Programme Information: M.Sc. in Mathematics
Dibrugarh University
Choice Based Credit System

The M.Sc. course in Mathematics consists of 4 semesters comprising of 100 credits in all. This is a post graduate programme combining both pure and applied oriented courses in Mathematics with Computer Laboratory courses offered by the faculty members of Department of Mathematics.

Objectives:

At the end of every programme, the students should:

- have a broad knowledge of mathematics and the techniques for solving problems in several areas, and the ability to apply those techniques with confidence.
- appreciate logical and precise arguments and the clear writing of mathematics.
- be able to use a variety of educational resources such as lectures, books, tutorial discussion, consulting lecturers, working together and (for nearly all students) electronic resources such as the Internet.
- have knowledge of the applications of mathematics in other subject(s) such as computer science, physics, biology, economics, experience of modeling situations in the 'real world' using mathematics.
- have an appreciation of the cultural and/or historical context of mathematics.

Admission:

Admission procedure, as framed by the University for all science departments is followed.

Eligibility:

Students who have completed their graduation from a recognized university with Mathematics as honours (a minimum of 45% of Marks) or as a subject in B.Sc. (a minimum of 50% of Marks) are eligible for admission. Quota for SC/ST and OBC/MOBC is according to the UGC rule.

Student intake:

The total intake is 40.

DEPARTMENT OF MATHEMATICS:: DIBRUGARH UNIVERSITY

Courses Structure of M.Sc. in Mathematics under Choice Based Credit System (CBCS)
Courses Structure for M.Sc. in Mathematics under Choice Based Credit System (CBCS) as approved by the Board of Studies in Mathematics 15.07.2013 and the Academic Council in its meeting held on _____.

The Post Graduate Programme in Mathematics shall be four semesters covering two academic years. A student has to register at least _____100_____ Credits in two academic sessions.

First Semester	:	20	Credit (Compulsory/Elective/ Optional)
Second Semester	:	20	Credits (Compulsory/Elective/ Optional)
Third Semester	:	20	Credits (Compulsory/Elective/ Optional)
Fourth Semester	:	20	Credits (Compulsory/Elective/ Optional)

The student shall have to opt two elective courses in the third semester and the same courses (Part II) shall have to be opted in the fourth semester.

Project Work	:	10	Credits (Extra Credit)
			(3 Credits in Third Semester and 7 Credits in Fourth Semester)

Semester	Course Code	Title of the Course	Credits - 4				Course Teacher
			L	T	P	Total	
COURSES							
---1st Semester	10100	Real Analysis	4	2		6	
	10200	Algebra - I	4	2		6	
	10300	Linear Algebra	4	2		6	
	10400	Tensor Analysis	5	2		7	
	10500	Differential Equations and Differential Geometry	4	2		6	
2nd Semester	20100	Complex Analysis	4	2		6	
	20200	Algebra - II	4	2		6	
	20300	Classical Mechanics	5	2		7	
	20400	Continuum Mechanics	4	2		6	
	20500	Functional Analysis	4	2		6	
3rd Semester	30100	Numerical Methods and Computer Programming (Core)	3	0	4	7	
	30200	General Topology (Core)	4	2		6	
	30300	Mathematical Methods (Core)	4	2		6	
	30400	Fluid Dynamics (Optional)	4	2		6	
	30500	Mechanics of Solids-I (Optional)	4	2		6	
	30600	Probability Theory and Statistics (Optional)	4	2		6	
	30700	Fuzzy Mathematics (Optional)	4	2		6	
	30800	Optimization Theory (Optional)	4	2		6	
	30900	Operations Research (Optional)	4	2		6	
4rth Semester	40100	Measure Theory (Core)	4	2		6	
	40200	Non-linear Dynamical Systems And Chaos (Core)	5	2		7	
	40300	Discrete Structure and Graph Theory (Core)	4	2		6	
	40400	Magnetohydrodynamics (Optional)	4	2		6	
	40500	Mathematical Modeling (Optional)	4	2		6	
	40600	Computational Fluid Dynamics (Optional)	4	2		6	
	40700	Mechanics of Solids-II (Optional)	4	2		6	
	40800	Operator Theory (Optional)	4	2		6	
	40900	Algebraic Topology (Optional)	4	2		6	
	41000	Algebraic Graph Theory (Optional)	4	2		6	
	41100	Theory of Modules (Optional)	4	2		6	
	41200	Algebraic Number Theory (Optional)	4	2		6	
	41300	Fields and Galois Theory (Optional)	4	2		6	

***** subject to the availability of teachers.

Note: L - Lecture of one hour duration per week,(assuming 15 weeks per semester); T - Tutorial; P - Practical

Project Work : 10 Credits (Extra Credit)

(3 Credits in Third Semester and 7 Credits in Fourth Semester)

It is not compulsory. Interested students may opt for the project work in addition to their compulsory Credits. In the third semester, the students have to submit a synopsis of their project which will carry 3 Credits and in the fourth semester, they have to submit their dissertation which will carry 7 Credits. If a student submits only the synopsis but no dissertation, he or she will not be awarded the Credit for the synopsis alone. However, it is to be mentioned that this Extra Credit shall not be counted for any gradation and/or ranking of the students in his / her M. Sc. result. Evaluation of the project work will be done in terms of Letter Grades and provision will be made in the Marks Sheet as well.

NEW(proposed) SYLLABUS M.A./M.Sc. IN MATHEMATICS

DIBRUGARH UNIVERSITY
(Effective from 2013)

SEMESTER –I

MATH 10100 Real Analysis
MATH 10200 Algebra –I
MATH 10300 Linear Algebra
MATH 10400 Tensor Analysis
MATH 10500 Differential Equations and Differential Geometry

SEMESTER –II

MATH 20100 Complex Analysis
MATH 20200 Algebra –II
MATH 20300 Classical Mechanics
MATH 20400 Continuum Mechanics
MATH 20500 Functional Analysis

SEMESTER –III

MATH 30100 Numerical Methods and Computer Programming
MATH 30200 General Topology
MATH 30300 Mathematical Methods

Optional Papers

MATH 30400 Fluid Dynamics
MATH 30500 Mechanics of Solid
MATH 30600 Probability Theory and Statistics

MATH 30700 Fuzzy Mathematics
MATH 30800 Optimization Theory
MATH 30900 Operations Research

SEMESTER –IV

MATH 40100 Measure Theory
MATH 40200 Nonlinear Dynamical systems and Chaos
MATH 40300 Descrete Structure and Graph Theory

Optional Papers

MATH 40400 Magnetohydrodynamics
MATH 40500 Mathematical Modelling
MATH 40600 Computational Fluid Dynamics
MATH 40700 Mechanics of Solid – II

MATH 40800 Operator Theory
MATH 40900 Algebraic Topology
MATH 41000 Algebraic Graph Theory
MATH 41000 Theory of Modules
MATH 41000 Algebraic Number Theory
MATH 41000 Fields and Galois Theory.

Department of Mathematics							*Dibrugarh University*
Title of the Course		**Real Analysis**			**Paper Number**		**10100**
Category	**Core**	**Year**	**1**	**Credits**	**4**	**Course Code**	**MATH**
		Semester	**I**				
Instructional Hours (Per week)		**Lecture**		**Tutorial**	**Lab Practical**		**Total**
		4		**2**			**6**
Objectives of the Course		***To build up a strong analytical foundation of the basic Real Analysis***					
Course Outline		**Unit 1: Revision** **Marks 12** Elementary set theory, finite, countable and uncountable sets, Real number system as a complete ordered field, Archimedean property, supremum and infimum. Sequences and series, convergence, limsup, liminf, Continuity, uniform continuity. **Unit 2: Sequences** **Marks 12** Sequences and series of functions, Pointwise and uniform convergence, Monotonic functions, types of discontinuity, Absolute Convergence, functions of bounded variation, Continuous functions of bounded variation. **Unit 3: Functions of Several Variables** **Marks 12** Linear Transformations, Differentiations, The Contraction principle, Inverse Function Theorem, Implicit function theorem, Rank Theorem, Determinants, Derivatives of Higher order. **Unit 4: Riemann-Stieltjes Integral** **Marks 12** Riemann-Stieltjes integrals, The R-S integral as a limit of sum, Classes of R-S integrable functions, Algebra of R-S integrable functions, Relation between Riemann and Riemann-Stieltjes integral. **Unit 5: Metric spaces** **Marks 12** Metric spaces, compactness, completeness, Bolzano Weierstrass theorem, Heine Borel theorem; connectedness and continuity, Spaces of continuous functions as examples.						
Recommended Text		1. R.G. Bartle and D.R. Sherbert : Introduction to Real Analysis, Wiley India, 3rd Ed. 2005 (For Unit 1 and 2). 2. W. Rudin, Principles of Mathematical Analysis, Mc-Graw Hill, 2000 (For Unit 3). 3. T.M. Apostol: Mathematical Analysis, Narosa Publishing House, 2008 (For Unit 3 and 4). 4. G.F. Simmons: Introduction to Topology and Modern Analysis, TMGH, 1963 (For Unit 5).					
Reference Books		1. Kaczor and Nowak : Problems in Mathematical Analysis I, II, AMS, 2000.					
Website and E-learning Source		http:/www.mathforum.org, http:/opensource.org					

Department of Mathematics							*Dibrugarh University*
Title of the Course		**Algebra-I**			**Paper Number**		**10200**
Category	**Core**	**Year**	**1**	**Credits**	**4**	**Course Code**	**MATH**
		Semester	**I**				
Instructional Hours (Per week)		**Lecture**		**Tutorial**	**Lab Practical**		**Total**
		4		**2**			**6**
Objectives of the Course							
Course Outline		**UNIT-I:** **Marks 15** A brief review of groups, their properties and examples, subgroups, isomorphism theorems ,symmetric, alternating and dihedral groups **UNIT-II:** **Marks 15** The class equation of finite groups, Sylow theorems, Direct products of groups **UNIT-III:** **Marks 15** Nilpotent and Solvable Groups, Normal and Subnormal Series **UNIT-IV:** **Marks 15** Rings and Homomorphism, Ideals and Quotient Rings, Field of quotients of an Integral Domain					
Recommended Text		1. I.N.Herstein: *Topics in Algebra*, Wiley Eastern Ltd., New Delhi, 1975 2. Thomas W.Hungerford, *Algebra,* Springer-Verlag, New york, 1974					
Reference Books		1. D.S. Dummit, R.M. Foote: Abstract Algebra –John Wiley&Sons,2003 2. P.B. Bhattacharya, S.K. Jain and S.R. Nagpaul: *Basic Abstract Algebra* (2nd Edition), Cambridge University Press, Indian edition, **1997**					
Website and E-learning Source							

Department of Mathematics							*Dibrugarh University*
Title of the Course		**Linear Algebra**			**Paper Number**		**10300**
Category	**Core**	**Year**	**1**	**Credits**	**4**	**Course Code**	**MATH**
		Semester	**I**				
Instructional Hours (Per week)		**Lecture**		**Tutorial**	**Lab Practical**		**Total**
		4		**2**	**----**		**6**
Objectives of the Course							
Course Outline		**Unit - I** **Marks : 12** Systems of linear equations, Vector Space, Linear Span, Bases and dimensions, change of bases, sums and direct sums. **Unit - II** **Marks : 12** Linear transformations, matrix representations of linear transformations, the rank and nullity theorem, Linear Operators and Eigenvectors, Diagonalization. **Unit – III** **Marks : 12** Dual spaces, transposes of linear transformations, invariant subspaces, Annihilators, the minimal polynomial, Jordan canonical form. **Unit – IV** **Marks : 12** Orthogonal Transformations, Unitary Transformations, The Principal Axis Theorem, Quadratic form. **Unit – V** **Marks : 12** Inner product spaces, orthonogonal bases, Gram-Schmidt process.				
Recommended Text		1. Hoffman and R. Kunze, *Linear Algebra*, Prentice-Hall of India, 1996. 2. P.K. Saikia, *Linear Algebra*, Prentice Hall, 2006. 3. C.W. Curtis, *Linear Algebra An Introductory Approach*, Springer, 1984.					
Reference Books		1. G. Schay, *Introduction to Linear Algebra*, Narosa, 1997. 2. G. Strang,*Linear Algebra and Its Applications*, Nelson Engineering, 4th Edn., 2007. 3. S. Axler, Linear Algebra Done Right, 2nd Edition, Springer, 1997. 4. Otto Bretscher, Linear Algebra with Applications, PH International, 1997.					
Website and E-learning Source		http://www.algebra.com					

Department of Mathematics						*Dibrugarh University*
Title of the Course:		**Tensor Analysis**			**Paper Number**	**10400**
Category	**Core**	**Year**	**1**	**Credit**	**4**	**Course Code**	**MATH**
		Semester	**I**				
Instruction Hours (Per week)		**Lecture**		**Tutorial**		**Lab Practical**	**Total**
		5		**2**		0	**7**
Objectives of the Course		***To build a strong foundation for Tensor Analysis for its application in Continuum Mechanics, Fluid Dynamics, MHD, Classical Mechanics etc.***					
Course outline		**UNIT –1 : Cartesian Tensor Algebra: Marks-18** Scalars**,** vectors and Tensors; Sufiix Notation, Cartesian summation convention, Kronecker delta, Permutation symbols, Matrices and determinants in Index notation, scalar multiplication, Cartesian Vector, Addition of vectors-coplanar vectors, Unit vectors, A basis of non-coplanar vectors, Scalar product-orthogonality, Vector product, Triple scalar product, Triple vector product, Reciprocal base system, Second order tensors, Examples of second order tensors, Scalar multiplication and addition, Contraction and multiplication, The vector of an antisymmetric tensor, Canonical form of a symmetric tensor, Higher order tensors, The quotient rule, Isotropic tensors. **UNIT–2 : Cartesian Tensor Calculus: Marks-06** Cartesian tensor notations for :Tensor function of time-like variables, Line integrals, Surface integrals, volume integrals, Change of variable with multiple integrals, Vector fields, The Vector operator ∇ -Gradient of a scalar, The divergence of a vector field, The curl of a vector field, Green's theorem and some of its variants, Stokes theorem. **UNIT : 3 General Tensors: Marks 18** Coordinate systems and conventions, Proper transformations, Contravariant vectors, Covarient vectors, The metric tensor, Examples, Absolute and relative tensor fields, Isotropic tensor, Tensor algebra, The quotient rule, Length of a vector and angle between vectors, Principal directions of a symmetric second order tensor, Covariant and contravariant base vectors, The physical components of a vector, The physical components of a tensor, **UNIT - 4 Marks 18** Differential of tensors, Parallel vector field, Christoffel symbols, Christoffel symbols in orthogonal coordinates, covariant differentiation, The grade, divergence,Laplacian and curl, Green's and Stoke's theorem in general tensor notation, Euclidean and other spaces . Intrinsic derivatives and its applications.					
Recommended Text		1. *Vectors, Tensors and the Basic Equations of Fluid Mechanics* Author: Rutherford Aris Dover Publication, Inc., New York. ISBN 0-486-66110-5 2. *Vector and Tensor Analysis,* Author Bosenko Tarapov Silverman, ISBN 10:0486638332, Dover Publication 3. *Vector Analysis and an Introduction to Tensor Analysis*, Authors : Seymour Lipschutz, Dennis Spellman and Murray R Spiegel, Schaum Outline Series, Tata Megraw Hill Education Pvt. Ltd., New Delhi.					
Reference Books		1. *Vector and Tensor Analysis,* Author : Utpal Chaterjee and Nandini Chaterjee Academic Publishers. 2. *Introduction to Tensor Calculus and Continuum Mechanics* by J. H. Heinbockel 3. *Tensor Calculus*, Author Barry Spain, Radha Publishing House, Calcutta. 4. *Continuum Mechanics* by D.S. Chandrasekharaiah, Lokenath Debnath, Prism Books Pvt. Ltd., Bangalore - India					
Website and E-learning Source		http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.algebra.com					

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<tr><td colspan="8">Department of Mathematics Dibrugarh University</td></tr>
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<tr><td colspan="2">Title of the Course</td><td colspan="3">Differential Equations and Differential Geometry</td><td colspan="2">Paper Number</td><td>10500</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">core</td><td>Year</td><td>1</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2">MATH</td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours (Per week)</td><td colspan="2">Lecture</td><td>Tutorial</td><td>Lab Practical</td><td>Total</td></tr>
<tr><td colspan="2">4</td><td>2</td><td>0</td><td>6</td></tr>
<tr><td colspan="2">Prerequisites for the Course</td><td colspan="6">Knowledge of Partial Differential Equations of First Order is essential. Knowledge of Curves and Surfaces are essential.</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">The students will learn the governing mathematical formulations and their solutions of various physical problems. Knowledge on geometric properties of various functions is expected.</td></tr>
<tr><td colspan="2">Course outline</td><td colspan="6">Differential Equations
Unit – 1 : Partial Differential Equations of Second Order Marks - 15
Liner partial differential equations of second order with constant co-efficient, Characteristic curves of second–order equations, Reduction to canonical forms, Separation of variables, Solutions of nonlinear equations of the second order by Monge’s method.

Unit – 2 : Laplace’s Equation, Wave Equation, Diffusion Equate Marks - 15
The occurrence of Laplace’s equation in Physics, Boundary value problems, Solution of Laplace’s equation by separation of variables,. The theory of Green’s function for Laplace’s equation, The occurrence of the Wave equation in Physics, Elementary solutions of the one-dimensional Wave equation, The occurrence of the Diffusion equation in Physics, Elementary solutions of the Diffusion equation, Solution of the Diffusion equation by separation of variables.

Differential Geometry
Unit – 3 : Curves in Space Marks - 8
Parametric equation of a curve, Contact of curves, Tangent vector, Curvature, Principal normal, Binormal, Torsion, Locus of centre of curvature, Screw curvature, Serret-Frenet formula, Theorem on uniqueness, Helics,

Unit – 4 : Envelopes and Fundamental magnitudes Marks - 14
Equation of a surface, Tangent plane and normal, envelopes, Edge of regression, Developable surfaces Curvilinear coordinates on a surface, First order magnitudes, Direction of a surface, Second order magnitudes, Derivative of n, curvature of normal section, Meunier’s theorem.

Unit – 5 : Curves on a Surfaces Marks - 8
Principal directions, First and second curvature, Euler’s theorem, conjugate directions, Asymptotic lines.</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="6">1. Elements of Partial Differential Equations by Ian. N. Sneddon, McGraw Hill Book Company.
2. Differential Geometry by Weathernbern Radha Publishing House.</td></tr>
<tr><td colspan="2">Reference Books</td><td colspan="6">1. Introduction to Partial Differential Equations by K.S. Rao, PHI Pvt. Ltd, New Delhi, 2005
2. Partial Differential Equations by K.S. Bhamra, PHI Pvt. Ltd, New Delhi, 2010
3. Three Dimensional Differential Geometry by B. Lal, Atma Ram & Sons, New Delhi, 1969
4. Differential Geometry by Eisen Hart, Princeton University Press.</td></tr>
<tr><td colspan="2">Website and E-learning Source</td><td colspan="6">http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org</td></tr>
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<tr><td colspan="8">Department of Mathematics Dibrugarh University</td></tr>
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<tr><td colspan="2">Title of the Course</td><td colspan="3">Complex Analysis</td><td colspan="2">Paper Number</td><td>20100</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>1</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td>Course Code</td><td>MATH</td></tr>
<tr><td>Semester</td><td>II</td><td></td><td></td></tr>
<tr><td colspan="2">Instructional Hours (Per week)</td><td colspan="2">Lecture</td><td>Tutorial</td><td colspan="2">Lab Practical</td><td>Total</td></tr>
<tr><td colspan="2"></td><td colspan="2">4</td><td>2</td><td colspan="2"></td><td>6</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6"></td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="6">Unit 1 : Revisions Marks 12
Functions of Complex variables, Mappings by exponential functions, limits, continuity, derivatives, Cauchy-Riemann equations, Analytic functions, Harmonic functions, Reflection principles, basic properties of Complex Integration, Cauchy's Theorem, Morera's Theorem, Cauchy Integral formula, Laurent's series, The Maximum modulus principle, Schewarz lemma, Liouville's theorem.

Unit 2 : Elementary functions Marks 12
The exponential functions, logarithmic function, Branches and derivatives of logarithm, Complex exponents, Trigonometric functions, Hyperbolic functions, Inverse trigonometric functions.

Unit 3 : Series Marks 12
Convergence of sequences, Convergence of series, Taylor series, Laurent Series, Absolute and uniform convergence of Power series, Uniqueness of series representation.

Unit 4 : Calculus of Residues Marks 12
Residue at a finite point, Residue at the point at infinity, Residue Theorem, Number of zeros and poles, Argument principle, Rouche's theorem, evaluation of Integrals.

Unit 5 : Conformal Mapping Marks 12
Linear Transformation, Linear fractional transformation, mappings of upper half plane, The transformation w = sin z; mappings by z^2 and Branches of $z^{1/2}$, square roots of polynomials, preservation of angles, scale factor, local inverses, harmonic conjugates, transformation of harmonic functions, Applications.</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="6">1. T.M. Apostol, Mathematical Analysis, Narosa Pub.

2. W. Rudin, Real and Complex Analysis, McGraw-Hill

3. J.C. Brown and R.V. Churchill, Complex Variables and Applications, Mc-Graw Hill.

4. Classical Complex Analysis – Lian-Shin Hahm and Bernard Epstein – Jones and Bartlett,-Learning. Sarma Books, Ambikagiri Nagar, Rongkimi Path, Ghy – 24</td></tr>
<tr><td colspan="2">Reference Books</td><td colspan="6">1. Complex Analysis, V.Karunakaran, Narosa Publication.
2. S. Ponuswami, Foundations of Complex Analysis, Narosa Publication.</td></tr>
<tr><td colspan="2">Website and E-learning Source</td><td colspan="6"></td></tr>
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Department of Mathematics							*Dibrugarh University*
Title of the Course		**Algebra-II**			**Paper Number**		**20200**
Category	**Core**	**Year**	**I**	**Credits**	**4**	**Course Code**	**MATH**
		Semester	**II**				
Instructional Hours (Per week)		**Lecture**		**Tutorial**	**Lab Practical**		**Total**
		4		**2**			**6**
Objectives of the Course							
Course Outline		**UNIT-I:** **Marks 15** Unique factorization domain, Principal Ideal Domain, Euclidean Domain **UNIT-II:** **Marks 15** Polynomial rings- Polynomials over the rational field – Polynomial rings over Commutative rings **UNIT-III:** **Marks 15** Algebraic Extensions of Fields, Adjunction of roots, Algebraic extensions, Algebraically closed fields **UNIT-IV:** **Marks 15** Splitting fields, Normal extensions, Multiple roots, finite fields , Separable extensions					
Recommended Text		1. I.N.Herstein: Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975 2. P.B. Bhattacharya, S.K. Jain and S.R. Nagpaul: Basic Abstract Algebra (2nd Edition), Cambridge University Press, Indian edition, **1997**					
Reference Books		1.D.S. Dummit, R.M. Foote: Abstract Algebra –John Wiley&Sons,2003 2. Thomas W.Hungerford, Algebra, Springer-Verlag, New york, 1974					
Website and E-learning Source							

Department of Mathematics							*Dibrugarh University*
Title of the Course		**Classical Mechanics**			**Paper Number**		**20300**
Category	**core**	**Year**	**1**	**Credits**	**4**	**Course Code**	**MATH**
		Semester	**II**				
Instructional Hours (Per week)		**Lecture**		**Tutorial**		**Lab Practical**	**Total**
		5		**2**			**7**
Objectives of the Course		**The learner will be able to learn the mathematical formulations of various mechanical problems**					
Course outline		**Unit 1:** **Marks 15** Introduction to the ideas of constrained motion, Different classifications of constrains of motion, Holonomic and nonholonomic constraints, rhenomic and scleronomic dynamical constraints, Concept of degree of freedom. Introduction to generalized coordinates, generalized velocities, Total Kinetic energy of a system of particles in terms of generalized velocity. Introduction to generalized momenta and generalized force. D'Alemberts principle and Lagrangian form of equation motion of a dynamical system of N particles. Few examples to explain the application of Lagrange's form of equation of motion, motion of projectile of a particle, motion of double pendulum and similar few other simple problems. **Unit II:** **Marks 30** Introduction to Technique of Calculus of variation : Euler's Lagrange differential equation, discussion of examples to explain the application of Euler's Lagrange differential equation, Brchistochrone problem, problem of shortest distance between two points on plane. Introduction of Hamilton's Principle of least action. Derivation of Lagrange's form of equation of motion using Hamilton's principle of least action. Lagranges form of equation for problems associated with nonholonomic constrains, conservation principles and symmetry properties, Lagranges, equation of motion for small oscillations. Introduction to phase space and Equationian : Hamilton's canonical equation of motion, canonical variables, cyclic co-ordinates, Canonical transformations and generating functions, Discussion on problem of motion of simple pendulum, double pendulum, motion of particle in a Use of Hamilton' canonical equation to solve certain simple dynamical problems (these includes all problems considered to explain use of Lagrange equatin of motions). Lagranges and Poissons's brackets: Integral invariant of Poincare, The Jacobi's identity, Hamilton's equation and Poison' bracket. Lagranges brackets, poison bracket, integral invariant of Poincare, the Jacobi's identity, Poisson's bracket and Hamilton's canonical equations. **Unit III:** **Marks 15** Hamilton Jacobi Method : Hamilton - Jacobi equation, Time independent Hamilton - Jacobi equation, canonical transformation generated by Hamilton characteristic function, application of Hamilton - Jacobi equation in solving problems of mechanics. Action and angle variables, regular frequencies, costant action torus in phase space, periodic systems, degenerated systems, completely degenerated systems.						
Recommended Text		1. Classical Mechanics by Herbert Goldstein, Addision Wesley Publishing Company, INC. USA. 2. Lagrangian and Hamiltonian Mechanics by M.G. Calkin, World Scientific, Singapore. 1996					
Reference Books		1. Modern approach to mechanics					

Website and E-learning Source	http://mathforum.org , http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org

Department of Mathematics						***Dibrugarh University***	
Title of the Course		**Continuum Mechanics**			**Paper Number**		**20400**
Category	**Core**	**Year**	**1**	**Credits**	**4**	**Course Code**	**MATH**
		Semester	**II**				
Instructional Hours (Per week)		**Lecture**		**Tutorial**	**Lab Practical**		**Total**
		4		**2**			**6**
Objectives of the Course		**The learner will be able to derive the basic principles of Continuum Mechanics in fluid flow problems.**					
Course Outline		**Unit-1: Continuum Hypothesis and Stress** **Marks 14** Continuum hypothesis, mass and density, body force and surface force, stress components, Cauchy's law, state of stress at a point, stress tensor, normal and shear stresses, principal stress, stress invariants, stress deviator, boundary condition for stress tensor. **Unit-2: Deformation and Strain** **Marks 14** Continuum configuration, Lagrangian and Eulerian description, material and spatial co-ordinates, deformation, displacement and deformation gradients, stretch and rotation tensor, strain tensor, strain-displacement relations, infinitesimal strain tensor, interpretation of linear strain tensor, compatibility conditions, principal strains, strain deviator. **Unit-3: Motion and Fundamental Laws of Continuum Mechanic** **Marks :16** Material and local time derivatives, velocity and acceleration, steady, uniform and linear motion, irrotational motion and potential flow, path lines, streamlines and vortex lines, Reynolds transport theorem, circulation and vorticity, conservation of mass, continuity equation, linear momentum principle, equation of motion, angular momentum principle, general solution of the equation of equilibrium, energy equation. **Unit-4: Equation of Fluid Mechanics** **Marks: 16** Viscous and inviscid fluids, viscous stress tensor, fluid pressure, incompressible and compressible fluids, Euler's equation of motion, Bernoulli's equation, circulation theorem, Stokes's condition, governing equations for a viscous fluid flow, initial and boundary conditions, Navier-Stokes equation.					
Recommended Text Book		1. CONTINUUM MECHANICS by D. S. Chandrasekharaiah and Lokenath Debnath, PRISM BOOKS PVT. LTD., Bangalore. 2.MATHEMATICAL THEORY OF CONTINUUM MECHANICS by Rabindranath Chatterjee, Narosa Publishing House.					
Reference Books		1.SCHAUM'S OUTLINE OF THEORY AND PROBLEMS OF CONTINUUM MECHANICS by George E. Mase., SCHAUM'S OUTLINE SERIES, McGraw-Hill. 2.VECTORS, TENSORS AND BASIC EQUATIONS OF FLUID MECHANICS by Rutherford Aris, DOVER PUBLICATIONS, INC., New York.					
Website and E-learning Source							

Department of Mathematics						*Dibrugarh University*
Title of the Course		**Functional Analysis**			**Paper Number**	**20500**
Category	**core**	**Year**	**1**	**Credits**	**4**	**Course Code**	**MATH**
		Semester	**II**				
Instructional Hours (Per week)		**Lecture**		**Tutorial**		**Lab Practical**	**Total**
		4		**2**			**6**
Objectives of the Course		***The learner will be able to relate the Topological and Algebraic properties in various structures.***					
Course outline		**Prerequisite :** Analysis, Set, Function, Countable Set, Uncountable Set, Cardinality and Inequalities linear Algebra, Vector Space, Linear Transformation between Vector Spaces. Metric Space, Definitions and Examples, Open Set, Close Set, Neighbourhood, Basic Topology, Continuity and Equivalent Metrics, Compactness, Sequences, Convergence, Cauchy Sequences and Completeness, Completion of Metric Spaces **Unit 1: Normal and Banach Space Marks 15** Normed Space , Definition and Properties, Banach Space, Definition Properties, Finit Dimensional Mormed Spaces and Subspaces, Compactness and Riesz's Lemma, Quotient Spaces, Series in Normed Space, Absolutely Convergence Series in Normed Spaces, Operators, Fixed Point Theorem, Contraction Mappings Principle and Applications. **Unit 2 : Bounded Linear Operators/Functionals Marks 15** Linear operators, Bounded Linear Operator, Spaces of Bounded Linear Operators, Inverse Operators, Continuous Linear Operator, Open Mapping Theorem, Closed graph Theorem and their Consequences, Uniform Boundedness Principal, Linear Functional, Linear Functional on Finite Dimensional Space, , Hanh-Banach Theorem and its Consequences. **Unit 3: Banach Algebra Marks 15** Algebra, Normed Algebra, Definition and Properties, Banach Algebra, Definition and Properties, The Gelfand-Mazur Theorem, Homomorphism, Isomorphism, Units, Regular Points, Non-Regular Points, Spectrum, Eigen value and Eigen Vector of an operator, **Unit 4: Hilbert Space Marks 15** Inner Product Space, Swartz Inequality, Hilbert Space, Isomorphic Hilbert Spaces, Orthogonal and Orthonormal Sets, Gram-Schmidt Orthogonalization Process, Parallelogram Law, Fourier Coefficient, Riez-Fischer Theorem , Total Sets, Parseval's Theorem, Orthogonal Sum, Operators On Hilbert Spaces: Adjoint of a Bounded Linear Operator**,** Self-Adjoient Operator.					
Recommended Text		1. *Introductory Functional Analysis with Applications* by E. Kreyszing John Wiley & Sons.. 2. *Foundation of Functional Analysis* by S. Ponnusamy, Narosa Publishing House. 3. *Functional Analysis* by P.K. Jain, O.P. Ahuja, K. Ahmed, New Age International (P) Limited 4. *Banach Algebras* by W. Zelazko, Elsevier publishing Company.					
Website and E-learning Source		http://mathforum.org http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org					

Department of Mathematics							*Dibrugarh University*
Title of the Course		**Numerical Methods and Computer Programming**			**Paper Number**		**30100**
Category	**Core**	**Year**	**2**	**Credits**	**4**	**Course Code**	**MATH**
		Semester	**III**				
Instructional Hours (Per week)		**Lecture**		**Tutorial**	**Lab Practical**		**Total**
		3			**4**		**7**
Objectives of the Course		***Learners will be able to solve physical problems using numerical methods through C-Programming***					
Course Outline		**Section A: Numerical Methods** **Unit 1 : Solution of system of equations : Marks 9** Doolittle and Crout's Decomposition , Successive approximation by Gauss Jacobi and Gauss Seidal Methods, Newton's method, Convergence of successive approximations. **Unit 2 : Solution of Ordinary Differential Equations : (Single Step Methods) Marks 9** Stability and Convergence of numerical methods, Runge-Kutta method of second, third and fourth order. **Unit 3: Predictor-Corrector Methods** : **Marks 9** General explicit method, Adam's-Bashforth method, Nystrom method, general implicit methods, Adam's Moultan and Milne-Simpson predictor-corrector methods					
Recommended Text		1. M.K. Jain, *Numerical Solutions of Differential Equations*, Wiley Eastern. 2. E.V. Krishnamurthy and S.K. Sen, *Numerical Algorithms*, Prentice Hall of India.					
Reference Books		1. F.B. Hilderbrand, *Elementary Numerical Analysis*, Tara McGraw Hills. 2. S.D. Conte, *Elementary Numerical Analysis*, Tata McGraw Hills.					
Website and E-learning Source		http://mathform.org.http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org.					

Course Outline	**Section B: C-Programming** **Unit 1 : Programme solving technique and C-Programming preliminaries Marks 9** Algorithm, flow charts, top down and bottom up approach, data types, operators, input-data statements in C, simple C programmes. **Unit 2 : Array, Pointer and Data Files Marks 9** Arrays to functions, pointers, operations on pointers, array using pointers, opening and closing data files, creation of a data file, processing of data file. **Section B : Practical Marks 15** Based on Section A and Section B
Recommended Text	1. B.S. Gottfried, *Programming with C*, Tata McGraw Hills. 2. R.G. Dromey, *How to solve it by Computers*, Prentice Hall 3. M.K. Jain, Numerical Solution of Differential Equations, Willey Eastern.
Reference Books	1. F. B, Hilderbrand, *Elementary Numerical Analysis*, Tara McGraw Hills. 2. S.D. Conte, *Elementary Numerical Analysis*, Tata McGraw Hills. 3. Y.P. Kanetkar , *Let us C*, BPB Publication. 4. E. Balaguruswamy, *Programming in C*, Tata Mc.Grew Hilsl. 5. E.V. Krishnamurthy, S.K. Sen, *Numerical Algorithms*, Prentice Hall of India. 6. J.B. Scarborough, *Numerical Mathematical Analysis*, Mc Grew Hill.
Website and E-learning Source	http://mathform.org.http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org.

Department of Mathematics							*Dibrugarh University*
Title of the Course		**General Topology**			**Paper Number**		**30200**
Category	**Core**	**Year**	**2**	**Credits**	**4**	**Course Code**	**MATH**
		Semester	**III**				
Instructional Hours (Per week)		**Lecture**		**Tutorial**	**Lab Practical**		**Total**
		4		**2**	**----**		**6**
Objectives of the Course		***Pre-requisite : Basic knowledge of metric space and continuity***					
Course Outline		**Unit 1: Basis** **Marks 15** Open Sets, Closed Sets, Neighbourhood, Limit Point, Interior, Closure, Basis, Sub-basis, finer and coarser topology, Subspace. **Unit 2:Continuity** **Marks 15** Continuous Functions, Open Functions, Closed Functions, Homoemorphism, Composition of Continuous Functions, Pasting Lemma, Product Topology, Quotient Topology. **Unit 3 : Compactness and Connectedness** **Marks 15** Compact Space, Countable Compact Spaces, Linderloff Space, Local Compactness, Connectedness, Path Connectedness , Local Connectedness,. **Unit 4: Separation Axiom and Countability :** **Marks 15** T_i (i = 1, 2, 3, 4, 5) spaces, Regular and Complete Regular Spaces, Normal Spaces, First and Second Countable Spaces, Separable Space.					
Recommended Text		1. Topology – A first course by J.R. Munkres, Prentice- Hall. New Delhi.					
Reference Books		1. *Introduction to Topology and Modern Analysis* by G.F. Simmons, Tata McGraw Hill, New Delhi. 2. *Schaum's Outlines General Topology* by S. Lipschutz, Tata McGraw Hill, New Delhi 3. *A Text Book of Topology* by B.C. Chatterjee, M.R. Adhikari, S. Ganguly. Asian Books Pvt. Ltd., New Delhi. 4. *General Topology* by S. Nande, S. Nanda, MacMillan India Ltd., New Delhi					
Website and E-learning Source		http://mathform.org.http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org.					

Department of Mathematics							*Dibrugarh University*
Title of the Course		**Mathematical Methods**			**Paper Number**		**30300**
Category	**Core**	**Year**	**2**	**Credits**	**4**	**Course Code**	**MATH**
		Semester	**III**				
Instructional Hours (Per week)		**Lecture**		**Tutorial**	**Lab Practical**		**Total**
		4		**2**			**6**
Objectives of the Course		***The learner is expected to know the differential equations.***					
Course Outline		**Unit 1 : Fredholm Integral Equations** **Marks – 10** Definition of Integral Equation, Eigen values and Eigen functions : Reduction to a system of algebraic equations, Reduction of ordinary differential equations into integral equations. Fredholm integral equations with separable kernals, Method of successive approximations, Iterative scheme for Fredholm Integral equations of second kind, Conditions of Uniform convergence and uniqueness of series solution. **Unit 2 : Voltera Integral Equations :** **Marks – 10** Voltera Integral Equations of second kind, Resolvant kernel of Voltera equation and its results, Application of iterative scheme to Voltera integral equation of the second kind. Convolution type kernals. **Unit 3 : Fourier Transform :** **Marks – 10** Fourier Integral Transform, Properties of Fourier Transform, Fourier sine and cosine transform, Application of Fourier transform to ordinary and partial differential equations of initial and boundary value problems. Evaluation of definite integrals. **Unit 4 : Calculus of Variation with one independent variable : Marks – 15** Basic ideas of calculus of variation, Euler's equation with fixed boundary of the functional $$I[y(x)] = \int_a^b f(x, y, y')\, dx$$ containing only the first order derivative of the only dependent variable with respect to one independent variable. Variational problems with functional having higher order derivatives of the only dependent variable, applications. **Unit 5 : Calculus of Variation with several independent variables :** **Marks – 15** Variational problems with functional dependent on functions of several independent variables having first order derivatives, Variational problems in parametric form, variational problems with subsidiary condition (simple case only), Isoperimetric problems, Applications.					
Recommended Text		1. R.P. Kanwal : *Linear Integral Equations, Theory and Techniques*, Academic Press, New York 1971. 2. M.R. Spiegel : *Theory and Problems of Laplace Transform.* 3. A.S. Gupta : *Calculus of Variation with Applications* : Prentice Hall of India (1999).					
Reference Books		1.S.G. Mikhlin : *Linear Integral Equations*, (Translated from Russian), Hindustan Book Agency, 1960 2. Hilderbrand : *Methods of Applied Mathematics.* 3. Raisinghania : *Integral Transforms.* 4. R. Courant and D. Hilbert : *Methods of Mathematical Physics*–Vol-I, Wiley Interscience, New York 1953.					
Website and E-learning Source		http://mathform.org.http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org.					

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<tr><td colspan="8">Department of Mathematics Dibrugarh University</td></tr>
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<tr><td colspan="2">Title of the Course</td><td colspan="3">Fluid Dynamics</td><td colspan="2">Paper Number</td><td>30400</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Optional</td><td>Year</td><td>2</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td>Course Code</td><td>MATH</td></tr>
<tr><td>Semester</td><td>III</td><td></td><td></td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours (Per week)</td><td colspan="2">Lecture</td><td>Tutorial</td><td colspan="2">Lab Practical</td><td>Total</td></tr>
<tr><td colspan="2">4</td><td>2</td><td colspan="2"></td><td>6</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">The learner will get adequate knowledge in the dynamics of fluid motion, their governing equations and the corresponding solutions.</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="6">UNIT-1 : MOTION OF INVISCID FLUID IN TWO DIMENSIONS
Marks: 10
Meaning of two dimensional motion, complex potential, velocity potential and stream function, sources, sinks and doublets, two dimensional image system, Milne-Thomson circle theorem, Blasius theorem, Magnus effect.

Unit-2 : MOTION OF SPHERE IN AXI-SYMMETRIC MOTION
Marks:10
Axi-symmetric flow, Stokes’s stream function, stationary sphere in a uniform stream, pressure on the surface of a sphere, thrust on a hemisphere, D’ Alembert’s Paradox, kinetic energy of liquid.

Unit-3 : EQUATION OF MOTION FOR VISCOUS FLOW
Marks: 15
Viscous fluid, co-efficient of viscosity, exact solution of Navier Stokes equation (Couette flow, Generalized Couette flow, Poiseuille flow, Hagen-Poiseuille flow through a pipe, flow between two concentric rotating cylinders, Stokes first problem), rate of change of circulation, diffusion of vorticity, energy dissipation due to viscosity.

Unit-4 THEORY OF SLOW MOTION Marks: 10

Stokes’ equations, Oseen’ equations, Reynolds number, lubrication theory.

Unit-5 BOUNDARY LAYER THEORY: Marks: 15

Laminar boundary layer, two-dimensional boundary layer equations for flow over a plane wall, Blasius equation, characteristic boundary layer parameters, similar solutions of boundary layer equations, separation of boundary layer, momentum and energy integral equation.</td></tr>
<tr><td colspan="2">Recommended Text Books</td><td colspan="6">1. Textbook of Fluid Dynamics by F. Chorlton, CBS Publishers & Distributors, New Delhi
2. Viscous Fluid Dynamics by J. L. Bansal, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi
3. Boundary layer theory by H. Schlichting, Paragamon press, London, 1995.</td></tr>
<tr><td colspan="2">Reference Books</td><td colspan="6">1. Fluid Dynamics by M. D. Raisinghania, S. Chand & Company Ltd., New Delhi.
2. An Introduction to Fluid Dynamics by G. K. Batchelor, Cambridge University Press.
3. Theoretical Hydrodynamics by Milne Thomson, Macmillon & Co.
4. Fluid Mechanics by A K Mohanty, PHI Private Ltd., New Delhi.</td></tr>
<tr><td colspan="2">Website and E-learning Source</td><td colspan="6">http://mathform.org.http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org.</td></tr>
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<tr><td colspan="2">Title of the Course</td><td colspan="3">Mechanics of Solids - I</td><td colspan="2">Paper Number</td><td>30500</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Optional</td><td>Year</td><td>2</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td>Course Code</td><td>MATH</td></tr>
<tr><td>Semester</td><td>III</td><td></td><td></td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours (Per week)</td><td colspan="2">Lecture</td><td>Tutorial</td><td colspan="2">Lab Practical</td><td>Total</td></tr>
<tr><td colspan="2">4</td><td>2</td><td colspan="2"></td><td>6</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">The learner will be able to understand the basic concept and application of mechanics of solids.</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="6">Unit-1: Stress- Strain Relations and Elasticity: Marks: 15

Generalized Hooke’s Law, work done by external forces, stress tensor potential, potential in case of linearly elastic body, elastic symmetry, energy integral for equations of motion of an elastic body, Betti’s identity and Clapeyron’s Theorem.

Unit-2: Fundamental Equations in the theory of Elasticity: Marks: 15

Equations of Elastic equilibrium and motion in terms of displacements, biharmonic function, Beltrami-Michell compatibility equations, fundamental boundary value problems in elastostatics and elastodynamics, Saint Venant’s Principle, simple problems of the theory of elasticity.

Unit-3: Two-dimensional Problems: Marks: 15

Plane Strain, Plane Stress, Generalized Plane Stress, Airy Stress Function, Airy’s function in polar co-ordinates, complex representation of biharmonic function, components of displacement vector and stress tensor.

Unit-4: Torsion Marks: 15

Torsion of cylindrical bars, Torsional rigidity, Torsion function, Lines of shearing stress, simple problems related to circle, ellipse and equilateral triangle.</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="6">1. Theory of Elasticity by Yu. A. Amenzade, MIR Publishers, Moscow.
2. Theory of Elasticity by S. P. Timoshenko and J. N. Goodier, McGraw Hill Education.</td></tr>
<tr><td colspan="2">Reference Books</td><td colspan="6">1. A Treatise on the Mathematical Theory of Elasticity by A. E. H. Love, Dover Publications.</td></tr>
<tr><td colspan="2">Website and E-learning Source</td><td colspan="6">http://mathform.org.http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org.</td></tr>
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Department of Mathematics							*Dibrugarh University*
Title of the Course		**Probability Theory and Statistics**			**Paper Number**		**30600**
Category	**Optional**	**Year**	**2**	**Credits**	**4**	**Course Code**	**MATH**
		Semester	**III**				
Instructional Hours (Per week)		**Lecture**		**Tutorial**	**Lab Practical**		**Total**
		4		**2**			**6**
Objectives of the Course							
Course Outline		**Prerequisite: Nil** **Unit I :** **Marks: 10** **Probability :** Axiomatic definition, Properties. Conditional probability, Bays rule and independence of events. Random variables, Distribution function, probability mass and density functions, Expectation, Moments, Moment generating function, Probability inequalities (Chebyshev, Markov, Jensen). **Unit II:** **Marks: 14** **Special distributions :** Bernoulli, Binomial, Geometric, Negative Binomial, Hypergeometric, Poisson, Uniform, Exponential, Gamma, Normal, covariance, correlation, Normal and Poisson approximations to Binomial. **Unit III:** **Marks: 14** Standard multivariate distributions, functions of random variables, modes of convergence, sequence of random variables, Joint distributions, Marginal and conditional distribution, Moments, Independence of random variables, weak and strong laws of large numbers, central limit theorem (i.i.d. case) **Unit IV:** **Marks: 12** Introduction to Stochastic processes, definitions and examples, discrete-time Markov chain renewal and regenerative processes, continuous-time Markov chains, martingales, Brownian motion. **Unit V:** **Marks: 10** Methods of Estimation, Properties of Estimators, Confidence intervals. Errors (Type I & II), Test of Hypothesis, Analysis of discrete data and Chi-square test of goodness of fit, sample test.						
Recommended Text		1.S. Ross, *A First Course in Probability*, 6th Edn., Pearson, 2002. 2.V. K. Rohatgi and A. K. Md. E. Saleh, *An Introduction to Probability and Statistics*, 2nd Edn., Wiley, 2001. 3.S. C. Gupta and V. K. Kapoor, *Fundamentals of Mathematical Statistics*, S. Chand, 2000. 4.G. R. Grimmett and D. R. Stirzaker, Probability and Random Processes, 3rd Edn., Oxford University Press, 2001.					
Reference Books		1.P. G. Hoel, S. C. Port and C. J. Stone, *Introduction to Probability Theory*, Universal Book Stall, 2000. 2.J Rosenthal, *A First Look at Rigorous Probability Theory*, 2nd Edn., World Scientific, 2006 3.S. M. Ross, *Stochastic Processes*, 2nd Edn, Wiley, 1995.					
Website and E-learning Source		http://mathform.org.http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org.					

Department of Mathematics								*Dibrugarh University*
Title of the Course		**Fuzzy Mathematics and its Applications**				**Paper Number**		**30700**
Category	**Optional**	**Year**	**2**	**Credits**	**4**	**Course Code**		**MATH**
		Semester	**III**					
Instructional Hours (Per week)		**Lecture**		**Tutorial**		**Lab Practical**		**Total**
		4		**2**		**--**		**6**
Objectives of the Course		***To introduce the concept of fuzzy sets, fuzzy relations, study its relation with possibility and probability theory, apply fuzzy set theory to uncertainty based situations***.						
Course outline		**Unit 1: Fundamentals of Fuzzy Sets: (Chapter 1, 2, 3) Marks 15** Level Subsets, Representation of Fuzzy Sets, Extension Principle for Fuzzy sets, Operations on Fuzzy Sets. **Unit 2: Fuzzy Arithmetic and Fuzzy Relations: (Chapter 4, 5) Marks 15** Fuzzy Numbers, Arithmetic operations on intervals, Fuzzy Number, Arithmetic operations on Fuzzy Numbers, Projectins and extensions of Fuzzy Relations, Binary Fuzzy Relations, Fuzzy Equivalence Relations, Fuzzy Compatibility Relations, Fuzzy Ordering Relations. **Unit 3: Construction of Fuzzy Membership Functions (Chapter10) Marks 15** **Unit 4: Uncertainty Measurement and Applications of Fuzzy Sets: (Chapter – 9, 15, 17) Marks 15** Information and Uncertainty, Non-specificity of Crisp Sets, Non-specificity of Fuzzy Sets, Fuzzyness of Fuzzy Sets, Application of Fuzzy sets in decision making and in Medical Diagnosis.						
Recommended Text		1. George J. Klir and Bo Yuan, *Fuzzy sets and Fuzzy Logic - Theory and applications*, Prentice Hal of India Ltd. , New Delhi, 2001						
Reference Books		1. H.J.Zimmerman, *Fuzzy set theory and its applications*, Allied publishers, Chennai, 1996. 2. Witold Pedrycz and Fernando Gomide, *An Introduction to Fuzzy Sets-Analysis and Design*, Prentice Hall of India Pvt Ltd. New Delhi, 2004						
Website and E-learning Source		http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org						

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<tr><td colspan="8">Department of Mathematics Dibrugarh University</td></tr>
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<tr><td colspan="2">Title of the Course</td><td colspan="3">Optimization Theory</td><td colspan="2">Paper Number</td><td>30800</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Optional</td><td>Year</td><td>2</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td>Course Code</td><td>MATH</td></tr>
<tr><td>Semester</td><td>III</td><td></td><td></td></tr>
<tr><td colspan="2">Instructional Hours</td><td colspan="2">Lecture</td><td>Tutorial</td><td colspan="2">Lab Practical</td><td>Total</td></tr>
<tr><td colspan="2">(Per week)</td><td colspan="2">4</td><td>2</td><td colspan="2">0</td><td>6</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">Learner can realize the concepts of optimization in a theoretical framework.</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="6">Unit 1 : Background : Marks – 15
Organization of Optimization Problems, System Models, Black Box Approach.

Unit 2 : Optimization Techniques : Marks – 15
Functions, Regions and Optimizations, Functions of a single variable : Analytical & Numerical Methods.

Unit 3 : Multivariable Search : Marks – 15
Analytical Methods. Lagrange Multipliers, Kuhn-Tucker Theorem, Simplex Theorem.

Unit 4 : Multivariable Functions : Marks – 15
Numerical Methods : Local and Global Optima, General Principle of Sequential Numerical Search, Gradient Methods.</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="6">1. Gordon S.G. Beveridge and Robert S. Schechter; Optimization: Theory and Practice, Mc-Graw Hill Book Co.</td></tr>
<tr><td colspan="2">Reference Books</td><td colspan="6">l. Erwin Kreyszig, Introductory Functional Analysis with Applications, Wiley Classic Library.
2. D.G. Luenberger, Optimization by Vector space methods, Wiley Pub. co</td></tr>
<tr><td colspan="2">Website and E-learning Source</td><td colspan="6">http://mathform.org.http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org.</td></tr>
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<tr><td colspan="8">Department of Mathematics Dibrugarh University</td></tr>
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<tr><td colspan="2">Title of the Course</td><td colspan="3">Operations Research</td><td colspan="2">Paper Number</td><td>30900</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Optional</td><td>Year</td><td>2</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td>Course Code</td><td>MATH</td></tr>
<tr><td>Semester</td><td>III</td><td></td><td></td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours (Per week)</td><td colspan="2">Lecture</td><td>Tutorial</td><td colspan="2">Lab Practical</td><td>Total</td></tr>
<tr><td colspan="2">4</td><td>2</td><td colspan="2"></td><td>6</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To build up a strong analytical foundation of the Operations Research methods and Theory</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="6">Unit 1: Revision Marks 12
Introduction to Operations Research: Basics definition, scope, objectives, phases, models and limitations of Operations Research. Linear Programming Problem – Formulation of LPP, Graphical solution of LPP. Simplex Method, Artificial variables, big-M method, two-phase method, degeneracy and unbound solutions.

Unit 2: Transportation Problems Marks 12
Transportation Problem. Formulation, solution, unbalanced Transportation problem. Finding basic feasible solutions – Northwest corner rule, least cost method and Vogel’s approximation method. Optimality test: the stepping stone method and MODI method.

Unit 3: Assignment Model Marks 12
Assignment model. Formulation. Hungarian method for optimal solution. Solving unbalanced problem. Traveling salesman problem and assignment problem.

Unit 4: Dynamic Programming Marks 12
Dynamic programming. Characteristics of dynamic programming. Dynamic programming approach for Priority Management employment smoothening, capital budgeting, Stage Coach/Shortest Path, cargo loading and Reliability problems.

Unit 5: Game Theory Marks 12
Games Theory. Competitive games, rectangular game, saddle point, minimax (maximin) method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy for 2 X 2 games.</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="6">1. P. Sankara Iyer, ”Operations Research”, Tata McGraw-Hill, 2008.
2. A.M. Natarajan, P. Balasubramani, A. Tamilarasi, “Operations Research”, PearsonEducation, 2005.</td></tr>
<tr><td colspan="2">Reference Books</td><td colspan="6">1. J K Sharma., “Operations Research Theory & Applications , 3e”, Macmillan India Ltd, 2007.
1. P. K. Gupta and D. S. Hira, “Operations Research”, S. Chand & Co., 2007.
2. J K Sharma., “Operations Research, Problems and Solutions, 3e”, Macmillan India Ltd.
4. N.V.S. Raju, “Operations Research”, HI-TECH, 2002.</td></tr>
<tr><td colspan="2">Website and E-learning Source</td><td colspan="6">http:/www.mathforum.org, http:/opensource.org</td></tr>
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<tr><td colspan="2">Title of the Course</td><td colspan="3">Measure Theory</td><td colspan="2">Paper Number</td><td>40100</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>2</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td>Course Code</td><td>MATH</td></tr>
<tr><td>Semester</td><td>IV</td><td></td><td></td></tr>
<tr><td colspan="2">Instructional Hours</td><td colspan="2">Lecture</td><td>Tutorial</td><td colspan="2">Lab Practical</td><td>Total</td></tr>
<tr><td colspan="2">(Per week)</td><td colspan="2">4</td><td>2</td><td colspan="2"></td><td>6</td></tr>
<tr><td>Objectives of the Course</td><td colspan="7"></td></tr>
<tr><td>Course Outline</td><td colspan="7">Unit 1 : Measurable Sets Marks 12

Outer measure, Lebesgue measure, measurable sets and their properties, Borel sets, Characterization of measurable sets, non-measurable sets.

Unit 2 : Measurable Functions Marks 12

Properties, Step functions, Characteristic functions, Simple functions, Continuous functions, Set of measure zero, Borel measurable function, Realization of non-negative measurable functions in terms of simple functions, Convergence in measure.

Unit 3 : Lebesgue Integrals Marks 12

Riemann integrals, Lebesgue integration of a simple function, Bounded convergence theorem, Fatou’s lemma, Monotonic Convergence Theorem, integrable functions, General Lebesgue Integral, Dominated convergence theorem.

Unit 4 : Differentiation and Indefinite integrals Marks 12

Dini Derivatives, functions of bounded variation, Jordan decomposition Theorem, Indefinite integrals, Signed measures and their derivatives, Hahn decomposition, Radon Nykodym theorem.

Unit 5 : L^p –Space Marks 12

The L^p space, Holder, Minkowski’s inequalities, summable sequence, essential supremum, Completeness of L^p space, Riesz- Fischer theorem, Bounded linear functional on L^p spaces, Riesz representation theorem.</td></tr>
<tr><td>Recommended Text</td><td colspan="7">1. H.L. Royden, Real Analysis, Mc-Millan
2. G.D. Berra, Measure Theory and Integration, Wiley Eastern LTD</td></tr>
<tr><td>Reference Books</td><td colspan="7">1. W. Rudin, Principles of Mathematical Analysis (Ed-3) , McGraw Hill</td></tr>
<tr><td>Website and E-learning Source</td><td colspan="7"></td></tr>
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<tr><td colspan="6">Department of Mathematics Dibrugarh University</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td colspan="2">Title of the Course</td><td colspan="3">Nonlinear Dynamical Systems and Chaos</td><td>Paper Number</td><td>40200</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>2</td><td rowspan="2">Credit 4</td><td>Course Code</td><td>MATH</td></tr>
<tr><td>Semester</td><td>IV</td><td></td><td></td></tr>
<tr><td colspan="2" rowspan="2">Instruction Hours (Per week)</td><td colspan="2">Lecture</td><td>Tutorial</td><td>Lab Practical</td><td>Total</td></tr>
<tr><td colspan="2">5</td><td>2</td><td>0</td><td>7</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="5">To build a strong foundation for Nonlinear Dynamics through Difference Equations and Differential Equations</td></tr>
<tr><td colspan="2">Course outline</td><td colspan="5">Unit-1 : One Dimensional Flows and Bifurcations Marks – 12

Introduction, Fixed points and Stability, Population Growth, Linear Stability Analysis, Existence and Uniqueness, Impossibility of oscillations, Potentials, Saddle-node bifurcation, Transcritical bifurcation, Pitchfork bifurcation, Imperfect bifurcations, Flow on the circle.

Unit-2 : Two Dimensional Flows and Bifurcations Marks – 24

Linear Systems: Definition, examples and classification of linear systems,
Phase planes: Introduction, phase portraits, conservative systems, Reversible systems, Index theory,
Limit cycles: Introduction and examples, Ruling out closed orbits, Liapunov Functions, Poincare-Bendixson, theorem, Lienard Systems, Relaxation Oscillators, Weakly non-linear oscillators, Saddle-node bifurcation, Transcritical bifurcation, Pitchfork bifurcation, Hopf bifurcation,

Unit 3 : Chaos Marks – 24

Lorenz Equations: Introduction, Simple properties of the Lorenz equation, Definitions of chaos, attractors and strange attractors,
One dimensional maps: Introduction, Fixed points and Cobwebs, Numeric and analysis of Logistic map, Renormalization,
Fractals: Countable and uncountable sets, Cantor set and its fractal property,
Dimensions of self similar fractals, Box Dimension, The von Koch curve, Strange attractors, The Baker’s map B.</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="5">1. Nonlinear Dynamics and Chaos by Steven H. Strogatz Westview Press, ISBN – 13 978-0-7382-0453-6
2. Understanding Nonlinear Dynamics, Author Daniel Kaplan and Leon Glass, Springer, New York.</td></tr>
<tr><td colspan="2">Reference Books</td><td colspan="5">1. Nonlinear Dynamics and Chaos by Thompson JMT and Stewart H B John Wiley and Sons, Chichester.
2.An Introduction to Chaotic Dynamical systems by Robert L Devancy Addison-Wesley Publishing Company Inc. 1989
3. Nonlinear Systems by P.G.Drazin Cambridge University Press.</td></tr>
<tr><td colspan="2">Website and E-learning Source</td><td colspan="5">http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.algebra.com</td></tr>
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Department of Mathematics							*Dibrugarh University*
Title of the Course		**Discrete Structure and Graph Theory**			**Paper Number**		**40300**
Category	**Core**	**Year**	**2**	**Credits**	**4**	**Course Code**	**MATH**
		Semester	**4**				
Instructional Hours (Per week)		**Lecture**		**Tutorial**		**Lab Practical**	**Total**
		4		**2**			**6**
Prerequisites for the Course		**Basic concepts of Discrete Structure and Graph Theory are essential**					
Objectives of the Course		***Students will learn few interesting topics of Discrete Structure as well as certain fascinating applications of different types of Graphs.***					
Course Outline		**Discrete Structure** **Unit – 1 : Grammars and Languages** **Marks - 12** Definitions and Examples, Context- free grammar, Regular grammar, Operations on Languages, Regular Grammar, Finite State Automata: State diagram of an Automata. **Graph Theory** **Unit - 2 : Graphs and Trees** **Marks - 12** Graph, Basic definitions, Isomorphism of graphs, Subgraphs, Walks, Paths, Circuits, Connected graphs, Disconnected graphs, Trees, Some properties of trees, Distance and centers in a tree, Rooted and binary trees, On counting trees, Spanning trees, Cut-sets, Some properties of a cut-set, Connectivity and Separability, Blocks. **Unit – 3 : Operations On Graphs** **Marks - 12** Planar and non-planar graphs, Kuratowski's two graphs, Different representations of a planar graph, Matrix representation of graphs, Incidence matrix, Adjacency matrix , Graph matchings, Graph coverings. **Unit - 4 : Directed Graphs and Enumeration of Graphs** **Marks - 12** Definition of Directed graphs (digraph), Some types of digraphs, Digraphs and binary relations, Directed paths and connectedness, Acyclic digraphs and decyclization, Enumeration of graphs, Types of enumeration, Counting labeled trees, Counting unlabelled trees. **Unit - 5 : Graph Algorithms** **Marks - 12** Algorithms, Shortest-path algorithms, Transitive closure of a digraph, Activity network, Topological sorting, Critical path, Graphs in computer programming (basic concepts).						
Recommended Text		1. Discrete Mathematical Structures with Applications to Computer Science, by J. P. Tremblay, R. Manohar, Tata McGraw Hill, 1997 2. Graph theory with applications to engineering and computer science by Narsigh Deo, Prentice- Hall of India Private Limited, New Delhi. 3. Graph Theory, by R. Haray, Narosa Publishing House, New Delhi, 2001					
Reference Books		1. Graph Theory by F. Harary, Addison Wesley, 1969. 2. G. Chartrand, Introductory Graph Theory, Dover Publications, 1984 3. J. L. Gross, J. Yellen, Handbook of Graph Theory, CRC Press, 2004.					
Website and E-learning Source		http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics,					

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<tr><td colspan="2">Title of the Course</td><td colspan="3">Magneto-hydrodynamics</td><td colspan="2">Paper Number</td><td>40400</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Optional</td><td>Year</td><td>2</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2">MATH</td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours (Per week)</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td>Lab Practical</td><td>Total</td></tr>
<tr><td colspan="2">4</td><td colspan="2">2</td><td></td><td>6</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">The learner will learn about the electrical properties of Fluid and the affects of magnetic fields on them.</td></tr>
<tr><td colspan="2">Course outline</td><td colspan="6">Unit 1: MHD Approximations Marks 12

The electrical properties of Fluid, electric and magnetic field, Lorentz force , action at a distance, the low frequency approximations, energetic aspects of MHD, magnetic energy.

Unit 2: The Kinematic aspects of MHD Marks 12

The magnetic induction equation, the anlogy with vorticity, diffusion and convection of magnetic field , Magnetic reynold number, the dynamo problem, Alfven’s theorems, Cowling problem, , the two dimensional kinematic problem with flow in the direction of no variation, the two dimensional kinematic problem with field in the direction of no variation, the two dimensional kinematic problem with current in the direction of no variation.

Unit 3: The magnetic force and its effects Marks 12

The magnetic force and the inertia force , magnetic stress , principal directions and stress, Magnetohydrostatic, The linear pinch confinement scheme, the force free fields, the magnetic field in moving fluid, invalidation of kelvin’s theorem on vorticty, the case of irrotational force per unit mass.

Unit 4: Boundary Conditions Marks 12

Boundary conditions for magnetic field, boundary condition for current, boundary conditions for electric field, boundary condition on velocity.

Unit 5: Marks 12

Linear magnetohydrodynamics : Linearised MHD equations for
i) 1-D case : The steady Hartmaan Flow problems, Poiseuille type flow, Coutte type of Flow, Linear Alfven waves, MHD Rayleigh problem
ii) 2-D case : Steady laminar flow in a pipe under uniform transverse field.</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="6">1. A text book of Magnetohydrodynamics , J.A. Schercliff, Pergamon Press, New York (1965).</td></tr>
<tr><td colspan="2">Reference Books</td><td colspan="6">1. Magnetohydrdynamics by T. G. Cowling, Interscience Publishers, 1957.</td></tr>
<tr><td colspan="2">Website and E-learning Source</td><td colspan="6">http://mathforum.org , http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org</td></tr>
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Department of Mathematics							*Dibrugarh University*
Title of the Course		**Mathematical Modeling**			**Paper Number**		**40500**
Category	**Optional**	**Year**	**2**	**Credits**	**4**	**Course Code**	**MATH**
		Semester	**IV**				
Instructional Hours (Per week)		**Lecture**		**Tutorial**		**Lab Practical**	**Total**
		4		**2**		**0**	**6**
Objectives of the Course		***Knowledge of Mathematical formulation of real life problems and techniques of solving them is expected.***					
Course outline		**Unit 1 : Introduction**: **Marks-15** The Technique on Mathematical Modelling, Mathematical Modelling Through Calculus, Mathematical Modelling Through Ordinary Differential Equations of first order, Linear Growth and Decay Models, Non-Linear Growth and Decay Models, Compartment Model, Mathematical Modelling in Dynamics through Ordinary Differential Equations of first order. **Unit 2 : Application Of Mathematical Modelling**: **Marks-15** Mathematical Modelling in Population Dynamics, Mathematical Modelling of Epidemics through systems of Ordinary Differential Equations of first order, Mathematical Modelling in Economics based on systems of Ordinary Differential Equations of first order, Mathematical Models in Medicine, Arms Race Battles and International Trade in terms of Ordinary Differential Equations. **Unit 3 : Modeling Through Difference Equations** **Marks-15** Modelling through Difference Equations, Some Simple Models, Mathematical modelling through Difference Equations in Economics, Finance, Population Dynamics and Genetics. **Unit 4 : Modelling Through Partial Differential Equations** **Marks-15** Partial Differential Equation Model for Birth-Death-Immigration-Emigration Process, Partial Differential Equation Model for a Stochastic-Epidemic Process, Model for Traffic on a Highway.					
Recommended Text		Mathematical Modelling by J.N.KAPUR, Wiley Eastern Ltd, New Delhi,					
Reference Books		An Introduction to Mathematical Modelling by EDWARD A. BENDER, John Wiley and sons, New York.					
Website and E-learning Source		http://mathforum.org , http://ocw.mit.edu/ocwweb/Mathematics , http://www.opensource.org,					

Department of Mathematics						*Dibrugarh University*
Title of the Course		**Computational Fluid Dynamics**			**Paper Number**	**40600**
Category	**Optional**	**Year**	**2**	**Credits**	**4** **Course Code**	**MATH**
		Semester	**IV**			
Instructional Hours (Per week)		**Lecture**		**Tutorial**	**Lab Practical**	**Total**
		4			2	6
Objectives of the Course		***The learner is expected to have both theoretical and hands on expertise in solving Fluid Dynamics problems using the CFD techniques and tools.***				
Course Outline		**Section A :Unit – I** **Marks – 10** Computational Fluid Dynamics, Governing Equations of Fluid Dynamics, Boundary Conditions, Forms of Governing Equations suitable for CFD, Classification of partial Differential Equations. **Unit – II :Basic aspects of Discretization :** **Marks – 20** Finite difference, Difference and Transformations Equations, Explicit and Implicit Approaches, Errors and Stability, General Transformation Equations, Stretched grid, Boundary-Fitted Co-ordinate Systems. **Unit – III CFD Techniques :** **Marks – 15** The Lax-Wendroff and MacCormack's Techniques, Relaxation, Central Difference Equations for Navier-Stokes Equations. **Section B : Practical** **Marks – 15** Numerical Formulation using Crank-Nicholson Technique for Couette flow and two-dimensional problems. Program development and execution.				
Recommended Text		1. John D Anderson, Jr. : *Computational Fluid Dynamics*, Mc-Graw Hill 2. John C. Tannehill, Dale A. Anderson and Richard H. Pletchor : *Computational Fluid Dynamics and Heat Transfer*; Taylors and Francis. 3. T.J. Chung : *Computational Fluid Dynamics*, Cambridge Univ. Press 4. Tapan K. Sengupta : *Computational Fluid Dynamics*, University Press				
Reference Books						
Website and E-learning Source		http://mathform.org.http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org.				

Department of Mathematics							*Dibrugarh University*
Title of the Course		**Mechanics of Solids-II**			**Paper Number**		**40700**
Category	**Optional**	**Year**	**2**	**Credits**	**4**	**Course Code**	**MATH**
		Semester	**IV**				
Instructional Hours (Per week)		**Lecture**		**Tutorial**	**Lab Practical**		**Total**
		4		**2**			**6**
Objectives of the Course		***The learner will be able to learn the mechanics of both elastic and plastic bodies***.					
Course Outline		**Unit-1: General Theorems of the theory of Elasticity: Marks: 15** Betti's Reciprocal theorem, principle of minimum potential energy, `Castigliano's principle, Rayleigh- Ritz method, Reissner's variational principle, equilibrium equations and boundary conditions for a geometrically non-linear body. **Unit-2: The propagation of waves in elastic solid media: Marks: 10** Waves of dilatation and distortion in isotropic elastic media, plane waves, Rayleigh surface waves, Love waves. **Unit-3: Foundations of the theory of Plasticity: Marks:10** Basic Concepts of Plasticity, the criterion of yielding, Tresca and Von Mises criteria, strain hardening, Levy-Mises and Prandtl-Reuss equations, Hencky stress strain relations. **Unit-4: The solution of elasto-plastic problems: Marks:15** Hohenemser's experiment, torsion and tension of thin walled tube and cylindrical bar, bending under conditions of plain strain, bending of prismatic beam, torsion of prismatic bar, torsion of a bar of non-uniform cross-section. **Unit-5: Plane Plastic Strain and theory of Slip line field: Marks:10** Plastic rigid materials, Plane strain, Plain strain equations, elementary slip line theory for plan plastic strain.						
Recommended Text		1. Theory of Elasticity by Yu. A. Amenzade, MIR Publishers, Moscow. 2. Theory of Elasticity by S. P. Timoshenko and J. N. Goodier, McGraw Hill Education. 3. Mathematical Theory of Plasticity by R. Hill, Clarendon Press, Oxford.					
Reference Books		1. *A Treatise on the Mathematical Theory of Elasticity* by A. E. H. Love, Dover Publications. 2. *Schaum's Outline of Theory and Problems of Continuum Mechanics* by George E. Mase., Schaum's Outline Series, McGraw-Hill. 3. *Fundamentals of the theory of Plasticity* by L. M. Kachanov, North-Holand publishing Company.					
Website and E-learning Source							

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<tr><td colspan="8">Department of Mathematics Dibrugarh University</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td colspan="2">Title of the Course</td><td colspan="3">Operator Theory</td><td colspan="2">Paper Number</td><td>40800</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Optional</td><td>Year</td><td>2</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td>Course Code</td><td>MATH</td></tr>
<tr><td>Semester</td><td>IV</td><td></td><td></td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours (Per week)</td><td colspan="2">Lecture</td><td>Tutorial</td><td colspan="2">Lab Practical</td><td>Total</td></tr>
<tr><td colspan="2">4</td><td>2</td><td colspan="2"></td><td>6</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To Study the Spectral Properties of various Operators on Normed and Inner Product Spaces.</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="6">Prerequisite: Functional Analysis

Unit-I : Spectral Theory of Linear Operators in Normed Spaces
Marks: 15
Spectral Theory in Finite Dimensional Normed Spaces and Its basic concepts, Spectral Properties of Bounded Linear Operators, Resolvent and Spectrum and Their Properties, Banach Algebra and Its properties.

Unit-II : Compact Linear Operators on Normed spaces and Their Spectrum Marks: 15
Compact Linear Operators on Normed Spaces and Its Properties, Spectral Properties of Compact Linear Operators, Further Spectral Properties of Compact Linear Operators.

Unit-III : Spectral Theory of Bounded Self-Adjoint Linear Operators
Marks: 15
Adjoint Linear Operators, Self-Adjoint Linear Operators, Spectral properties of Bounded Self Adjoint Linear operators, Further Spectral Properties of Bounded Self Adjoint Linear Operators, Positive Operator, Square Root of Positive Operator, Projection operators.

Unit-IV : Unbounded linear operators on Hilbert Space
Marks: 15
Unbounded Linear Operators and Their Hilbert Adjoint operators, Symmetric and Self Adjoint linear operators, Closed Linear Operator and Closure, Multiplication and Differentiation of Operators.</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="6">1. Erwin Kreyszig, Introduction to Functional Analysis with Applications, John Wiley & Sons.</td></tr>
<tr><td colspan="2">Reference Books</td><td colspan="6">1. Martin Schechter, Principles of Functional Analysis, Student Edition, Academic Press.
2. Balmore V. Limaye, Functional Analysis, New Age International Ltd.</td></tr>
<tr><td colspan="2">Website and E-learning Source</td><td colspan="6">http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.algebra.com</td></tr>
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<tr><td colspan="8">Department of Mathematics Dibrugarh University</td></tr>
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<tr><td colspan="2">Title of the Course</td><td colspan="3">Algebraic Topology</td><td colspan="2">Paper Number</td><td>40900</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Optional</td><td>Year</td><td>2</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td>Course Code</td><td>MATH</td></tr>
<tr><td>Semester</td><td>IV</td><td></td><td></td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours (Per week)</td><td colspan="2">Lecture</td><td>Tutorial</td><td colspan="2">Lab Practical</td><td>Total</td></tr>
<tr><td colspan="2">4</td><td>2</td><td colspan="2"></td><td>6</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To study Homotopy Theory, Homology Theory and Covering Projections.</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="6">Unit 1: Fundamental Group: Marks : 15

Introduction, Homotopy, Contractible Spaces and Homotopy type, Fundamental Group and its Properties, Simply Connected Spaces, The Fundamental Group of Circle.(Chapter 2)

Unit 2: Finite Simplicial Complexes : Marks : 15

Simplicial Complexes, Polyhedra and Triangulations, Simplicial Approximation, Barycentric Subdivision, Simplicial Approximation Theorem.(Chapter 3)

Unit 3: Simplicial Homology: Marks : 15

Introduction, Orientation of Simplicial Complexes, Simplicial Chain Complex and Homology, Some Examples. (Chapter 4)

Unit 4: Covering Projections: Marks : 15

Introduction, properties of covering projections, applications of homotopy lifting theorem, Lifting of an arbitrary map. (Chapter 5)</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="6">1. Satya Deo, Algebraic Topology, A Primer , Hindustan Book Agency, New Delhi, 2003.</td></tr>
<tr><td colspan="2">Reference Books</td><td colspan="6">1. B.K.Lahiri, Algebraic Topology, Narosa Publishing House, 2000</td></tr>
<tr><td colspan="2">Website and E-learning Source</td><td colspan="6">http://mathform.org.http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org.</td></tr>
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<tr><td colspan="8">Department of Mathematics Dibrugarh University</td></tr>
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<tr><td colspan="2">Title of the Course</td><td colspan="3">Algebraic Graph Theory</td><td colspan="2">Paper Number</td><td>41000</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Optional</td><td>Year</td><td>2</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td>Course Code</td><td>MATH</td></tr>
<tr><td>Semester</td><td>IV</td><td></td><td></td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours (Per week)</td><td colspan="2">Lecture</td><td>Tutorial</td><td colspan="2">Lab Practical</td><td>Total</td></tr>
<tr><td colspan="2">4</td><td>2</td><td colspan="2"></td><td>6</td></tr>
<tr><td colspan="2">Prerequisites for the Course</td><td colspan="6">Basics of Graph Theory and Linear Algebra are required.</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">Students will learn the algebraic extension and application of Graph Theory.</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="6">Unit – 1 : Reviews : Marks - 10

Basic Definitions of Graph theory and Linear Algebra, Matrix Representations of a graph : Adjacency matrix and Incidence matrix.

Unit - II Marks - 20

Eigenvalues of Graphs : A Little Matrix Theory, Eigenvalues and Walks, Eigenvalues and Labeling of graphs, Lower and Upper Bounds for the Eigenvalues, S eidel matrix of a graph.

Unit - III Marks - 20

Graph Laplacians : Laplacian of a graph, Laplace Eigenvalues, Eigenvalues & Vertex partition of graphs, The Max-Cut Problem, Travelling Salesman Problem, Random Walks on graphs.

Unit – IV Marks - 10

Spectral Graph Theory : Introduction, Angles, Star sets and Star partitions, Integral Graphs.</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="6">1. R. J. Wilson, l. W. Beineke, Topics in Algebraic Graph Theory, Cambridge University Press, 2004.
2. C. Godsil, G. Royle, Algebraic Graph Theory, Springer Verlag Newyork, 2001.</td></tr>
<tr><td colspan="2">Reference Books</td><td colspan="6">1. Norman Biggs, Algebraic Graph Theory, Cambridge University Press, 1974.
2. U. Knauer, Algebraic Graph Theory, Hubert & Co., Germany, 2011.</td></tr>
<tr><td colspan="2">Website and E-learning Source</td><td colspan="6">http://www.graphtheory.com/</td></tr>
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<tr><td colspan="2">Title of the Course</td><td colspan="3">Theory of Modules</td><td colspan="2">Paper Number</td><td>41100</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Optional</td><td>Year</td><td>2</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td>Course Code</td><td>MATH</td></tr>
<tr><td>Semester</td><td>IV</td><td></td><td></td></tr>
<tr><td colspan="2">Instructional Hours (Per week)</td><td colspan="2">Lecture</td><td>Tutorial</td><td colspan="2">Lab Practical</td><td>Total</td></tr>
<tr><td colspan="2"></td><td colspan="2"></td><td></td><td colspan="2"></td><td></td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6"></td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="6">UNIT-I: Marks – 15

Basic concepts of Modules, Direct Products and Sums, Free Modules, Bases for Free Modules

UNIT-II: Marks – 15

Injective Modules, Properties of Injectives, Divisibility, Embedding in Injectives, Injective Hulls,Noetherian Rings

UNIT-III: Marks – 15

Tensor product of Modules, Tensor Product of Algebras, Free and Tensor Algebras, Exterior Algebras,

UNIT-IV: Marks – 15

Simple Modules and Primitive rings, Cyclic Modules, Density, Jacobson radical and its Characterization</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="6">John Dauns, Modules and Rings, Cambridge University Press, 1994</td></tr>
<tr><td colspan="2">Reference Books</td><td colspan="6">1. S.Lang, Algebra, Addison-Wesley,1994
2. N. Jacobson, Basic Algebra II, Hindustan Publishing Corporation, New Delhi, 2002.
3. M.F. Atiyah and I.G. MacDonald, Introduction to Commutative Algebra, Addison Wesley, 1969</td></tr>
<tr><td colspan="2">Website and E-learning Source</td><td colspan="6"></td></tr>
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Department of Mathematics							*Dibrugarh University*
Title of the Course		**Algebraic Number Theory**			**Paper Number**		**41200**
Category	**Optional**	**Year**	**2**	**Credits**	**4**	**Course Code**	**MATH**
		Semester	**IV**				
Instructional Hours (Per week)		**Lecture**		**Tutorial**	**Lab Practical**		**Total**
		4		**2**			**6**
Objectives of the Course							
Course Outline		**UNIT-I: Algebraic Integers:** **Marks - 20** Localisation, Integral Closure,Prime Ideals, Galois Extensions, Dedekind rings, Discrete Valuation Rings, Explicit factorisation of a prime, Projective Modules over Dedekind Rings **UNIT-II: Completions:** **Marks – 20** Polynomial in complete fields,Filtrations,Unramified Extenxions,Tamely ramified extensions **UNIT-III:** **Marks – 20** Complementary Modules,The different and ramification, The discriminant, Roots of Unity, Quadratic Fields, Gauss Sums, Relations in Ideal classes					
Recommended Text		1 S. Lang, Algebraic Number Theory, Addison- Wesley, 1970					
Reference Books		1. Richard A. Mollin, Algebraic Number Theory, CRC Press, 1999 2. Stewart and Tall, Algebraic Number Theory and Fermat's Last Theorem, A K Peters, 2002.					
Website and E-learning Source							

Department of Mathematics							*Dibrugarh University*
Title of the Course		**Fields and Galois Theory**			**Paper Number**		**41300**
Category	**Optional**	**Year**	**2**	**Credits**	**4**	**Course Code**	**MATH**
		Semester	**IV**				
Instructional Hours (Per week)		**Lecture**		**Tutorial**	**Lab Practical**		**Total**
		4		**2**			**6**
Objectives of the Course							
Course Outline		**Unit - I** **Marks – 15** Fields and their Extensions, Splitting Fields, The Algebraic Closure of a field. **Unit - I I** **Marks – 15** Separability, Automorphisms of Field Extensions. **Unit - I II** **Marks – 15** Fundamental Theorem of Galois Theory, Roots of Unity, Finite Fields. **Unit - I V** **Marks – 15** Primitive Elements, Galois Theory of Equations, Solution of Equations by Radicals.					
Recommended Text		1. P.M. Cohn : *Basic Algebra*, Springer International Edition 2003					
Reference Books		1. Thomas W. Hungerford, *Algebra*, Springer-Verlag, New York, 1974 2. Ian Stewart, *Galois Theory*, Chapman & Hall, 1945 3. Emil Artin, *Galois Theory*, University of Notice Dame Press, 1971					
Website and E-learning Source		http://mathform.org.http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org.					

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