ASSAM SCIENCE AND TECHNOLOGY UNIVERSITY

Guwahati

Course Structure and Syllabus

(From Academic Session 2018-19 onwards)

M.Sc. Mathematics (CBCS)

3rd Semester

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Sl. No.	Sub-Code	Subject	Hours per Week			Credits	Marks	
			L	T	P	C	CE	ESE
Theory								
Core								
1	MMA182301	Numerical Methods and Computer Programming	3	0	4	5	30	70
2	MMA182302	General Topology	4	2	0	6	30	70
3	MMA182303	Mathematical Methods	4	2	0	6	30	70
Optional (Any One Paper)								
1	MMA18230E11	Fluid Dynamics	4	2	0	6	30	70
2	MMA18230E12	Mechanics of Solids-I	4	2	0	6	30	70
3	MMA18230E13	Probability Theory and Statistics	4	2	0	6	30	70
4	MMA18230E14	Fuzzy Mathematics	4	2	0	6	30	70
5	MMA18230E15	Optimization Theory	4	2	0	6	30	70
6	MMA18230E16	Operations Research	4	2	0	6	30	70
Total			**15**	**6**	**4**	**23**	**120**	**280**
Total Contact Hours per week: 25								
Total Credit : 23								

Course Code	Course Title	Hours per week L-T-P	Credit C
MMA182301	**Numerical Methods and Computer Programming**	**3-0-4**	**5**

Objectives of the Course:
Learners will be able to solve physical problems using numerical methods through C-Programming

Section A: Numerical Methods
Unit 1: Solution of system of equations
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)
Stability and Convergence of numerical methods, Runge-Kutta method of second, third and fourth order.

Unit 3: Predictor-Corrector Methods
General explicit method, Adam's-Bashforth method, Nystrom method, general implicit methods, Adam's Moultan and Milne-Simpson predictor-corrector methods

Section B: C-Programming
Unit 1: Programme solving technique and C-Programming preliminaries
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
Arrays to functions, pointers, operations on pointers, array using pointers, opening and closing data files, creation of a data file, processing of data file.

Text Books:

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 Hills.
5. E.V. Krishnamurthy, S.K. Sen, *Numerical Algorithms*, Prentice Hall of India.
6. J.B. Scarborough, *Numerical Mathematical Analysis*, Mc Grew Hill.

Course Code	Course Title	Hours per week L-T-P	Credit C
MMA182302	General Topology	4-2-0	6

Objectives of the Course:
Pre-requisite: Basic knowledge of metric space and continuity

Unit 1: Basis
Open Sets, Closed Sets, Neighbourhood, Limit Point, Interior, Closure, Basis, Sub-basis, finer and coarser topology, Subspace.

Unit 2: Continuity
Continuous Functions, Open Functions, Closed Functions, Homoemorphism, Composition of Continuous Functions, Pasting Lemma, Product Topology, Quotient Topology.

Unit 3: Compactness and Connectedness
Compact Space, Countable Compact Spaces, Linderloff Space, Local Compactness, Connectedness, Path Connectedness, Local Connectedness,

Unit 4: Separation Axiom and Countability
T_i (i = 1, 2, 3, 4, 5) spaces, Regular and Complete Regular Spaces, Normal Spaces, First and Second Countable Spaces, Separable Space.

Text Books:

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.

Course Code	Course Title	Hours per week L-T-P	Credit C
MMA182303	**Mathematical Methods**	**4-2-0**	**6**

Objective of the course

The learner is expected to know the differential equations.

Unit 1: Fredholm Integral Equations

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

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

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

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

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.

Text Books:

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.

Course Code	Course Title	Hours per week L-T-P	Credit C
MMA18230E11	**Fluid Dynamics**	**4-2-0**	**6**

Objectives of the Course

The learner will get adequate knowledge in the dynamics of fluid motion, their governing equations and the corresponding solutions.

Unit-1: MOTION OF INVISCID FLUID IN TWO DIMENSIONS

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

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

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

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

Unit-5: BOUNDARY LAYER THEORY

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.

Text Books:

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.

Reference Books:

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.

Course Code	Course Title	Hours per week L-T-P	Credit C
MMA18230E12	**Mechanics of Solids-I**	**4-2-0**	**6**

Objectives of the Course

The learner will be able to understand the basic concept and application of mechanics of solids.

Unit-1: Stress- Strain Relations and Elasticity

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

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

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

Torsion of cylindrical bars, Torsional rigidity, Torsion function, Lines of shearing stress, simple problems related to circle, ellipse and equilateral triangle.

Text Books:

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.

Reference Books:

1. A Treatise on the Mathematical Theory of Elasticity by A. E. H. Love, Dover Publications.

Course Code	Course Title	Hours per week L-T-P	Credit C
MMA18230E13	**Probability Theory and Statistics**	**4-2-0**	**6**

Unit 1:

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 2:

Special Distributions: Bernoulli, Binomial, Geometric, Negative Binomial, Hypergeometric, Poisson, Uniform, Exponential, Gamma, Normal, covariance, correlation, Normal and Poisson approximations to Binomial.

Unit 3:

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 4:

Introduction to Stochastic processes, definitions and examples, discrete-time Markov chain renewal and regenerative processes, continuous-time Markov chains, martingales, Brownian motion.

Unit 5:

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.

Text Books:

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.

Course Code	Course Title	Hours per week L-T-P	Credit C
MMA18230E14	**Fuzzy Mathematics**	**4-2-0**	**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.

Unit 1: Fundamentals of Fuzzy Sets
Level Subsets, Representation of Fuzzy Sets, Extension Principle for Fuzzy sets, Operations on Fuzzy Sets.

Unit 2: Fuzzy Arithmetic and Fuzzy Relations
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

Unit 4: Uncertainty Measurement and Applications of Fuzzy Sets
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.

Text Books:

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

Course Code	Course Title	Hours per week L-T-P	Credit C
MMA18230E15	**Optimization Theory**	**4-2-0**	**6**

Objectives of the Course

Learner can realize the concepts of optimization in a theoretical framework.

Unit 1: Background

Organization of Optimization Problems, System Models, Black Box Approach.

Unit 2: Optimization Techniques

Functions, Regions and Optimizations, Functions of a single variable:

Analytical & Numerical Methods.

Unit 3: Multivariable Search

Analytical Methods. Lagrange Multipliers, Kuhn-Tucker Theorem, Simplex Theorem.

Unit 4: Multivariable Functions

Numerical Methods: Local and Global Optima, General Principle of Sequential Numerical Search, Gradient Methods.

Text Books:

1. Gordon S.G. Beveridge and Robert S. Schechter; Optimization: Theory and Practice, Mc-Graw Hill Book Co.

Reference Books:

l. Erwin Kreyszig, Introductory Functional Analysis with Applications, Wiley Classic Library.

2. D.G. Luenberger, Optimization by Vector space methods, Wiley Pub. Co

Course Code	Course Title	Hours per week L-T-P	Credit C
MMA18230E16	**Operations Research**	**4-2-0**	**6**

Objectives of the Course

To build up a strong analytical foundation of the Operations Research methods and Theory

Unit 1: Revision
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
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
Assignment model. Formulation. Hungarian method for optimal solution. Solving unbalanced problem. Traveling salesman problem and assignment problem.

Unit 4: Dynamic Programming
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
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.

Text Books:

1. P. Sankara Iyer, "Operations Research", Tata McGraw-Hill, 2008.
2. A.M. Natarajan, P. Balasubramani, A. Tamilarasi, "Operations Research", Pearson Education, 2005.

Reference Books:

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.
3. N.V.S. Raju, "Operations Research", HI-TECH, 2002.

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