SYLLABUS

FOR

M.SC. IN MATHEMATICS
(UNDER CBCS SYSTEM)

A FOUR SEMESTERS COURSE

(Effective from the academic session 2020 – 2021 and onwards)

COOCH BEHAR PANCHANAN BARMA UNIVERSITY

COOCH BEHAR, WEST BENGAL

COOCH BEHAR PANCHANAN BARMA UNIVERSITY

Syllabus for M.Sc. in Mathematics
(Under CBCS system)

OBJECTIVE:

The duration of the Post Graduate course in Mathematics of Cooch Behar Panchanan Barma University will consist of two years with Semester-I, Semester-II, Semester-III and Semester-IV each of six months duration leading to Semester-I, Semester-II, Semester-III and Semester-IV examinations in Mathematics at the end of each semester.

Syllabus for the P.G. course in Mathematics under CBCS system is hereby framed following the guidelines of U.G.C. according to the following schemes and structures. All the students admitted to P.G. course in Mathematics shall take courses of Semester-I, Semester-II, Semester-III and Semester-IV.

SCHEME:

Total Marks = 1600 with 400 marks in each semester comprising of four papers in each semester with 100 marks in each paper. Out of the total marks 20% marks is allotted for Continuous Evaluation/Class test and 5% marks is allotted for regular attendance. In Semester-I, four core courses will be taught. In a similar manner, another four core courses will be taught in Semester-II.

All the written papers will be evaluated by internal examiners only. The Internal Assessment Tests (Continuous Evaluations) will be taken by the Department and all the internal members will evaluate the answer scripts on the respective papers/topics.

SEMESTER COURSE STRUCTURE OF M.Sc. (MATHEMATICS) under CBCS system

SYLLABUS for SEMESTER – I

SEMESTERS	PAPERS	TOPICS	MARKS (CREDIT)
Semester I	Core -1	Real Analysis	100 (5)
	Core - 2	Abstract Algebra	100 (5)
	Core - 3	Ordinary Differential Equations and Special Functions	100 (5)
	Core - 4	Classical Mechanics	100 (5)

PAPER WISE DISTRIBUTION OF MARKS

Sl. No.	Paper	Written	Class Test	Attendance	Total	Credit
1.	Core - 1	75	20	05	100	05
2.	Core - 2	75	20	05	100	05
3.	Core - 3	75	20	05	100	05
4.	Core - 4	75	20	05	100	05

SEMESTER I

Duration: 6 Months (Including Examinations)
Total Marks: 400, Total No. of Lectures: 70 Hours per paper

	Papers	Topics	Marks (Credit)
Semester I	Core - 1	Real Analysis	100 (5)
	Core - 2	Abstract Algebra	100 (5)
	Core - 3	Ordinary Differential Equations and Special Functions	100 (5)
	Core - 4	Classical Mechanics	100 (5)

Core - 1
REAL ANALYSIS
(70 LECTURES)

Bounded Variation:

Functions of Bounded Variation and their properties, Riemann- Stieltjes integrals and its properties, Absolutely Continuous Functions.

The Lebesgue Measure:

Lebesgue Measure: (Lebesgue) Outer measure and measure on R, Measurable sets form an σ-algebra, Borel sets, Borel σ - algebra, open sets, closed sets are measurable, Existence of a non-measurable set, Measure space, Measurable Function and its properties, Borel measurable functions, Concept of Almost Everywhere (a.e.), sets of measure zero, Steinhaus Theorem, Sequence of measurable functions, Egorov's Theorem, Applications of Lusin Theorem.

The Lebesgue Integral:

Simple and Step Functions, Lebesgue integral of simple and step functions, Lebesgue integral of a bounded function over a set of finite measure, Bounded Convergence Theorem, Lebesgue integral of non-negative function, Fatou's Lemma, Monotone Convergence Theorem. The General Lebesgue integral: Lebesgue Integral of an arbitrary Measurable Function, Lebesgue Integrable functions. Dominated Convergence Theorem. Convergence in Measure. Riemann Integral as Lebesgue Integral. Product measure spaces, Fubini's Theorem (applications only).

References:

1. Apostol, T.M., Mathematical Analysis, Narosa Publishing House, 2002.
2. Royden, H.L., Fitzpatrick P.M., Real Analysis, 4th Edition, Pearson.
3. Aliprantis, C.D., Burkinshaw, O., Principles of Real Analysis, Third Edition, Harcourt Asia Pvt. Ltd., 1998.

Further Reading:

1. Halmos, P.R., Measure Theory, Springer, 2007.
2. Rudin, W., Principles of Mathematical Analysis, Tata McGraw Hill, 2001.
3. Rudin, W., Real and Complex Analysis, McGraw-Hill Book Co., 1966.
4. Tao, T., An Introduction to Measure Theory, American Mathematical Society.
5. Kolmogorov, A.N., Fomin, S.V., Measures, Lebesgue Integrals, and Hilbert Space, Academic Press,
6. New York & London, 1961.
7. Rana, I.K., An introduction to Measure and Integration, Second Edition, Narosa.
8. Barra, G.D., Measure Theory and Integration, Woodhead Pub.
9. Kingman, J.F.C. and Taylor, S.J., Introduction to Measure and Probability, Cambridge University Press, 1966.
10. Cohn, D.L., Measure Theory, Birkhauser, 2013.
11. Wheeden, R.L. and Zygmund, A., Measure and Integral, Monographs and Textbooks in Pure and Applied Mathematics, 1977.
12. Sohrab, H.H., Basic Real Analysis, Birkhauser, 2003.

Core - 2

ABSTRACT ALGEBRA

(70 LECTURES)

Groups:

Review of basic concepts of Group Theory: Lagrange's Theorem, Cyclic Groups, Permutation Groups and Groups of Symmetry: S_n; A_n; D_n, Conjugacy Classes, Index of a Subgroup, Divisible Abelian Groups. Homomorphism of Groups, Normal Subgroups, Quotient Groups, Isomorphism Theorems, Cayley's Theorem.

Direct Product and Semi-Direct Product of Groups, Fundamental Theorem (Structure Theorem) of Finite Abelian Groups, Cauchy's Theorem, Group Action, Sylow Theorems and their applications. Solvable Groups (Definition and Examples only). Field extension, Galois' theory. Modules.

Rings:
Ideals and Homomorphisms, Prime and Maximal Ideals, Quotient Field of an Integral Domain, Polynomial and Power Series Rings. Divisibility Theory : Euclidean Domain, Principal Ideal Domain, Unique Factorization Domain, Gauss' Theorem, Irrudicibility of polynomials, Chinese remainder theorem.

References:

1. Dummit, D.S., Foote, R.M., Abstract Algebra, Second Edition, John Wiley & Sons, Inc., 1999.
2. Gallian, J., Contemporary Abstract Algebra, Narosa, 2011.
3. Herstein, I.N., Topics in Abstract Algebra, Wiley Eastern Limited.
4. Sen M.K., Ghosh S., Mukhopadhyay P., Topics in Abstract Algebra, Universities Press.

Further Reading:

1. Roman, S., Fundamentals of Group Theory: An Advanced Approach, Birkhauser, 2012.
2. Malik, D.S., Mordesen, J.M., Sen, M.K., Fundamentals of Abstract Algebra, The McGraw-Hill Companies, Inc, 1997.
3. Rotman, J., The Theory of Groups: An Introduction, Allyn and Bacon, Inc., Boston.
4. Rotman, J., A First Course In Abstract Algebra, Prentice Hall, 2005.
5. Pinter, Charles. C., A Book of Abstract Algebra, McGraw Hill, 1982.
6. Fraleigh, J.B., A First Course in Abstract Algebra, Narosa.
7. Jacobson, N., Basic Algebra, I & II, Hindusthan Publishing Corporation, India.
8. Hungerford, T.W., Algebra, Springer.
9. Artin, M., Algebra, Prentice Hall of India, 2007.
10. Goldhaber, J.K., Ehrlich, G., Algebra, The Macmillan Company, Collier-Macmillan Limited, London.
11. Gopalakrishnan, N.S., University Algebra, New Age International, 2005.

Core - 3

ORDINARY DIFFERENTIAL EQUATIONS & SPECIAL FUNCTIONS (70 LECTURES)

Ordinary Differential Equations:

Existence and Uniqueness:
First order ODE, Initial value problems, Existence theorem, Uniqueness, basic theorems, Ascoli Arzela theorem (statement only), Theorem on convergence of solution of initial value problems. Picard – Lindelöf theorem (statement only), Peano's existence theorem (statement only) and corollaries.

Boundary Value Problems for Second Order Equations:
Ordinary Differential Equations of the Strum-Liouville type and their properties, Application to Boundary Value Problems, Eigen values and Eigen functions, Orthogonality theorem, Expansion theorem. Green's function for Ordinary Differential Equations, Application to Boundary Value Problems.

Special Functions:

Singularities:
Fundamental System of Integrals, Singularity of a Linear Differential Equation. Solution in the neighbourhood of a singularity, Regular Integral, Equation of Fuchsian type, Series solution by Frobenius method.

Legendre Polynomials:
Legendre Functions, Generating Function, Legendre Functions of First & Second kind, Laplace Integral, Orthogonal Properties of Legendre Polynomials, Rodrigue's Formula.

Bessel Functions:
Bessel's Functions, Series Solution, Generating Function, Integral Representation of Bessel's Functions, Recurrence Relations, Asymptotic Expansion of Bessel Functions.

Hermite Polynomial:
Hermite equation and its solution, Generating function, Rodrigue's formula, Recurrence relations, Orthogonal Properties of Hermite Polynomials.

Lagurre polynomial:
Lagurre equation and its solution, Generating function, Recurrence relations, Orthogonal Properties of Hermite Polynomials.

Hypergeometric Function:
Hypergeometric Functions, Series Solution near zero, one and infinity. Integral Formula, Confluent Hypergeometric function, Integral representation of Hypergeometric function, Differentiation of Hypergeometric Function.

References:

1. Simmons, G.F., Differential Equations, Tata McGraw Hill.
2. Agarwal, Ravi P. and O' Regan D., An Introduction to Ordinary Differential Equations, Springer, 2000.

Further Reading:

1. Codington, E.A and Levinson, N., Theory of Ordinary Differential Equation, McGraw Hill.
2. Ince, E.L., Ordinary Differential Equation, Dover.
3. Estham, M.S.P., Theory of Ordinary Differential Equations, Van Nostrand Reinhold Compa.Ny, 1970.
4. Piaggio, H.T.H., An Elementary Treatise On Differential Equations And Their Applications, G. Bell And Sons, Ltd, 1949.

5. Hartman, P., Ordinary Differential Equations, SIAM, 2002.
6. Zill, D. G., Cullen, M.R., Differential Equations with Boundary Value Problems, Brooks/Cole, 2009.

Core - 4

CLASSICAL MECHANICS

(70 LECTURES)

Dynamical systems, Generalized coordinates, Degrees of freedom, Principle of virtual work. D'Alembert's principle. Unilateral and bilateral constraints. Holonomic and non-holonomic system. Lagrange's equations for holonomic systems. Lagrange's equation for impulsive forces and for systems involving dissipatative forces. Conservation theorems. Hamilton's principle and principle of least action. Hamilton's canonical equations. Canonical transformation with different generating functions. Lagrange and Poisson brackets and their properties. Hamilton-Jacobi equations and separation of variables. Routh's equations Poisson's identity. Jacobi-Poisson Theorem. Brachistochrone problem. Configuration space and system point.

Special theory of relativity, Galilean transformation, Basic postulates of relativity, Lorentz transformation, Consequences of Lorentz transformation, Relativistic momentum: variation of mass with velocity, relativistic force, work and energy.

Variation of functional, Necessary and sufficient conditions for extrema, Euler-Lagrange's equations and its Applications: Geodesic, minimum surface of revolution, Brachistochrone problem and other boundary value problems in ordinary and partial differential equations.

References:

1. Goldstein, H., Classical Mechanics, Dover.
2. Arnold, V.I.(Vogtmann, K., Weinstein, A.), Mathematical Methods of Classical Mechanics, Springer(GTM), 1989.

Further Reading:

1. Rana, N.C. and Jog, P.S., Classical Mechanics, Tata McGraw Hill..
2. Louis, N.H.and Finch, J.D., Analytical Mechanics.
3. Ramsay, A.S., Dynamics, Part-II.