 3rd ed. McGraw-Hill
2. T.M. Apostal, Mathematical Analysis, Narosa Publ., New Delhi, 1985.
3. R. G. Bartle and Donaid R Sherbert, Real Analysis, John Wiley & Sons.
4. H. L. Royden, Real Analysis, McMillan.

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Paper Code: CCMATH103
Topology
Credits: 5, Full Marks: 70, Pass Marks: 28
Time: 3 hours

Nine questions will be set, out of which candidates are required to answer 5 questions. Q. No. 1 is compulsory, consisting of ten shorts answer type questions, each of 3 marks, covering entire syllabus of the paper uniformly. Rest four questions, each of 10 marks will be required to be answered, selecting one from each unit.

UNIT I – Fundamentals of a topological space
Definition and examples of topological spaces. Closed sets, closure. Dense subsets. Neighborhoods, Interior, exterior and boundary. Accumulation points and derived sets. Bases and sub-bases. Subspaces and relative topologies. Quotient topology.

[2 QUESTIONS]

UNIT II – Continuity and connectedness
Continuity and homeomorphism, Product of topological spaces, connected space and its properties.

[2 QUESTIONS]

UNIT III – Countability and separation axiom
First and second countable spaces. Lindelof's theorem, separable spaces, second countability and seperability. Separation axioms T_0, T_1, T_2, T_3, T_4 : their characterizations and basic properties. Urysohn's Lemma. Tietze extension theorem.

[2 QUESTIONS]

UNIT IV – Compactness
Compactness, continuous image of compact sets. Basic property of compactness. Compactness and finite intersection property Tychonoff's theorem, one point compactification of a topological space.

[2 QUESTIONS]

Text/ Reference Books:

1. K.D. Joshi. Introduction to General Toplogy, Wiley Eastern Ltd. 1983.
2. W.J. Pervin. Foundations of General Topology Academic Press Inc. New York 1964.
3. G.F. Simmons, Introduction to Topology and Modern Analysis, Mc Graw Hill Int. book company.
4. J.R. Munkres, Topology A first course, Prentice hall India Pvt. Ltd.
5. S. Lipschutz, General Topology, Schaum's out line series.

UNIVERSITY DEPARTMENT OF MATHETMATICS, N.P. UNIVERSITY
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Paper Code: CCMATH104
Complex Analysis
Credits: 5, Full Marks: 70, Pass Marks: 28
Time: 3 hours

Nine questions will be set, out of which candidates are required to answer 5 questions. Q. No. 1 is compulsory, consisting of ten shorts answer type questions, each of 3 marks, covering entire syllabus of the paper uniformly. Rest four questions, each of 10 marks will be required to be answered, selecting one from each unit.

UNIT I – Complex Integration
Cauchy-Goursat Theorem, Cauchy's Integral formula, Higher order derivatives, Morera's Theorem, Cauchy's inequality, Liouville's theorem and Fundamental theorem of Algebl\ra.
[2 QUESTIONS]

UNIT II – Power Series
Circle of convergence. Absolute and uniform convergence. Taylor's theorem, Laurent's theorem. Maximum modulus principle.
[2 QUESTIONS]

UNIT III – Singularities and Cauchy Residue Theorem
Isolated singularities. Meromorphic functions. The argument principle, Rouche's theorem poles and Zeros. Residues, Cauchy's residue theorem. Contour Integration. Evaluation of integrals.
[2 QUESTIONS]

UNIT IV – Analytic Continuation and its application
Definition of Analytic continuations and related problems, Uniqueness theorem of Analytic continuation, Standard method/Power series method of Analytic continuation along a curve, Singularity of the circle of convergence of power series.
[2 QUESTIONS]

Text/ Reference Books:

1. Churchill and Brown, Complex variables and applications, McGraw-Hill Pub. Company.
2. Walter Rudin. Real and Complex Analysis. Mc Graw Hill Book Co. 1966
3. E.C. Titchmarsh. The theory of Functions. Oxford University Press. London.

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SEMESTER II

UNIVERSITY DEPARTMENT OF MATHETMATICS, N.P. UNIVERSITY
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Paper Code: ECMATH201
Programming in C and MATLAB
Credits: 5, Full Marks: 70, Pass Marks: 28
Time: 3 hours

Nine questions will be set, out of which candidates are required to answer 5 questions. Q. No. 1 is compulsory, consisting of ten shorts answer type questions, each of 3 marks, covering entire syllabus of the paper uniformly. Rest four questions, each of 10 marks will be required to be answered, selecting one from each unit.

UNIT -I
Planning the Computer Program : Concept of problem solving, Problem definition, Program design, Debugging, Types of errors in programming, Documentation. Techniques of Problem Solving : Flowcharting, algorithms, pseudo code, decision table, Structured programming concepts, Programming methodologies viz. top-down and bottom-up programming.
Overview of C : History of C, Importance of C, Structure of a C Program.
Elements of C : C Character set, identifiers and keywords, Date types, Constants and Varieables, Assignment statement, Symbolic constant.
Input/output : Unformatted & formatted I/O function, Input functions viz. scanf ( ), getch ( ), getche ( ), getchar ( ), gets ( ), output functions viz. printf ( ), putch ( ), Putchar ( ), puts( ).
Operators & Expression : Arithmetic, relational, logical, bitwise, unary, assignment, conditional operators and special operators. Arithmetic expressions, evaluation of arithmetic expression, type casting and conversion, operator hierarchy & associativity.
Decisioin making & branching : Decision making with IF statement, IF-ELSE statement, Nested IF statement, ELSE-IF ladder, switch statement, go to statement.
Decision making & looping : For, while, and do-while loop, jumps in loops, break, continue statement. Understanding header files : stdio.h, math.h, ctype.h and its function prototypes.
[2 QUESTIONS]

UNIT II –
Functions : Definition, prototype, passing parameters, recursion.
Storage classes in C : auto, extern, register and static storage class, their scope, storage & lifetime.
Structure, Union, enum
Arrays : Definition, types, initialization, processing an array, Strings & arrays.
Pointer and its implemention using Function, Structure, baion, Array
File Handling : Needs of File Handling, File Modes, Type of Files, Open/Create, Read, Write, Delete, Copy, Rename, searching etc.
[2 QUESTIONS]

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UNIT III –
Introduction to MATLAB, Elementary MATH Built-in-Functions, Creating Arrays, one dimensional, two dimensional arrays, variable, strings. Mathematical operations with arrays, Script files, Two dimensional plots, Functions and Function files.

[2 QUESTIONS]

UNIT IV –
Programming in MATLAB, Relational and Logical operators, Conditional statements, the switch-case statement, Loops, Nested Loops and Nested conditional statements, The break and continue commands, Polynomials, Curve Fitting and Interpolation, Applications to Numerical Analysis.

[2 QUESTIONS]

Text/ Reference Books:

1. Yashwant Kanetker, Working with C. BPB
2. Reema Tharej, Programming with C, Oxford
3. Balagurusamy, E., Computing Fundamentals and C Programming, Tata McGraw-Hill
4. Jeri R. Hanly & Elliot P. Koffman, Problem Solving and Program Design in C, Addson Wesley.
5. Yashwant Kanetker, Let us C, BPB
6. Rajaraman, V., Computer Programming in C, PHI
7. Amos Gilat, MATLAB- An introduction with Applicatins, Wiley India

UNIVERSITY DEPARTMENT OF MATHETMATICS, N.P. UNIVERSITY
CBCS PATTER SYLLABUS W.E.F. 2016-17

Paper Code: CCMATH202
Ordinary Differential Equations
Credits: 5, Full Marks: 70, Pass Marks: 28
Time: 3 hours

Nine questions will be set, out of which candidates are required to answer 5 questions. Q. No. 1 is compulsory, consisting of ten shorts answer type questions, each of 3 marks, covering entire syllabus of the paper uniformly. Rest four questions, each of 10 marks will be required to be answered, selecting one from each unit.

UNIT I – First order ODE
Existence and uniqueness of the solution to ODE, Picard's existence theorem, Lipschitz condition, Uniqueness theorem, Picard's method of successive approximation.
[2 QUESTIONS]

UNIT II – Second and higher order ODE
Algebraic properties of solutions of homogeneous equations & wronskian of second order ODE, nth order ODE, Wronskian or n functions and its properties, Annihilator method to solve non homogeneous ODE with constant coefficients, initial value problem, Existence and uniqueness theorem.
[2 QUESTIONS]

UNIT III – Linear System of ODE's
Linear system of ODEs, Existence and Uniqueness of linear system, linear homogeneous system with constant coefficients, method of eigen value and eigen vectors, Fundamental solution, Reduction of higher order linear equation into first order linear equations.
[2 QUESTIONS]

UNIT IV – Boundary Value Problem
Strum-Lioville boundary value problem with homogenous boundary conditions. Green's function, Green's function techniques for solving self-adjoint boundary value problem.
[2 QUESTIONS]

Text/ Reference Books:

1. E.A. Coddington and N. Levinson. Theory of Ordinary Differential Equations. Mc Graw-Hill, NY (1955).
2. M. Brawn, Differential equations and their applications, Springer-Verrlag New York (1992).
3. Chakrabarti, Elements of ordinary differential equations and special functions, New Age, Int. Publ. (1990).
4. M.D. Raisinghani, Advanced differential equations, S. Chand and Company, 2001
5. A Coddington, An introduction to Ordinary Differential equations, Prentice Hall of India, New delhi, 1987.

UNIVERSITY DEPARTMENT OF MATHETMATICS, N.P. UNIVERSITY
CBCS PATTER SYLLABUS W.E.F. 2016-17

Paper Code: CCMATH203
Differential Geometry and Tensor Analysis
Credits: 5, Full Marks: 70, Pass Marks: 28
Time: 3 hours

Nine questions will be set, out of which candidates are required to answer 5 questions. Q. No. 1 is compulsory, consisting of ten shorts answer type questions, each of 3 marks, covering entire syllabus of the paper uniformly. Rest four questions, each of 10 marks will be required to be answered, selecting one from each unit.

UNIT I – Curves in Space
Curvature and torsion. Serret-Frenet formula. Circular helix, the circle of curvature. Osculating sphere, Bertrand curves.

[2 QUESTIONS]

UNIT II – Curves on a Surface
Curves on a surface-parametric curves. Fundamental magnitude, curvature of normal section. Principal directions and principal curvatures, lines of curvature, Rodrique's formula. Dupin's theorem, theorem of Euler, Conjugate directions and Asymplotic lines.

[2 QUESTIONS]

UNIT III – Family of Surfaces
One parameter family of surfaces – Envelope the edge of regression, Developables associated with space curves. Gaussian Curvature, Surface of constant curvature.

[2 QUESTIONS]

UNIT IV – Basics of tensor
Tensors, Tensor Algebra, Contraction, Quotient theorem. Metric Tensor, Angle between two vector.

[2 QUESTIONS]

Text/ Reference Books:
1. C.E. Weatherburn. Differential geometry of three dimensions.
2. C.E. Weatherburn. Tensor Calculus.
3. R.S. Mishra, Tensor Calculus and Riemanian Geometry.
4. T.J. Willmore, Differential Geometry.

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Paper Code: CCMATH204
Programming in C & MATLAB (Practical)
Credits: 5, Full Marks: 70, Pass Marks: 28
Time: 3 hours

Programming in C :

Write programs to understand different logics using flow chart.

Write programs to understand printf, scanf, gets, getchar, puts, sqrt etc functions.

Write prgrams to illustrate the concepts of constants, variables and data types.

Write programs to illustrate operators and expressions in C.

Write programs to illustrate decision making and branching in C.

Write programs to illustrate decision making and looping in C.

Analysis of various programs, i.e. Find the syntax error, logical error and outputs.

Write programs to illustrate array in C.

Write programs to illustrate of user defined functions.

Write programs to illustrate structure and unions.

Write programs to illustrate concept of pointers, character strings and string manipulations.

Write programs to illustrate of user defined functions using pointers, array, structure, union etc.

Write programs to illustrate File Handling in C.

Programming in MATLAB :

Write programs to illustrate Built-in functions and Arrays

Write Programs to illustrate Script files, functions and function files

Write programs to illustrate two dimensional plots

Write programs to illustrate curve fitting and interpolation.

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SEMESTER III

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Paper Code: CCMATH301
Functional Analysis
Credits: 5, Full Marks: 70, Pass Marks: 28
Time: 3 hours

Nine questions will be set, out of which candidates are required to answer 5 questions. Q. No. 1 is compulsory, consisting of ten shorts answer type questions, each of 3 marks, covering entire syllabus of the paper uniformly. Rest four questions, each of 10 marks will be required to be answered, selecting one from each unit.

UNIT I – Normed linear spaces
Normed Linear Spaces: Definition and Examples, NLS as a metric space, Open sets, closed sets etc in a NLS, Convergence and Continuity. Banach spaces and examples. Quotient space of normed linear spaces and its completeness, equivalent norms.

[2 QUESTIONS]

UNIT II – Transformation on linear spaces
Bounded linear transformations, normed linear spaces of bounded linear transformations, dual spaces with examples. Hahn-Banach theorem Open mapping and closed graph theorem, the natural imbedding of N in N**. Reflexive spaces.

[2 QUESTIONS]

UNIT III – Hilbert Spaces
Inner product spaces. Hilbert spaces. Orthonormal Sets. Bessel's inequality. Complete orthonormal sets and Parseval's identity. Projection theorem. Rietz representation theorem Reflexivity of Hilbert spaces.

[2 QUESTIONS]

UNIT IV – Operators in Hilbert Space
Linear Transformation & Linear Functionals. Adjoint of an operator on a Hilbert space.. Self-adjoint operators. Positive, normal and unitary oerators.

[2 QUESTIONS]

Text/ Reference Books:

1. G.F. Simmons, Topology and modern analysis TMH.
2. G. Bachman and L. Narici, Functional Analysis, A P.
3. R.E. Edwards, Functional Analysis. Holt Rinehart and Winston, New York 1958
4. C Goffman and G. Pedrick. First Course in Functional Analysis, PHT, 1987
5. Kreyszig, Functional analysis with applications, John Wiley and sons.

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Paper Code: CCMATH302
Partial Differential Equation
Credits: 5, Full Marks: 70, Pass Marks: 28
Time: 3 hours

Nine questions will be set, out of which candidates are required to answer 5 questions. Q. No. 1 is compulsory, consisting of ten shorts answer type questions, each of 3 marks, covering entire syllabus of the paper uniformly. Rest four questions, each of 10 marks will be required to be answered, selecting one from each unit.

UNIT I – Classification of 2nd order PDE & Laplace equation
Classification of second order PDE & reduction to Canonical forms, Fundamental Solutions of two dimensional Laplace equation in Cartesian form.

[2 QUESTIONS]

UNIT II – Heat Equation
Derivation and Fundamental solution of one dimensional Heat equation in Cartesian form. Application Problems.

[2 QUESTIONS]

UNIT III – Wave Equation
Derivation and Fundamental solution of one dimensional Wave equation in Cartesian form. Application Problems.

[2 QUESTIONS]

UNIT IV – Integral Transforms and Green's function Methods of Solution
Solutions of P.d.e. using separation of variables, Fourier transform and Laplace transform, Green's function and solutions of boundary value problems using Laplace transformation.

[2 QUESTIONS]

Text/ Reference Books:

1. L.C. Evans, Partial Dirrerential Equations, Graduate Studies in Mathematics, Volume 19, AMS, 1998.
2. I.N. Sneddon, Use of integrals transforms, McGraw Hill.
3. P. Prasad and R. Ravindran, Partial differential equation.
4. K. Sankara Rao, Partial differential equation, new age.
5. E. Kreyszing, Advanced Engineering Mathematics, John Wiley & Sons.

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Paper Code: ECMATH303
Students should opt for anyone of the following three courses :

A. **OPTIMIZATION TECHNIQUES**
B. **ADVANCED DISCRETE MATHEMATICS**
C. **INTEGRAL TRANFORMS**

Paper Code : ECMATH303 (A)
Optimization Techniques
Credits: 5, Full Marks: 70, Pass Marks: 28
Time: 3 hours

Nine questions will be set, out of which candidates are required to answer 5 questions. Q. No. 1 is compulsory, consisting of ten shorts answer type questions, each of 3 marks, covering entire syllabus of the paper uniformly. Rest four questions, each of 10 marks will be required to be answered, selecting one from each unit.

UNIT I – Dual Simplex Method
Infeasible optimal initial solution, Dual simplex mthod, Its advantage over simplex method, difference between simplex and dual simplex method.

[2 QUESTIONS]

UNIT II – Sensitivity Analysis
Changes in coefficients in the objective function, Changes in the structure of the LPP due to addition of new variable/Deleting of existing variable/Addition of new constraints/Deletion of existing contraints.

[2 QUESTIONS]

UNIT III – Theory of Games
Characteristics of game theory, maximin criteria and optimal strategy, solution of game with saddle points, Rectangular games without saddle points and its solutions by linear programming.

[2 QUESTIONS]

UNIT IV – Queuing Theory
Basic characteristics of queueing system, different perfomance measure, steady state solution of Markovian queueing modals: M/M/1, M/M/1 with limited waiting space, M/M/C, M/M/C with limited waiting space.

[2 QUESTIONS]

Text/ Reference Books:

1. S.D. Sharma, Operation Research, Kedar Nath, Ram Nath and Company (1972)
2. H.A. Taha, Operations Research, Prentice-Hall of India Private Limited (2003)
3. R.K. Gupta, Operations Research, Krishna Prakashan.

UNIVERSITY DEPARTMENT OF MATHETMATICS, N.P. UNIVERSITY
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Paper Code: ECMATH303 (B)
Advanced Discrete Mathematics
Credits: 5, Full Marks: 70, Pass Marks: 28
Time: 3 hours

Nine questions will be set, out of which candidates are required to answer 5 questions. Q. No. 1 is compulsory, consisting of ten shorts answer type questions, each of 3 marks, covering entire syllabus of the paper uniformly. Rest four questions, each of 10 marks will be required to be answered, selecting one from each unit.

UNIT I – Automata Theory
Finite state automata & types of automata, deterministic and non deterministic finite state automata, non deterministic finite state automata (NDFSA), transition diagram. Moor Machine, Mealy Machine Turing Machine.

[2 QUESTIONS]

UNIT II – Eulerian and Hamiltonian Graphs
Eulerian graph and its characterizations, Hamiltonian graph and sufficient conditions for a graph to be Hamiltonian.

[2 QUESTIONS]

UNIT III – Planar graph and vertex coloring of a graph
Planar graphs, Platonic graphs. Euler's theorem for planar graphs. Vertex coloring, chromatic number, chromatic polynomial, Brooks theorem, edge coloring, chromatic index, map coloring fine color theorem.

[2 QUESTIONS]

UNIT IV – Algorithms in graph theory
NP – complete problems, good algorithms, connector problem and Kruskal's algorithm. Algorithms for Chinese postman problem. The Shortest path problem, Dijkstra's algorithm.

[2 QUESTIONS]

Text/ Reference Books:

1. R. J. Wilson, Introduction to Graph Theory, 5^{th} ed., Addison Wesley, 2012.
2. John Clark and Derek Allan Holton, A first look at Graph Theory, World Sc., 1991
3. Narsingh Deo, Graph Theory, PHI New Delhi
4. Uday Singh Rajpoot, Advanced Discreet Mathematics, PHI (Eastern economic edition)

UNIVERSITY DEPARTMENT OF MATHETMATICS, N.P. UNIVERSITY
CBCS PATTER SYLLABUS W.E.F. 2016-17

Paper Code: ECMATH303 (C)
Integral Transforms
Credits: 5, Full Marks: 70, Pass Marks: 28
Time: 3 hours

Nine questions will be set, out of which candidates are required to answer 5 questions. Q. No. 1 is compulsory, consisting of ten shorts answer type questions, each of 3 marks, covering entire syllabus of the paper uniformly. Rest four questions, each of 10 marks will be required to be answered, selecting one from each unit.

UNIT I – Laplace and Stieltjes Transforms
Laplace Transform : Definition and convergence theorems, Absolute convergence, Uniform Convergence, Complex inversion formula. Convolution theorem, Tauberian Theorems.
Stieltjes Transform : Definition and convergence heorem, Hardy and Littlewood theorem.
[2 QUESTIONS]

UNIT II – Fourier Transforms
Fourier Transform, Fourier Cosine Transform, Fourier Sine Tranform, Conditions for existence of Fourier Transforms, Convolution Integral, Parseval's Theorem, Inversion Theorem.
[2 QUESTIONS]

UNIT III – Mellin Transform
Definition and elementary properties of Mellin transform, Mellin Transform of derivatives and integrals, The Mellin inversion theorem, Convolution theorems, solution of some integral equations via Mellin transform.
[2 QUESTIONS]

UNIT IV – Hankel Transform
Definition and elementary properties of Hankel Transform, Inversion theorem, Transform of elementary functions, Transform of derivatives of functions, Parseval relation, Relation between Fourier and Hankel transform.
[2 QUESTIONS]

Text/ Reference Books:
1. D. V. Widder, The Laplace Transform, Princeton Univ. Press.
2. Ian N. Sneddn, The use of integral Transforms, McGraw Hill.
3. Ian N. Sneddon, Fourier Transforms, Dover Publications, 2010
4. Loknath Debnath, Integral Transforms and their Applications, Chapman and Hall/CRC; 2nd ed., 2006
5. R. N. Bracewell, The Fourier Transform and its Applications, TMH, India.

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ECMATH 304
Students should opt for anyone of the following
A. FLUID DYNAMICS
B. ANALYTICAL DYNAMICS AND CALCULUS OF VARIATIONS
C. PROBABILITY AND STATISTICS

Paper Code: ECMATH304 (A)
Fluid Dynamics
Credits: 5, Full Marks: 70, Pass Marks: 28
Time: 3 hours

Nine questions will be set, out of which candidates are required to answer 5 questions. Q. No. 1 is compulsory, consisting of ten shorts answer type questions, each of 3 marks, covering entire syllabus of the paper uniformly. Rest four questions, each of 10 marks will be required to be answered, selecting one from each unit.

UNIT I – Kinematics
Lagrangian and Eulerian methods, Equation of continuity in different coordinate systems, Boundary surfaces, Stream lines, Path lines and streak lines. Velocity potential, Irrotational and Rotational motions. vortex lines.

[2 QUESTIONS]

UNIT II – Equations of Motion
Largrange's and Euler's equations of motion. Bernoulli's theorem. Equation of motion by flux method. Implusive actions. Stream function, Irrotational motion.

[2 QUESTIONS]

UNIT III –
Complex velocity potential. Sources, sinks doublets and their images in two dimention. Conformal mapping. Milne-Thomson circle theorem.

[2 QUESTIONS]

UNIT IV –
Two-dimensional Irrotational motion produced by motion of circular, co-axial and elliptic cylinders in an infinite mass of liquid. Theorem of Blasius. Motion of a sphere through a liquid at rest at infinity. Liquid streaming past a fixed sphere. Equation of motion of a sphere.

[2 QUESTIONS]

Text/ Reference Books:

1. W.H. Besant, A. S. Ramsey. A Treatise on Hydro Mechanics. Part II. CBS Publ., 2006
2. G. K. Batchelor. An Introduction of Fluid Mechanics. Comb. Unov. Press, 2000.
3. F. Choriton. Textbook of Fluid Dynamics. C.B.S. Publishers. Delhi 1985
4. P. K. Bansal, A Text Book of Fluid mechanics, Laxmi Publ., 2008.

5. M. D. Raisnghania, Fluid dynamics, S Chand Publ.

UNIVERSITY DEPARTMENT OF MATHETMATICS, N.P. UNIVERSITY
CBCS PATTER SYLLABUS W.E.F. 2016-17

Paper Code: ECMATH304 (B)
Analytical Dynamics and Calculus of Variations
Credits: 5, Full Marks: 70, Pass Marks: 28
Time: 3 hours

Nine questions will be set, out of which candidates are required to answer 5 questions. Q. No. 1 is compulsory, consisting of ten shorts answer type questions, each of 3 marks, covering entire syllabus of the paper uniformly. Rest four questions, each of 10 marks will be required to be answered, selecting one from each unit.

UNIT I – Lagrangian Dynamics
Generalized coordinates, Holonomic and Non-holonomic systems, Scleronomic and Rheonomic system, Generalized potential. Lagrange's equations of first and second kind, Energy equation for conservative fields.

[2 QUESTIONS]

UNIT II – Equations of Hamilton and Routh
Hamilton cononical equations. Equation of energy from Hamilton's equations, Cyclic coordinates, Routh's equations, Jacooi-Poisson Theorem.

[2 QUESTIONS]

UNIT III – Calcular of Variations
Motivating problems of calculus of variations fundamental lemma of calculus of variations Euler's equation, Brachistochrone problem Shortest distance, Geodesic, Minimum surface of revolution.

[2 QUESTIONS]

UNIT IV – Variational Principal in Dynamics and Brackets
Hamilton's Principle, Principle of least action. Jacobi's equations. Hamilton-Jacobi equations. Jacobi theorem. Lagrange brackets and Poisson brackets. Invariance of Langrange brackets and Poisson brackets under canonical transformations.

[2 QUESTIONS]

Text/ Reference Books:

1. H. Goldstein, Classical Mechanics (2nd edition), Narosa, Publishing House, New Delhi.
2. I. M. Gelfand and S.V. Fomin, Calculus of variation, prentice Hall.
3. S. L. Loney, An elementary treatise on Statics, Kalyani Publishers, N. Delhi 1979.
4. A. S. Ramsey, Newtonian Gravitation. The English Language Book Society and the Cambridge University Press.
5. N. C. Rana & P. S. Chandra Joag, Classical Mechanics. Tata McGraw Hill 1991
6. Lours N. Hand and Janel, D. Finch, Analytical Mechanics, Cambridge Univ. Press.

UNIVERSITY DEPARTMENT OF MATHETMATICS, N.P. UNIVERSITY
CBCS PATTER SYLLABUS W.E.F. 2016-17

Paper Code: ECMATH304 (C)
Probability and Statistics
Credits: 5, Full Marks: 70, Pass Marks: 28
Time: 3 hours

Nine questions will be set, out of which candidates are required to answer 5 questions. Q. No. 1 is compulsory, consisting of ten shorts answer type questions, each of 3 marks, covering entire syllabus of the paper uniformly. Rest four questions, each of 10 marks will be required to be answered, selecting one from each unit.

UNIT I –
Introduction to descriptive statistics and exploratory data analysis, sample space, discrete probability, independent events, Bayes theorem, random variables distribution functions, expectation and moments, marginal probability distribution, central limit theorem.
[2 QUESTIONS]

UNIT II –
Theoretical distributions, Standard discrete and continuous univariate distributions, Sampling distributions, standard errors such as statistical, biased or unbiased etc, Methods of estimation, Properties of estimators, Confidence intervals, Tests of hypothesis.
[2 QUESTIONS]

UNIT III –
Large sample tests, tests of single proportions, difference of proportions, tests of significance for single mean, difference of mean and difference of standard deviation. Chi-square distribution, goodness of fit, Chi-square test for independence of attributes, degree of freedom, population variance.
[2 QUESTIONS]

UNIT IV –
Tests of significance based on t, F and Z distributions.
[2 QUESTIONS]

Text/ Reference Books:

1. S. C. Gupta : Fundamentals of Statistics. Himalaya Publishing House, 1981.
2. Richard A. Johnson, Miller and Freunots : Probability and Statistics for Engineers.
3. B. Rosuer : Fundamentals of Biostatistics, Duxbury Thompson Learning, 2000.

M.Sc./M.A. MATHEMATICS
SYLLABUS BASED ON CBCS SEMESTER SYSTEM
W. E. F. THE SESSION 2016-2017

SEMESTER IV

UNIVERSITY DEPARTMENT OF MATHETMATICS, N.P. UNIVERSITY
CBCS PATTER SYLLABUS W.E.F. 2016-17

Paper Code: CCMATH401
Numerical Solution of ODE/PDE
Credits: 5, Full Marks: 70, Pass Marks: 28
Time: 3 hours

Nine questions will be set, out of which candidates are required to answer 5 questions. Q. No. 1 is compulsory, consisting of ten shorts answer type questions, each of 3 marks, covering entire syllabus of the paper uniformly. Rest four questions, each of 10 marks will be required to be answered, selecting one from each unit.

UNIT I – Numerical Solution of ODE-1
Picard's method of successive approximations for solution of first order ODE, Picard's method for simultaneous first ODE, Picard's method for second order ODE, Euler's method, Improved Euler's method, Modified Euler's method.

[2 QUESTIONS]

UNIT II – Numerical Solution of ODE-2
First order Runge-Kutta method, Runge-Kutta method of second order, Higher order Runge-Kutta methods, Runge-Kutta methods for simultaneous first order equations, Runge-Kutta method for second order ODE, Predictor-Corrector methods, Milne method, Adams-Bashforth method.

[2 QUESTIONS]

UNIT III – Numerical solutions of parabolic PDE
Numerical difference approximation of partial derivatives, Numerical solution of Heat equation, Two and three levels explicit and implicit difference schemes. Convergence and stability analysis.

[2 QUESTIONS]

UNIT IV – Numerical Solutions of Hyperbolic and Elliptic PDE
Numerical solution of hyperbolic PDE in one and two space dimension : explicit and implicit schemes. ADI methods. Difference schemes for first order equations. Numerical solutions of elliptic equations.

[2 QUESTIONS]

Text/ Reference Books:

1. M. K. Jain, S. R. K. Iyenger and R. K. Jain, Computational Methods for Partial differential equations, Wiley eastern, 1994.
2. M. K. Jain, Numerical solution of Differential Equations, second edition, Wiley Eastern.
3. Vedamurthy and Iyengar, Numerical methods, Vikas Publ., 2011.
4. V. Griffiths and I. M. Smith, Numerical Methods of Engineers, Oxford University Press. 1993.
5. F. General and P. O. Wheatley, Applied Numerical Analysis, Addison-Wesley, 1998.

6. K. E. Atkinson, An Introduction to Numerical Analysis, John Wiley & Sons.

UNIVERSITY DEPARTMENT OF MATHETMATICS, N.P. UNIVERSITY
CBCS PATTER SYLLABUS W.E.F. 2016-17

Paper Code: ECMATH402
Students should opt for anyone of the following three courses :

A. **MATHEMATICAL MODELING**
B. **Fourier and Wavelet Analysis**
C. **OPERATIONS RESEARCH**

Paper Code: CCMATH402 (A)
MATHEMATICAL MODELING
Credits: 5, Full Marks: 70, Pass Marks: 28
Time: 3 hours

Nine questions will be set, out of which candidates are required to answer 5 questions. Q. No. 1 is compulsory, consisting of ten shorts answer type questions, each of 3 marks, covering entire syllabus of the paper uniformly. Rest four questions, each of 10 marks will be required to be answered, selecting one from each unit.

UNIT I – Introduction to mathematical modeling
Simple situations requiring mathematical modeling, techniques of mathematical modeling, classifications, characteristics and limitations of mathematical models, some simple illustrations.

[2 QUESTIONS]

UNIT II – Mathematical modeling through differential equations
Linear growth and decay models, non linear growth and decay models, Compartment models, Mathematical modeling in dynamics through ordinary differential equations of first order.

[2 QUESTIONS]

UNIT III – Mathematical models through difference equations
Some simple mathematical models, basic theory of linear difference equations with constant coefficients.

[2 QUESTIONS]

UNIT IV – Application of mathematical modeling in economics, finance & genetics
Mathematical modeling through difference equations in economics and finance, mathematical modeling through difference equations in population dynamics and genetics.

[2 QUESTIONS]

Text/ Reference Books:

1. J. N. Kapur, Mathematica Modeling, Wiley Eastern.
2. D. N. Burghes, Mathematical modeling in social Management and Life Science, Ellie Herwood and John Wiley.
3. F. Charlton, Ordinary Differential and Difference Equations, Van Nostrand.

UNIVERSITY DEPARTMENT OF MATHETMATICS, N.P. UNIVERSITY
CBCS PATTER SYLLABUS W.E.F. 2016-17

Paper Code: ECMATH402 (B)
Fourier and Wavelet Analysis
Credits: 5, Full Marks: 70, Pass Marks: 28
Time: 3 hours

Nine questions will be set, out of which candidates are required to answer 5 questions. Q. No. 1 is compulsory, consisting of ten shorts answer type questions, each of 3 marks, covering entire syllabus of the paper uniformly. Rest four questions, each of 10 marks will be required to be answered, selecting one from each unit.

UNIT I – Fourier series of periodic functins
Fourier Coefficients, partial sums, the Dirichlet and Fejer Kernels, convergence theorems. Fourier integrals : convolution, inversion, Plancherel's formula. Generalized Fourier Series, Orthogonality and completeness.

[2 QUESTIONS]

UNIT II – The Fourier Transform
basic properties, Inversion, Convolution, Plancherrel Theorem, The Fourier Transform for L2 functions, Dilatations, Translations, and Modulations. Windowed Fourier Transform, Discrete Fourier Transform.

[2 QUESTIONS]

UNIT III – Haar System and Haar Transform
The Haar System, Dyadic Step Functions, Haar bases on [0, 1]. Comparison of Haar series and Fourier Series. The Discrete Haar Transform (DHT), the DHT in two dimensions, Image analysis with the DHT.

[2 QUESTIONS]

UNIT IV – Orthonormal wavelet bases and Multiresolution analysis
Definition and examples, Constructin of Orthonormal wavelet bases, Scaling functions and their properties. The Discrete wavelet Transform, Wavelet frames, Multiscale Analysis, DWT for finite signals. The Continuous Wavelet Transform, Inverse CWT and admissibility conditions.

[2 QUESTIONS]

Text/ Reference Books:

1. D. F. Walnut, An Introduction to Wavelet Analysis, Birkhauser
2. M. A. Pinsky, Introduction to Fourier Analysis and Wavelets, AMS.
3. J. S. Walker, A Primer on Wavelets and Their Scientific Applications, CRC, 1999.
4. R. M. Rao, A. S. Bopardikar, Wavelet Transforms, Pearsons, India, 2010.
5. I. Daubechies, Ten Lectures on Wavelets, SIAM, 1992.
6. Y. Meyer, Wavelets : Algorithms and Applications, SIAM, 1993.
7. S. V. Narasinmhan et al, Introduction to Wavelet Transform, Narosa, India, 2012.

A. K. Louis et al, Wavelets: Theory and Applications, John Wiley & Sons, 1998

UNIVERSITY DEPARTMENT OF MATHETMATICS, N.P. UNIVERSITY
CBCS PATTER SYLLABUS W.E.F. 2016-17

Paper Code: ECMATH402 (C)
Operatins Research
Credits: 5, Full Marks: 70, Pass Marks: 28
Time: 3 hours

Nine questions will be set, out of which candidates are required to answer 5 questions. Q. No. 1 is compulsory, consisting of ten shorts answer type questions, each of 3 marks, covering entire syllabus of the paper uniformly. Rest four questions, each of 10 marks will be required to be answered, selecting one from each unit.

UNIT I – Integer Programming
Branch and bound technique, Gomory's cutting plane method.

[2 QUESTIONS]

UNIT II – Non Linear Programming
One and multi variable, Unconstrained optimization, Kuhn-Tucker Condititons for costrained optimization, Quadratic programming, Wolf's and Beal's method.

[2 QUESTIONS]

UNIT III – Inventory
Known demand, probabilistic demand, Deterministic Models and Probabilistic models without lead-time.

[2 QUESTIONS]

UNIT IV – Project Planning and Control with PERT-CPM
Rules of network construction, Time calculation in networks, Critical path method, PERT, PERT calculation, advantages of network (PERT/CPM), Difference between CPM and PERT.

[2 QUESTIONS]

Text/ Reference Books:

1. S. D. Sharma, Operation Research, Kedar Nath, Ram Nath and Company (1972).
2. H. A. Taha, Operations Research, PHI, 2003.
3. R. K. Gupta, Operations Research, Krishna Prakashan.

UNIVERSITY DEPARTMENT OF MATHETMATICS, N.P. UNIVERSITY
CBCS PATTER SYLLABUS W.E.F. 2016-17

Paper Code: ECMATH403
Students should opt for anyone of the following three courses :

A. **MATHEMATICS OF FINANCE AND INSURANCE**
B. **HADAMARD MATRICES AND COMBINATORIAL DESIGNS**
C. **INTEGRAL EQUATIONS**

Paper Code: ECMATH403 (A)
MATHEMATICS OF FINANCE AND INSURANCE
Credits: 5, Full Marks: 70, Pass Marks: 28
Time: 3 hours

Nine questions will be set, out of which candidates are required to answer 5 questions. Q. No. 1 is compulsory, consisting of ten shorts answer type questions, each of 3 marks, covering entire syllabus of the paper uniformly. Rest four questions, each of 10 marks will be required to be answered, selecting one from each unit.

UNIT I –
Financial Derivatives – An Introduction : Types of Financial Derivatives – Forwards and Futures : Options and its kind : and SWAPS.
The Arbitrage Theorem and Introduction to portfolio Selection and Capital Market Theory – Static and Continuous – Time Model.

[2 QUESTIONS]

UNIT II –
Pricing by Arbitrage – A single – Period Option Pricing Model :
Multi Pricing
Model – Cox – Rose – Rubinstein Model : Bounds on Option Prices.
The Dynamics of Derivative Prices – Stochastic Differential Equations (SDEs) – Major Models of SDEs. Lonear Constant Coefficient SDEs : Geometric SDEs : Square Root Process : Mean Reverting Process and Omstein – Uhlenbeck Process.

Martingale Measue and Risk-Neutral Probabilities : Pricing of Binomial Options with equivalent martingale measures.

[2 QUESTIONS]

UNIT III –
The Black-Scholes Option Pricing Model – Using no arbitrage approach, limiting case of Binomial Option Pricing and Risk – Neutral probabilities. The Americal Option Pricing – Extended Trading Strategies; Analysis of American Put Options : early exercise premium and relation to free boundary problems.
Concepts from Insurance : Introduction : The Claim Number Process : The Claim Size Process : Solvability of the Portfolio : Reinsurance and Ruin Problem. Premium and Ordering of Risks – Premium Calculation Principles and ordering Distributions.

[2 QUESTIONS]

UNIVERSITY DEPARTMENT OF MATHETMATICS, N.P. UNIVERSITY
CBCS PATTER SYLLABUS W.E.F. 2016-17

UNIT IV –
Distributions of Aggregate Claim Amount – Individual and Collective Model : Compound Distributions : Claim Number of Distributions : Recursive Computation Methods : Lundberg Bounds and Approximation by Compound Distributions. Risk Processes – Time – Dependent Risk Models : Poisson Arrival Processes : Ruin Probabilities and Bounds Asymptotic and Approximation. Time Dependent Risk Models – Ruin Problems and Computations of Ruin Functions; Dual Queuing Model : Risk Models in Continuous Time and Numerical Evaluation of Ruin Functions.

[2 QUESTIONS]

Text/ Reference Books:

1. John C. Hull, Options. Futures and other derivatives. Prentice Hall of India Pvt. Ltd.
2. Sheldon M. Rose,// An Introduction to Mathematical Finance. Cambridge University Press.

UNIVERSITY DEPARTMENT OF MATHETMATICS, N.P. UNIVERSITY
CBCS PATTER SYLLABUS W.E.F. 2016-17

Paper Code: ECMATH403 (B)
Hadamard Matrices and Combinatorial Designs
Credits: 5, Full Marks: 70, Pass Marks: 28
Time: 3 hours

Nine questions will be set, out of which candidates are required to answer 5 questions. Q. No. 1 is compulsory, consisting of ten shorts answer type questions, each of 3 marks, covering entire syllabus of the paper uniformly. Rest four questions, each of 10 marks will be required to be answered, selecting one from each unit.

UNIT I – Introduction to Hadamard Matrices
Order of Hadamard Matrix, Hadamard Matrix Conjecture, Kronecker Product of Hadamard Matrices, Sylvestor Hadamard Matrices, Equivalence of Hadamard matrices, Maximum Determinant Theorem.

[2 QUESTIONS]

UNIT II – Construction of Hadamard Matrices
Hadamard matrices by Paley type I and type II methods, Williamson's method of construction. Number of in-equivalent Hadamard matrices of order 16 & 20.

[2 QUESTIONS]

UNIT III – Orthogonal Designs
Orthogonal-design, weighing and Conference matrices, Baumert-Hall method for the construction of Hadamard matrices.

[2 QUESTIONS]

UNIT IV – Application of Hadamard Matrices
Construction of BIBD's from Hadamard matrices. Error correcting codes. Application of Hadamard matrices in the constructin of error correcting codes.

[2 QUESTIONS]

Text/ Reference Books:

1. Marshal Hall (Jr.), Combinatorial Theory, Blaisdel Publishing house, 1986

UNIVERSITY DEPARTMENT OF MATHETMATICS, N.P. UNIVERSITY
CBCS PATTER SYLLABUS W.E.F. 2016-17

Paper Code: ECMATH403 (C)
Integral Equations
Credits: 5, Full Marks: 70, Pass Marks: 28
Time: 3 hours

Nine questions will be set, out of which candidates are required to answer 5 questions. Q. No. 1 is compulsory, consisting of ten shorts answer type questions, each of 3 marks, covering entire syllabus of the paper uniformly. Rest four questions, each of 10 marks will be required to be answered, selecting one from each unit.

UNIT I – Classification of Linear Integral Equations
Fredholm, Volterra, Integro-Differential Equations, Singular Integral Equations, Converting Volterra Equation to ODE, Conversion of IVP to Volterra equation, Conversion of BVP to Fredholm equation.

[2 QUESTIONS]

UNIT II – Fredholm Integral Equations
Decomposition method, Direct Computation method, successive approximation method, method of successive substitutions, Homogeneous Fredholm Equations, Comparison between alternative methods.

[2 QUESTIONS]

UNIT III – Volterra Integral Equation
Solution of VIE, Series solution method, Successive Approximation method, Successive substitution method, Comparison between alternative methods.

[2 QUESTIONS]

UNIT IV – Singular Integral Equations
Abel problem, Generalized Abel Integral Equation, Existence and uniqueness of solutions using fixed-point theorems in case of Linear and nonlinear Volterra and Fredholm integral equations. Solution of Integral equations by Laplace, Fourier transforms methods.

[2 QUESTIONS]

Text/ Reference Books:

1. Murry R. Spiegal, Laplace Transform (SCHAUM Outline Series), McGraw-Hill.
2. Abdul J. Jerry, Introduction to integral equations with applications, Marcel Dekkar Inc. NY.
3. R. P. Kanwal, Linear Integral equations, Springer Sc., 1997
4. Harry Hochsdedt, Integral Equations, John Wiley & Sons.

MATH 404

PROJECT

ON ANY ONE OF SPECIAL PAPER

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