REDUCED SYLLABUS
FOR
ODD SEMESTERS (1ST, 3RD, 5TH)

FOR THE SESSION
2020 - 2021

B.SC. MATHEMATICS (HONOURS)
ON CHOICE BASED CREDIT SYSTEM

COOCH BEHAR PANCHANAN BARMA UNIVERSITY

First, Third and Fifth Semester papers which will be taught in Mathematics (Honours)

Semester	Course Name	Course Detail
I	Core–1	**Calculus, Geometry & Differential Equation**
	Core–2	**Algebra**
	Generic Elective–1	**Differential Calculus**
III	Core–5	**Theory of Real Functions**
	Core –6	**Group Theory**
	Core –7	**Partial Differential Equation**
	Core –7 Practical	**Do**
	Skill Enhancement Course–1	**Logic and Sets**
	Generic Elective–3	**Differential Calculus**
V	Core–11	**Probability and Statistics**
	Core–12	**Laplace Transform, Riemann Integration & Series of functions**
	Discipline Specific Elective–1	**Linear Programming and Game Theory**
	Discipline Specific Elective–2	**Introduction to Integral Equation and Dynamical System**

Reduced syllabus for Semester-I

Core Subjects Syllabus

Core 1 – Calculus, Geometry & Differential Equation

Objectives: This course will help students to understand various kinds of standard functions and graphs, techniques of integrations and limits. It helps to build concepts on three dimensional geometry. Also, it gives basic idea about formation and solution of differential equations.

Calculus, Geometry & Differential Equation	
	6 Credits
Unit 1	
Hyperbolic functions, higher order derivatives, Leibnitz rule and its applications to problems of type $e^{(ax+b)}\sin x$, $e^{ax+b}\cos x$, $(ax+b)^n\sin x$, $(ax+b)^n\cos x$, concavity and inflection points, envelopes, asymptotes, L'Hospital's rule	
Unit 2	
Reduction formulae, derivations and illustrations of reduction formulae of the type $\int \sin^n x\,dx$, $\int \cos^n x\,dx$, $\int \tan^n x\,dx$, $\int \sec^n x\,dx$, $\int (\log x)^n dx$, $\int \sin^n x \sin^m x\,dx$, area under a curve, area and volume of surface of revolution	
Unit 3	
Reflection properties of conics, rotation of axes and second degree equations, classification of conics using the discriminant, polar equations of conics. Spheres. Cylindrical surfaces. Central conicoids, paraboloids	
Unit 4	
Differential equations and mathematical models. General, particular, explicit, implicit and singular solutions of a differential equation. Exact differential equations and integrating factors, separable equations and equations reducible to this form, linear equation and Bernoulli equations	
[Reference Books]	
▸ G.B. Thomas and R.L. Finney, Calculus, 9th Ed., Pearson Education, Delhi, 2005. ▸ M.J. Strauss, G.L. Bradley and K. J. Smith, Calculus, 3rd Ed., Dorling Kindersley (India) P. Ltd. (Pearson Education), Delhi, 2007.	

- H. Anton, I. Bivens and S. Davis, Calculus, 7th Ed., John Wiley and Sons (Asia) P. Ltd., Singapore, 2002.
- R. Courant and F. John, Introduction to Calculus and Analysis (Volumes I & II), Springer-Verlag, New York, Inc., 1989.
- S.L. Ross, Differential Equations, 3rd Ed., John Wiley and Sons, India, 2004.
- Murray, D., Introductory Course in Differential Equations, Longmans Green and Co.
- G.F.Simmons, Differential Equations, Tata Mcgraw Hill.
- T. Apostol, Calculus, Volumes I and II.
- S. Goldberg, Calculus and mathematical analysis.

Core 2 - Algebra

Objectives: Basic concepts of complex algebra, theory of equations, set theory, vector spaces and matrices shall be discussed in this course.

Algebra	
	6 Credits
Unit 1	
Complex Number, Polar representation of complex numbers, nth roots of unity, De Moivre's theorem for rational indices and its applications. Exponential, Sine, Cosine and Logarithm of a Complex number, Hyperbolic function Theory of equations: Fundamental theorem of Classical Algebra (statement only), Nature of roots of an equation, Statement of Rolle's theorem, Relation between roots and coefficients, transformation of equation, Descartes rule of signs, Reciprocal, cubic (Cardan's Method) and bi-quadratic (Ferrari's Method) equation. Inequality: The inequality involving AM≥ GM≥ HM, Cauchy-Schwartz inequality.	
Unit 2	
Equivalence relations. Functions, composition of functions, Invertible functions, Principles of Mathematical induction, statement of Fundamental Theorem of Arithmetic.	
Unit 3	
Systems of linear equations, row reduction and echelon forms, vector equations, the matrix equation Ax=b, solution sets of linear systems	
Unit 4	
Vector spaces, subspaces, linear combination of vectors, linear span, linear independence, basis and dimension, dimension of subspaces.	

Unit 5
Introduction to linear transformations, matrix of a linear transformation, inverse of a matrix, characterizations of invertible matrices rank of a matrix, Eigen values, eigen vectors and characteristic equation of a matrix. Cayley-Hamilton theorem and its use in finding the inverse of a matrix.
Reference Books
▸ Titu Andreescu and Dorin Andrica, Complex Numbers from A to Z, Birkhauser, 2006. ▸ Edgar G. Goodaire and Michael M. Parmenter, Discrete Mathematics with Graph Theory, 3rd Ed., Pearson Education (Singapore) P. Ltd., Indian Reprint, 2005. ▸ David C.Lay, Linear Algebra and its Applications, 3rd Ed., Pearson Education Asia, Indian Reprint, 2007. ▸ K. Hoffman, R. Kunze, Linear algebra. ▸ W.S. Burnstine and A.W. Panton, Theory of equations.

Generic Elective (GE) Subjects Syllabus

GE 1(a): Differential Calculus

Objectives: This course will help students to understand limit, continuity, differentiability, partial differentiation, mean value theorems, maxima and minima, indeterminate forms etc. Various applications of calculus shall also be discussed.

Differential Calculus	
	6 Credits
Unit 1	
Limit and Continuity (ε and δ definition), Types of discontinuities, Differentiability of functions, Successive differentiation, Leibnitz's theorem, Partial differentiation, Euler's theorem on homogeneous functions.	
Unit 2	
Tangents and normals, Curvature, Asymptotes	
Unit 3	
Rolle's theorem, Mean Value theorems, Taylor's theorem with Lagrange's and Cauchy's forms of remainder, Maxima and Minima, Indeterminate forms	
Reference Books	
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.

Reduced syllabus for Semester-III

Core Subjects Syllabus

Core 5 – Theory of Real Functions

Objectives: Students will be able to grasp the various aspects of real functions like existence and importance of limits of a functions at a certain point of the domain, continuity and differentiability of real functions. It has been discussed about Mean Value Theorems of various forms of remainder and its applications.

Theory of Real Functions	
	6 Credits
Unit 1	
Limits of functions (ε - δ approach), sequential criterion for limits, divergence criteria. Limit theorems, one sided limits. Infinite limits and limits at infinity. Continuous functions, sequential criterion for continuity and discontinuity. Algebra of continuous functions. Continuous functions on an interval, intermediate value theorem	
Unit 2	
Differentiability of a function at a point and in an interval, Caratheodory's theorem, algebra of differentiable functions. Rolle's theorem. Mean value theorems, Applications of mean value theorem to inequalities and approximation of polynomials.	
Unit 3	
Cauchy's mean value theorem. Taylor's theorem with Lagrange's form of remainder, Taylor's theorem with Cauchy's form of remainder, Taylor's series and Maclaurin's series expansions of exponential and trigonometric functions	
Reference Books	
▸ R. Bartle and D.R. Sherbert, Introduction to Real Analysis, John Wiley and Sons, 2003. ▸ K.A. Ross, Elementary Analysis: The Theory of Calculus, Springer, 2004. ▸ A. Mattuck, Introduction to Analysis, Prentice Hall, 1999. ▸ S.R. Ghorpade and B.V. Limaye, a Course in Calculus and Real Analysis, Springer,	

2006.

- T. Apostol, Mathematical Analysis, Narosa Publishing House
- Courant and John, Introduction to Calculus and Analysis, Vol II, Springer
- W. Rudin, Principles of Mathematical Analysis, Tata McGraw-Hill
- Terence Tao, Analysis II, Hindustan Book Agency, 2006
- SatishShirali and Harikishan L. Vasudeva, Metric Spaces, Springer Verlag, London, 2006.

Core 6 – Group Theory

Objectives: In this course of study, students will learn concepts on group theory from definition to group isomorphisms.

Group Theory	
	6 Credits
Unit 1	
Definition and examples of groups including permutation groups and quaternion groups (illustration through matrices), elementary properties of groups. Subgroups and examples of subgroups, centralizer, normaliser, centre of a group, product of two subgroups.	
Unit 2	
Properties of cyclic groups, classification of subgroups of cyclic groups. Cycle notation for permutations, properties of permutations, even and odd permutations, alternating group, properties of cosets, Lagrange's theorem and consequences including Fermat's Little theorem.	
Reference Books	
- John B. Fraleigh, A First Course in Abstract Algebra, 7th Ed., Pearson, 2002. - M. Artin, Abstract Algebra, 2nd Ed., Pearson, 2011. - Joseph A. Gallian, Contemporary Abstract Algebra, 4th Ed., Narosa Publishing House, New Delhi, 1999. - Joseph J. Rotman, An Introduction to the Theory of Groups, 4th Ed., Springer Verlag, 1995. - I.N. Herstein, Topics in Algebra, Wiley Eastern Limited, India, 1975. - D.S. Malik, John M. Mordeson and M.K. Sen, Fundamentals of abstract algebra.	

Core 7 – Partial Differential Equation (With Practical)

Objectives: Students will learn about formations and method of solving partial differential equations. Also, with the design of practical syllabus, students will get better insight of solutions of PDEs.

Partial Differential Equation	
	6 Credits
Unit 1	
Partial Differential Equations – Basic concepts and definitions, Mathematical Problems. First-Order Equations: Classification, Construction and Geometrical Interpretation. Method of Characteristics for obtaining General Solution of Quasi Linear Equations. Canonical Forms of First-order Linear Equations. Method of Separation of Variables for solving first – order partial differential equations.	
Unit 2: List of Practical (using any software)	
1. Plotting of a solution of Cauchy problem for first order PDE. 2. Plotting the characteristics for the first order PDE. 3. Plot the integral surfaces of a given first order PDE with initial data.	
Reference Books	
▸ Tyn Myint-U and Lokenath Debnath, *Linear Partial Differential Equations for Scientists and Engineers*, 4th Ed., Springer, Indian reprint, 2006. ▸ S.L. Ross, *Differential Equations*, 3rd Ed., John Wiley and Sons, India, 2004. ▸ Martha L Abell, James P Braselton, *Differential Equations with MATHEMATICA*, 3rd Ed., Elsevier Academic Press, 2004.	

Skill Enhancement Subjects Syllabus

SEC 1(a)–Logic and Sets

Objectives: Introduction of logic and sets has been discussed. Students will learn about truth table, different propositions, predicates and quantifiers, various operations between two sets and logical equivalences etc in this course.

Logic and Sets	
	2 Credits
Unit 1	
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	
Unit 2	
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.	
Unit 3	
Relation: Product set. Composition of relations, types of relations, partitions, equivalence Relations with example of congruence modulo relation.	
Reference Books	
▸ R.P. Grimaldi, Discrete Mathematics and Combinatorial Mathematics, Pearson Education, 1998. ▸ P.R. Halmos, Naive Set Theory, Springer, 1974. ▸ E. Kamke, Theory of Sets, Dover Publishers, 1950.	

Generic Elective (GE) Subjects Syllabus

GE 3(a): Differential Calculus

Objectives: This course will help students to understand limit, continuity, differentiability, partial differentiation, mean value theorems, maxima and minima, indeterminate forms etc. Various applications of calculus shall also be discussed.

Same as in GE 1(a)

Reduced syllabus for Semester-V

Core Subjects Syllabus

Core 11- Probability and Statistics

Objectives: In this course students will know about basic concepts on probability and statistics. Definition of probability, application of Bayes theorem, various probability functions and their

applications, numerous measures to determine the nature of sampling data etc. have been discussed in this course.

Probability and Statistics	
	6 Credits
Unit 1	
Random experiments, Simple and compound events. Event space. Classical and frequency definition of probability and their drawbacks. Axioms of Probability. Statistical regularity. Multiplication rule of Probabilities. Bayes' thorem.	
Unit 2	
Independent events. Independent random experiments. Independent trials. Bernoulli trials and binomial law. Poisson trials. Random variables. Probability distribution. Distribution function. Discrete and continuous distributions. uniform, binomial, Poisson, geometric, negative binomial, continuous distributions: uniform, normal, exponential. Mathematical expectation, mean, variance, moments, central moments, dispersion, skewness and kurtosis. Median, mode, quartiles, moment generating function, Characteristic function.	
Unit 3	
Concept of population and Sampling. Sampling distribution of Statistic. Estimates of Population characteristic or parameter. Unbiased and consistent estimates. Sample characteristic as estimates of the corresponding population characteristic.	
Reference Books	
▸ 1. V.K Rohtagi and A.K. Saleh, *An Introduction to Probability and Statistics*, 2nd Ed., John Wiley & Sons, 2005. ▸ 2. A.M. Goon, M.K. Gupta and T.S. Dasgupta, *Fundamentals of Statistics* (Vol. I), 7th Ed., The World Press Pvt. Ltd., 2000. ▸ 3. R.V. Hogg and A.T. Craig, Introduction to Mathematical Statistics, Macmillan Publishing Co. Inc., 1978. ▸ 4. Neil A. Weiss, *Introductory Statistics*, 7th Ed., Pearson Education, 2007. ▸ 5. A.M. Goon, M.K. Gupta and T.S. Dasgupta, *An Outline of Statistical Theory* (Vol. II), 2nd Ed., The World Press Pvt. Ltd., 2000.	

Core 12 – Laplace Transform, Riemann Integration & Series of functions

Objectives: Theory and application of Laplace transformations, theory and concepts of Riemann integration and nature, convergence of series of functions and Fourier series will be discussed in this course.

Laplace Transform, Riemann Integration & Series of functions	
	6 Credits

Unit 1

Laplace Transform: Laplace of some standard functions, Existence conditions for the Laplace Transform, Shifting theorems, Laplace transform of derivatives and integrals, Inverse Laplace transform and their properties, Convolution theorem, Initial and final value theorem, Applications of Laplace transform to solve ODEs .

Unit 2

Riemann integration and Improper integral: inequalities of upper and lower sums, Darboux integration, Darboux theorem, Riemann conditions of integrability, Riemann sum and definition of Riemann integral through Riemann sums, equivalence of two definitions. Riemann integrability of monotone and continuous functions, properties of the Riemann integral, Fundamental theorem of Integral Calculus.

Improper integrals. Convergence of Beta and Gamma functions.

Unit 3

Series of functions: Pointwise and uniform convergence of sequence of functions. Theorems on continuity, derivability and integrability of the limit function of a sequence of functions.

Unit-4

Fourier series, Trigonometric Fourier series and its convergence

Reference Books

- 1. E. Kreyszig, *Advanced Engineering Mathematics*, John Wiley & Sons, 2011.
- 2. R.K. Jain and S.R.K. Iyenger, *Advanced Engineering Mathematics*, Narosa Publishing House, 2009.
- 3. F. B. Hildebrand, *Methods of Applied Mathematics*, Courier Dover Publications, 1992.
- 4. K.A. Ross, *Elementary Analysis, The Theory of Calculus*, Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004.
- 5. R.G. Bartle D.R. Sherbert, *Introduction to Real Analysis*, 3rd Ed., John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2002.
- 6. Charles G. Denlinger, *Elements of Real Analysis*, Jones & Bartlett (Student Edition), 2011.

Discipline Specific Electives Subjects Syllabus

DSE 1(a) – Linear Programming and Game Theory

Objectives: In this course, the students will be able to learn about various optimization techniques pertaining to linear programming and apply linear programming to problems arising from real life. Also, the students will learn the basic concepts of game theory through a problem solving approach.

Linear Programming and Game Theory	
	6 Credits
Unit 1	
Introduction to linear programming problem. Theory of simplex method, graphical solution, convex sets, optimality and unboundedness, the simplex algorithm, simplex method in tableau format, introduction to artificial variables, two-phase method. Big-M method	
Unit 2	
Duality, formulation of the dual problem, primal-dual relationships Transportation problem and its mathematical formulation, northwest-corner method, least cost method and Vogel approximation method for determination of starting basic solution, algorithm for solving transportation problem	
Unit 3	
Game theory: formulation of two person's zero sum game, solving two person zero sum game, games with mixed strategies	
Reference Books	
▸ Suresh Chandra, Jayadeva, Aparna Mehra, Numerical optimization with applications, Alpha Science. ▸ Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali, Linear Programming and Network Flows, 2nd Ed., John Wiley and Sons, India, 2004. ▸ F.S. Hillier and G.J. Lieberman, Introduction to Operations Research, 9th Ed., Tata McGraw Hill, Singapore, 2009. ▸ Hamdy A. Taha, Operations Research, An Introduction, 8th Ed., Prentice-Hall India, 2006. ▸ G. Hadley, Linear Programming, Narosa Publishing House, New Delhi, 2002.	

DSE 2(a) – Introduction to Integral equation and Dynamical system

Objectives: Preliminary idea about integral equation and dynamical system have been discussed here. The applications in real world problems have also been discussed in dynamical system.

Introduction to Integral equation and Dynamical system	
	6 Credits
Unit 1	
Introduction and basic Examples. Classification, Conversion to Volterra Equation to ODE, Conversion of IVP and BVP to Integral equation, Decomposition, Direct Computation, Successive Approximation, Successive substitution method for Fredholm Integral equations.	
Unit 2	
Successive approximation. Successive substitution method for Volterra integral equation	
Unit 3	
Formulation of physical system, Existence and uniqueness of solution of a dynamical system, linear system, solution of linear system, fundamental matrix, Fundamental matrices of non autonomous system.	
Reference Books	
▸ F.G Tricomi, Integral Equations, Dover Publications Inc. New York, 1985 ▸ D. Porter and D.S.G. Stirling, Integral Equations: A Practical Treatment from Spectral Theory to Applications, Cambridge University Press, 1990 ▸ N.I. Muskhelishvili, Singular Integral Equations, Dover Publications Inc., New York, 2008. ▸ G.C. Layek, An introduction to Dynamical Systems and Chaos, Springer, 2015. ▸ L.Perko, Differential Equations and Dynamical Systems, Springer, 2001. ▸ S.H. Strogatz, Non-linear Dynamics and chaos, CRC Press, 2017	