ASSAM SCIENCE AND TECHNOLOGY UNIVERSITY

Guwahati

Course Structure and Syllabus

(From Academic Session 2018-19 onwards)

M.Sc. Mathematics (CBCS)

1st Semester

Sl. No.	Sub-Code	Subject	Hours per Week			Credits
			L	T	P	C
Theory						
1	MMA182101	Real Analysis	3	1	0	4
2	MMA182102	Algebra - I	3	1	0	4
3	MMA182103	Linear Algebra	3	1	0	4
4	MMA182104	Tensor Analysis	3	2	0	5
5	MMA182105	Differential Equations and Differential Geometry	3	1	0	4
		Total	15	6	0	**21**
Total Contact Hours per week : 21						
Total Credit : 21						

Detailed Syllabus

Course Code	Course Title	Hours per week L-T-P	Credit C
MMA182101	**Real Analysis**	**3-1-0**	**4**

Objectives of the Course: To build up a strong analytical foundation of the basic Real Analysis

Unit 1: Revision **Marks 10**

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 15**

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 15**

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 15**

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 15**

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

Course Code	Course Title	Hours per week L-T-P	Credit C
MMA182102	**Algebra-I**	**3-1-0**	**4**

Unit-1: **Marks 10**

A brief review of groups, their properties and examples, subgroups, isomorphism theorems, symmetric, alternating and dihedral groups.

Unit-2: **Marks 20**

The class equation of finite groups, Sylow theorems, Direct products of groups.

Unit-3: **Marks 20**

Nilpotent and Solvable Groups, Normal and Subnormal Series.

Unit-4: **Marks 20**

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**

Course Code	Course Title	Hours per week L-T-P	Credit C
MMA182103	**Linear Algebra**	**3-1-0**	**4**

Unit-1: **Marks : 10**

Systems of linear equations, Vector Space, Linear Span, Bases and dimensions, change of bases, sums and direct sums.

Unit-2: **Marks : 15**

Linear transformations, matrix representations of linear transformations, the rank and nullity theorem, Linear Operators and Eigenvectors, Diagonalization.

Unit-3: **Marks : 15**

Dual spaces, transposes of linear transformations, invariant subspaces, Annihilators, the minimal polynomial, Jordan canonical form.

Unit-4: **Marks : 15**

Orthogonal Transformations, Unitary Transformations, The Principal Axis Theorem, Quadratic form.

Unit-5: **Marks : 15**

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

Course Code	Course Title	Hours per week L-T-P	Credit C
MMA182104	**Tensor Analysis**	**3-2-0**	**5**

Objective of the Course: To build a strong foundation for Tensor Analysis for its application in Continuum Mechanics, Fluid Dynamics, MHD, Classical Mechanics etc.

Unit –1: Cartesian Tensor Algebra: **Marks-20**

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-10**

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- 20**

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- 20**

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, ISBN10:0486638332, 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

Course Code	Course Title	Hours per week L-T-P	Credit C
MMA182105	**Differential Equations and Differential Geometry**	**3-1-0**	**4**

Prerequisites for the Course: Knowledge of Partial Differential Equations of First Order is essential. Knowledge of Curves and Surfaces are essential.

Objectives of the Course: The students will learn the governing mathematical formulations and their solutions of various physical problems. Knowledge on geometric properties of various functions is expected.

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 - 20**

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 - 10**

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 - 15**

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, Meunie's theorem.

Unit – 5: Curves on a Surfaces **Marks – 10**

Principal directions, First and second curvature, Eule's theorem, conjugate directions, Asymptotic lines.

Recommended Text

1. *Elements of Partial Differential Equations* by Ian. N. Sneddon, McGraw Hill Book Company.
2. *Differential Geometry* by Weathernbern Radha Publishing House.

Reference Books

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.

Website and Elearning Source

http://mathforum.org,http://ocw.mit.edu/ocwweb/Mathematics,http://www.opensource.org

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