SYLLABUS
FOR
B.SC. PROGRAM IN MATHEMATICS

Under

Choice Based Credit System

(CBCS)

Effective from the academic session 2019-2020

KAZI NAZRUL UNIVERSITY

ASANSOL-713 340, PASCHIM BARDHAMAN

WEST BENGAL

SEMESTER I

CORE COURSE-1(1)

Course code: BSCPMTMC101
Differential Calculus (Full marks-50)

Limit of functions, Algebra of limits, Continuous functions, Properties of continuous functions, Monotone functions, Inverse function. Differentiability of functions, Successive differentiation, Leibnitz's theorem, Rolle's theorem, Mean value theorem of Lagrange and of Cauchy with geometrical interpretations. Taylor's theorem and Maclaurin's theorem with remainder in Lagrange's and Cauchy's form and application of mean value theorem, Darboux's theorem. Series expansion of $\sin x, \cos x, \log(1+x), (1+x)^n, a^x$ with domain of convergence.

Partial differentiation, Euler's theorem on homogeneous functions.

Determination of maxima and minima, Indeterminate forms.

Tangents and normals, Curvature, Asymptotes, Singular points, Tracing of curves. Parametric representation of curves and tracing of parametric curves, Polar coordinates and tracing of curves in polar coordinates.

References:

1. H. Anton, I. Birens and S. Davis, *Calculus*, John Wiley and Sons, Inc., 2002.
2. G.B. Thomas and R.L. Finney, *Calculus*, Pearson Education, 2007.
3. Richard R.Goldberg, *Methods of Real Analysis*, Oxford and IBH, 2012.
4. Shanti Naryayn and P. K. Mittal, *Differential Calculus*, S Chand.
5. K.C.Maity and R.K.Ghosh, *Differential Calculus*, Books and Allied (P) Ltd.

SEMESTER II

CORE COURSE-1(2)

Course code: BSCPMTMC201
Differential Equations and Vector Calculus (Full marks-50)

First order exact differential equations. Integrating factors, rules to find an integrating factor. First order higher degree equations solvable for x, y, p. Methods for solving higher-order differential equations. Basic theory of linear differential equations, Wronskian, and its properties. Solving a differential equation by reducing its order.

Linear homogenous equations with constant coefficients, Linear non-homogenous equations, The method of variation of parameters, The Cauchy-Euler equation, Simultaneous differential equations, Total differential equations.

Definition of vector, Resolution of vectors into components along three directions. Scalar and vector products of two and three vectors. Applications to geometry and mechanics**.**

Continuity and differentiability of vector-valued function of one variable. Velocity and acceleration. Vector-valued functions of two and three variables, Gradient of scalar function, Divergence, Curl and their properties.

References:

1. Shepley L. Ross, *Differential Equations*, 3rd Ed., John Wiley and Sons, 1984.
2. B. Spain, *Vector Analysis*, D.Van Nostrand Company Ltd.
3. L. Brand, *Vector Analysis*, Dover Publications Inc.
4. Shanti Narayan**,** *A Text Book of Vector Analysis*, 19th Edn, S.Chand publishing.
5. M. Spiegel, S.Lipschutz , D. Spellman, *Vector Analysis*, McGraw-Hill.

SEMESTER III

CORE COURSE-1(3)

Course code: BSCPMTMC301
Algebra (Full marks-50)

Definition and examples of groups, examples of abelian and non-abelian groups, the group Zn of integers under addition modulo n and the group U(n) of units under multiplication modulo n. Cyclic groups from number systems, complex roots of unity, circle group, the general linear group GLn(n,R), groups of symmetries of (i) an isosceles triangle, (ii) an equilateral triangle, (iii) a rectangle, and (iv) a square, the permutation group Sym (n), Group of quaternions. group of permutation, Normal subgroups: their definition, examples, and characterizations, Quotient groups. Divisor of zeros, Rings, Integral domain, fields.

Solution of non-homogeneous system of three linear equations by matrix inversion method. Elementary row and column operations, rank of a matrix, row reduced echelon form and fully reduced normal form.

Vector spaces over reals, simple examples, Euclidean 3-space E^3, linear dependence and independence of a finite set of vectors, sub-spaces, definition and examples.

References:

1. John B. Fraleigh, *A First Course in Abstract Algebra*, 7th Ed., Pearson, 2002**.**
2. M. Artin, *Abstract Algebra*, 2nd Ed., Pearson, 2011.
3. Joseph A Gallian, *Contemporary Abstract Algebra*, 4th Ed., Narosa, 1999.
4. George E Andrews, *Number Theory*, Hindustan Publishing Corporation, 1984.
5. S. K. Mapa, *Higher Algebra (Abstract and Linear),* Sarat Book House.

6. Promode Kumar Saikia, *Linear Algebra With Applications*, Pearson.
7. U. M. Swamy & A. V. S. N. Murthy, *Algebra: Abstract and Modern*, Pearson.
8. Ghosh & Chakravorty, *Higher Algebra (Classical & Modern),* U. N. Dhur & Sons Pvt. Ltd.

SEMESTER IV

CORE COURSE-1(4)

Course code: BSCPMTMC401
Real Analysis (Full marks-50)

Finite and infinite sets, examples of countable and uncountable sets.Real line, bounded sets,suprema and infima, completeness property of R, Archimedean property of R, intervals. Conceptof cluster points and statement of Bolzano-Weierstrass theorem.

Real Sequence, Bounded sequence, Cauchy convergence criterion for sequences. Cauchy's theorem on limits, order preservation and squeeze theorem, monotone sequences and their convergence (monotone convergence theorem without proof).
Infinite series. Cauchy convergence criterion for series, positive term series, geometric series, comparison test, convergence of p-series, Root test, Ratio test, alternating series, Leibnitz's test(Tests of Convergence without proof). Definition and examples of absolute and conditional convergence.

Sequences and series of functions, Pointwise and uniform convergence. M_n-test, M-test, Statements of the results about uniform convergence and integrability and differentiability of functions, Power series and radius of convergence.

References:

1. T. M. Apostol, *Calculus* (Vol. I), John Wiley and Sons (Asia) P. Ltd., 2002.
2. R.G. Bartle and D. R Sherbert, *Introduction to Real Analysis,* John Wiley and Sons.
3. E. Fischer, *Intermediate Real Analysis*, Springer Verlag, 1983.
4. K.A. Ross, *Elementary Analysis- The Theory of Calculus Series*- Undergraduate Texts In Mathematics, Springer Verlag, 2003.
5. Richard R.Goldberg, *Methods of Real Analysis*, Oxford and IBH, 2012.

SEMESTER V

DESCIPLINE SPECIFIC ELECTIVE (DSE-1(1))

(Choose any one from the following)

Course code: BSCPMTMDSE501

Mechanics (Full marks-50)

Rectilinear motion, Motion under repulsive force (i) proportional to distance (ii) inversely proportional to square of the distance, Motion under attractive force inversely proportional to square of the distance, Motion under gravitational acceleration.

Simple harmonic motion, Damped oscillation, Forced and Damped oscillation, Elastic string and spiral string, Hook's law, Particle attached to a horizontal elastic string, Particle attached to a vertical elastic string.

Projectiles motion in vacuum and in a medium with resistance varying linearly as velocity. Motion under forces varying as distance from a fixed point.

Central orbit. Kepler's laws of motion. Motion under inverse square law..

References

1. S. L. Loney, *An Elementary Treatise On the Dynamics of a Particle and a Rigid Body*, Cambridge University Press.
2. J. L. Synge and B. A. Griffith, *Principles of Mechanics*, McGraw-Hill.
3. A. S. Ramsey, *Dynamics (Part I & II)*, Cambridge University Press.
4. F. Chorlton, *A Text Book of Dynamics*, E. Horwood.

Course code: BSCPMTMDSE502
Numerical Analysis (Full marks-50)

Approximate numbers, significant figures, rounding off numbers. Errors - absolute, relative and percentage. General formula for errors. Errors in arithmetic operations.

Ordinary and divided differences. Newton's forward and backward interpolation formulae. Newton's divided difference formula. Lagrange interpolation formula. Errors in interpolation formulae. Problems related to interpolations.

Numerical integration - Newton- Cotes' formula. Trapezoidal rule and Simpson's 1/3 rule - their inherent error and geometrical significance.

Solution of first order ODE. - Picard's method and Euler's method.

Solution for real roots of algebraic and transcendental equations - Regula Falsi Method , Fixed point iteration method and Newton - Raphson Method - their convergences (statement only).

References:

1. F. B. Hildebrand, *Introduction to Numerical Analysis*, McGraw-Hill.
2. C. F. Gerald and P. O. Wheatley Applied *Numerical Analysis*, Pearson.
3. J. B. Scarborough, *Numerical Mathematical Analysis*, Oxford and IBH Publishing.
4. Nayak, P.K., Numerical Analysis: Theory & Applications, Asian Books Pvt. Ltd.
5. B. Dasgupta, Applied *Mathematical Methods*, Pearson.
6. A. Gupta and S. C. Bose , *Introduction to Numerical Analysis*, Academic Press

SEMESTER VI

DISCIPLINE SPECIFIC ELECTIVE (DSE-1(2))

(Choose any one from the following)

Course code: BSCPMTMDSE601
Linear Programming Problems (Full marks-50)

Motivation of Linear Programming problem. Statement of L.P.P., Formulation of L.P.P., Slack and Surplus variables. L.P.P. is matrix form. Convex set, Hyperplane, Extreme points, convex Polyhedron, Basic solutions and Basic Feasible Solutions (B.F.S.). Degenerate and Non-degenerate B.F.S.

Fundamental Theorem of L.P.P. (Statement only) Reduction of a feasible solution to a B.F.S. Standard form of an L.P.P. Solution by graphical method (for two variables). Simplex method, Simplex algorithm, Artificial variable technique (Big M method).

Duality in L.P.P.: Concept of duality, Fundamental properties of duality, Fundamental theorems of duality, Duality & Simplex method.

Transportation Problem (T.P.): Mathematical formulation, Existence of feasible solution, Loops and their properties, Initial basic feasible solutions (different methods, like North West corner, Row minima, Column minima, Matrix minima & Vogel's Approximation method), Optimal solutions, Degeneracy in T.P., Unbalanced T.P.

References:

1. G. Hadley, *Linear Programming*, Addison – Wesley.
2. R. Bronson and G. Naadimuthu, *Schaum's Outline of Operations Research,* Schaum's Outline.
3. J.G. Chakravorty and P.R. Ghosh, *Linear Programming and Game Theory*, Moulik Library.
4. J. K. Sharma, *Operations Research – Theory and Applications*, Macmillan.
5. H. A. Taha, *Operations Research – An Introduction,* Prentice-Hall

Course code: BSCPMTMDSE602
Probability & Statistics (Full marks-50)

Elements of probability Theory: Random experiment, Outcome, Event, Mutually Exclusive Events, Equally likely and Exhaustive. Classical definition of probability, Theorems of Total Probability, Conditional probability and Statistical Independence. Shortcoming of the classical definition. Axiomatic approach problems, Random Variable and its Expectation, Theorems on mathematical expectation. Joint distribution of two random variables.
Theoretical Probability Distribution Discrete and Continuous (p.m.f., p.d.f.) Binomial, Poisson and Normal distributions and their properties.

Mathematical expectation, Moments, Measures of skewness and kurtosis, Moment generating function, Characteristic function.

Theory of estimation, point estimation, unbiasedness, minimum variance, consistency, efficiency, maximum likelihood method; Interval estimation –confidence interval, approximate confidence interval.

Bivariate Frequency Distribution. Scatter Diagram, Correlation co-efficient- definition and properties. Regression lines.

References:

1. S. Ross – *First Course in Probability*, Pearson Education.
2. R. V. Hogg, J. W. Mekenard and A.T. Craig, *Introduction to Mathematical Statistics*, Pearson Education.
3. A.Gupta, *Groundwork of Mathematical Probability & Statistics,* Academic publishers.
4. Banerjee, De & Sen, *Mathematical Probability*, U. N. Dhur & Sons Pvt. Ltd.

Semester III

SKILL ENHANCEMENT COURSE (SEC-1)

Course code: BSCPMTMSE301
Mathematical Logic and Sets (Full marks-50)

Introduction, propositions, truth table, negation, conjunction and disjunction. Implications, biconditional propositions, converse, contra positive and inverse propositions and precedence of logical operators. Propositional equivalence: Logical equivalences. Predicates and quantifiers: Introduction, Quantifiers, Binding variables and Negations.

Sets, subsets, Set operations and the laws of set theory and Venn diagrams. Examples of finite and infinite sets. Finite sets and counting principle. Empty set, properties of empty set. Standard set operations. Classes of sets. Power set of a set.

Difference and Symmetric difference of two sets. Set identities, generalized union and intersections. Relation: Product set. Composition of relations, Types of relations, Partitions, Equivalence Relations with example of congruence modulo relation. Partial ordering relations, n- ary relations.

Reference:

1. R.P. Grimaldi, Discrete Mathematics and Combinatorial Mathematics, Pearson Education, 1998.
2. P.R. Halmos, Naive Set Theory, Springer, 1974.
3. E. Kamke, Theory of Sets, Dover Publishers, 1950.

Semester IV

SKILL ENHANCEMENT COURSE (SEC-2)

Course code: BSCPMTMSE401
Boolean Algebra (Full marks-50)

Definition, examples and basic properties of ordered sets, maps between ordered sets, duality principle, maximal and minimal elements, lattices as ordered sets, complete lattices, lattices as algebraic structures, sublattices, products and homomorphisms. Definition, examples and properties of modular and distributive
lattices, Boolean algebras.

Boolean polynomials, minimal forms of Boolean polynomials, Quinn-McCluskey method, Karnaugh diagrams, switching circuits and minimization of switching circuits using Boolean algebra.

References:

1. B A. Davey and H. A. Priestley, Introduction to Lattices and Order, Cambridge University Press, Cambridge,1990.
2. Rudolf Lidl and G¨unter Pilz, Applied Abstract Algebra, 2nd Ed., Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004.

Semester V

SKILL ENHANCEMENT COURSE (SEC-3)

Course code: BSCPMTMSE501
Number Theory (Full marks-50)

Division algorithm, Lame'e theorem, Linear Diophantine equation, fundamental theorem of arithmetic, prime counting function, statement of prime number theorem, Goldbach conjecture, binary and decimal representation of integers, linear congruences, complete set of residues.

Number theoretic functions, sum and number of divisors, totally multiplicative functions, definition and properties of the Dirichlet product, the Mobious inversion formula, the greatest integer function, Euler's phi-function.

References:

1. David M. Burton, Elementary number Theory, Tata McGraw-Hill.
2. N. Robinns, Beginning Number Theory, Narosa Publishing House..

Semester VI

SKILL ENHANCEMENT COURSE (SEC-4)

Course code: BSCPMTMSE601
Graph Theory (Full marks-50)

Definition, examples and basic properties of graphs, pseudo graphs, complete graphs, bipartite graphs isomorphism of graphs.

Eulerian circuits, Eulerian graph, semi-Eulerian graph and theorems, Hamiltonian cycles and theorems. Representation of a graph by a matrix, the adjacency matrix, incidence matrix, weighted graph,

Travelling salesman's problem, shortest path, Tree and their properties, spanning tree, Dijkstra's algorithm, Warshall algorithm.

References:

1. J. Clark and D. A. Holton: A First Look at Graph Theory, Allied Publishers Ltd., 1995.
2. D. S. Malik, M. K. Sen and S. Ghosh: Introduction to Graph Theory, Cengage Learning Asia.
3. Nar Sing Deo : *Graph Theory*, Prentice-Hall, 1974.
4. J. A. Bondy and U.S.R. Murty: Graph Theory with Applications, Macmillan, 1976.
5. Edgar G. Goodaire and Michael M. Parmenter, Discrete Mathematics with Graph Theory, 2nd Edition, Pearson Education (Singapore) P. Ltd., Indian Reprint 2003.

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