DIRECTORATE OF DISTANCE EDUCATION

SYLLABUS
M.Sc. Course in Mathematics

VIDYASAGAR UNIVERSITY
MIDNAPORE - 721102
M.Sc. Syllabus in Applied Mathematics and Oceanology
and Computer Programming

VIDYASAGAR UNIVERSITY

M.Sc. Part - I

M.Sc. Part - I Course: 500 marks

First Paper:
Group- A: Real Analysis (40 marks)
Group- B: Functions of Complex Variables (30 marks)
Group- C: Ordinary Differential Equations (30 marks)

Second Paper:
Group- A: Algebra (50 marks)
Group - B: Functional Analysis (50 marks)

Third Paper:
Group - A: Probability and Statistics (30 marks)
Group - B: Numerical Analysis (40 marks)
Group - C: Introduction to Computing (30 marks)

Fourth Paper:
Group - A: Principle of Mechanics (50 marks)
Group-B: Partial Differential Equation (50 marks)

Fifth Paper:
Group- A: Mechanics of Continuous Media (50 marks)
Group- B: Practical (50 marks)

M.Sc Part - II Course: 500 marks.

Sixth Paper:
Group A: Computer Science II (50 marks).
Group B: Computer Science Practical (50 marks)

Seventh Paper:
Group A: Electromagnetic Theory (25 marks)
Group B: Any one of the following subjections: Gas dynamics Quantum Mechanics, Fuzzy sets and its application in R. Computer
Science - III, wave dynamics,

Conceptional

Applicant Statistics

(25 marks each.)

Group C: Fluid Mechanics (30 marks)
Group D: Magneto hydro-dynamics (20 marks)

Eighth paper: Group A: Mathematical Method (50 marks)
Group B: Elements of Optimization and O.R. (50 marks) for students with or as special paper/Dynamical Oceanography and Meterology (50 marks) for students with or as special paper.

Ninth and Tenth Paper: (100 marks each): Any one of the following of subjects:

(a) Operations Research: (OR)
Ninth paper - Advance optimization and O.R. - I
Tenth Paper - Advance optimization and O.R. - II

(b) Oceanography and Meterology: (OM)
Ninth Paper - Dynamical Oceanography
Tenth Paper - Group A: Dynamical Meterology (75 marks)
Group B: Dynamical Meterology Practical (25 marks)

Subjects to be offered in any particular year will be decided by the department.

(VIII) Group - A: 50
Group - B: OR (50)

IX) OM (50)

IX) OR & OM (100)

(X) OR & OM (100)

(X) (75)

M.Sc. Syllabus in Applied Mathematics with Oceanology and Computer Programming
Vidyasagar University
PAPER - 1
Group - A

Real Analysis
(Marks - 40)

1. Functions of bounded variation & its simple properties. Total variation & its additive property. Variation function & its properties. Necessary & sufficient conditions for a function to be bounded variation.


GROUP - B
(PAPER - 1)

Functions of Complex Variables
(Marks - 30)


GROUP - C (PAPER - 1)

Ordinary Differential Equations
(Marks - 30)


PAPER - II

GROUP - A

Algebra
(50 Marks)

Distributive Lattice. Complements.

**Group - B (Paper - II)**

**Functional Analysis**

(50-Marks)


Linear metric space. Examples. Normed linear spaces. Examples. Norm is continuous operator. ANLS is complete if every absolutely convergent series is convergent.

Bounded linear transformation. Set of all bounded linear transformation $B(X,Y)$ from NLS X into NLS Y is a NLSB. $(X,Y)$ is a Banach space if Y is a Banch space. Statement of Hahn-Banach theorem. Theorems obtained as application of Hahn-Banach theorem. Open mapping theorem. Closed Graph Theorem. Banach Steinhaus theorem.


**PAPER - III**

**GROUP - A**

**Probability and Statistics**

(Marks - 30)

Stochastic Process:

Markov chains with finite and countable state space. Classification of states. Limiting behaviour of n state transition probabilities.


**GROUP - B**

**Numerical Analysis**


(b) Digital Technique:
(iii) Algebra for Digital System: Logic gates. Simplifying Boolean expressions by Veitch Karnaugh Map method.
(iv) Combinatorial circuit design procedure and implementation by Binary operators and logic gates.


Ordinary Differential Equations:-
Finite difference scheme for the linear equations with first order partial derivatives. Mixed problem for the heat equation. The wave equation. Finite element method and its illustration by a simple example.

GROUP - C
(PAPER III)
Introducing to Computing
(30 marks)
(a) Computer Fundamentals: Bit, Byte Nibble, Basic structure of computer - I/O Unit, ALU, CU, Memory Unit. Peripheral devices.

PAPER - IV
GROUP - A
PRINCIPLES OF MECHANICS
(Marks - 50)

System of particles
System of particles :-
Linear momentum. Angular momentum. Conservative forces.
Conservation of Linear momentum. Angular momentum and total energy. Virial theorem.
Motion relative to rotating Earth. A brief review of orbital mechanics with special reference to satellite mechanics. Faucault's pendulum.
Inertial tensor and moment of inertia. Angular momentum and Kinetic energy. Euler's dynamical equations and torque free motion of rigid body about a fixed point on it.
Motions of a symmetrical top with one point fixed.

Small oscillation about equilibrium. Lagrange's method.
Special theory of relativity in Classical mechanics

Special theory of relativity in classical Mechanics:-
Postulates of special theory of relativity. Lorentz transformation.
Force and energy equations in relativistic mechanics. Instead of deducing from usual D'Alembert's principle the following approach may be followed.

First order autonomous system-basic theory, rotation, natural boundaries, simple examples.
Second order autonomous systems-Systems of ordern, tied points equilibrium & stability, separation of variables.
Hamiltonian systems, generalized co-ordinate conservation Linear conservative systems, standard examples (the cubic potential the general potential etc) Laarangians. etc.

GROUP - B (PAPER - IV)
Partial Differential Equation
(Marks - 50)

Partial Differential Equation
The existence theorem of Cauchy an Kowaleswsky. Methods of solving first order linear and non-linear equations and higher order linear equations with constant coefficients.
Equations of second order:
Reduction to canonical forms of linear and quasi-linear
equations of second order in two independent variables and classification of equations, characteristics curves. Adjoint equation. Self-adjoint equations, canonical forms and classification of second order linear equations in many independent variables.

Linear partial differential equations with constant coefficients: Green's Function construction with the help of delta function.

Hyperbolic equations:

The equation of vibration of a string. Formulation of the mixed initial and boundary value problem. Existence, uniqueness and continuous dependence of the solution on the initial conditions. D'Alembert's formula for the vibration of an infinite string. The domain of dependence, the domain of influence, Method of separation of variables, Investigation of the conditions under which the series converges and represent the solution. Riemann Volterra method of solution, Goursat's problem for one-dimensional wave equation.

Elliptic equations:

Occurrence of Laplace's equation, the fundamental solutions of Laplace's equations in two independent variables. Harmonic functions, regularity, characterization of harmonic functions by their mean value property. Uniqueness, continuous dependence and existence of solutions, Method of separation of variables for the solutions of Laplace equations in two and three dimensions, the Dirichlet's and Neumann's problems. Dirichlet's principles, Green's functions or the Laplace's equations in two and three dimension, solution of Dirichlet's and Neumann's problem for a disc half-space and a sphere. The potentials due to a volume distribution a single layer and to a double layer. Representation of a harmonic function by potentials of simple and double layers. Poisson's general solution.

Parabolic equations:


PAPER - V

Group - A

(Marks - 50)

Mechanics of Continuous Media:


Impulsive motion of fluid. Energy equation Motion in two

Paper - V
Group - B
(Marks - 50)

Practical
(a) DOS, UNIX and WINDOWS 95/98
(b) Identification of PC components and Assemble of some components.
(c) Spread Sheet-LOTUS.
(d) Word processing-Page maker/ MS-WORD/LATEX.
(e) Numerical and Statistical problems in FORTRAN-77 and C. Problems on FORTRAN-77 & C.

Numerical Problems:

Double integration.

method for a pair of equations-higher degree.

Statistical Problems:
1. Preparation of Frequency table his stogram.
2. Problems on simple frequency distribution: mean, median, quartile, mode, standard deviation, moments, skewness, Kurtosis beta and gamma coefficient.
3. Preparation of Poisson, binomial and normal probability distribution table. Problems on group frequency distribution mean, s.d. median, mode, quartile, percentiles.
4. On Bivariate distribution-correlation coefficient regression lines curve fitting.

Searching and Sorting:
1. Linear and binary search.
2. Sorting: Bubble insertion, quick heap and merge sort.

String manipulation (C only):
1. No. of occurrence of a letter in a given string.
2. Palindrome of string.
3. Rewrite the name with surname first.
4. Print a string in a reverse order.
5. String searching.
6. Sorting of names in alphabetic order.
7. Find and replace a given letter or word in a given string.
8. Combinations of letters of a word.
9. Conversion of name into abbreviation form.
Misc. Problems.
1. Generation of random numbers.
2. Generation of prime numbers.
3. Graph plotting.
4. Multiple choice test.
5. Multiplication of polynomials.
6. Preparation of calender.
7. Fibonacci no.

Paper - VI
Group - A, Marks - 50

Computer Science

Computer Organisation: 10

Basic of computer organisation, Computer structures, Component of CPU Registers, Adders, ALU, Control unit, Basic concepts, Memory, Characteristics-primary & Secondary Storage, Hierarchy of memory, Cache memory, Virtual memory, Basic concept of I/O, Standard I/O Interrupts. Direct memory access, Concepts of parallelism in computing systems.

Data structure: 15


Graph algorithm: Representation of graph, DFS and BFS algorithm, shortest path algorithm, Dijsktra algorithm.

Computer Network: 10

Concept of centralised and distributed computing, Advantage of Networking LAN, WAN, Internet and Its applications.

Operating System: 15

What is OS? History, Concept Process, Files, Shell, System Call, Structures-monolithic, layer virtual, client-server model.

Processor management: Concept of inter process communication (race, mutual, exclusion, semaphore, massage passing) Scheduling: round-robin, priority-queue.

Device management : Device and device Controllers, interrupt handlers and device drivers RAM dish Floppy disk terminal.

Memory management : Single allocation technique, partition technique paging technique, multiprogramming, Virtual memory.


Group B : Practical Marks -50

(a) Programming in C++
(b) Programming in Visual C++Basic.
(c) Computer Network (including e-mail)
(d) DBMS-Foxpro/ Oracle/ Sybase/ Power Builder/ Excel/ Developer 2000
(e) Practical Note Book + VIVA
Electromagnetic Theory


2. Field Equations and Conservation laws: Equation of continuity displacement current, Maxwell's equations, energy in electromagnetic field, Poynting vector, electromagnetic potentials, non-uniqueness of electromagnetic potential and concept of gauge Lorentz gauge, Coulumb gauge Field equations in terms of differential forms.

3. Field of Moving charges and radiation
   Retarded potentials, Lcniard Wiechert Potentials, field produced by an arbitrary moving charges particle, the field of a uniformly moving charged particle, radiation from an accelerated charged particle at low velocity, radiation from an accelerated charged particle at high velocity.

4. Plane electromagnetic waves and their Propagation
   Electromagnetic waves in vacuum, dielectrics, Conducting media, skin effect reflection & refraction of electromagnetic wave. Fresnel formulas.

Gas Dynamics


Fuzzy Sets and its application in O.R.


Linear Programming Problems with fuzzy resources:
(i) Vendegay's approach
(ii) Werner's approach
L.P.P. with fuzzy resources and objective: Zimmermann's approach.

**Paper-VII: Group-B**

**Wave dynamic (25 marks)**


Nonlinear waves: Stocks finite amplitude waves.

**Paper - VII: Group - B**

**Computational fluid dynamics (25 marks)**

Conservation principles of fluid dynamics, basic equations for viscous and non-viscous flow boundary conditions.

Finite difference method: Schemes for Pecybuuir Hyperbolic and Elliptic type equations Splitting.


**Paper-VII: Group - B**

**Applied Statistics (25 marks)**

Analysis of variance: Introduction, different sources of variation, techniques in one-way and two-way classified data and their computations.

Time series: Introduction, Components of time series, adjustment to time series date, secular trend, Measurement of trend, monthly trend from annual data, Seasonal variation, Measurement of seasonal variation. Cyclical fluctuation, Business forecasting, Exponential smoothing.

Index Numbers: Introduction, Methods of construction of Index numbers, Tests of Index numbers, chain base method, cost of Living Index numbers, Bias in Laspeyres and Paasche's formula for C.L.I., Base shifting. Splicing and Deflation, Errors in Index numbers.

Statistical Quality control: Introduction, chance and assignable causes, control chart for variables and attributes, Formulae for central lane and control limits, Sampling Inspection, Single and Double Sampling Inspection Plans.

OR

**Paper-VII, Group-B, Marks-25**

**Computer Science - III**

**Computer Graphics:**

Overview of graphics system: Video display devices, Cathode-Ray tube, Rasterscan displays, Graphics software.

Points & lines, line drawing algorithms, Circle generation.

2D transformations: Translation, rotation, scaling, reflection, matrix representation, Clipping. Point & line.

3D transformation: Scaling, rotation, reflection, translation & projection, equation of plane.

What is AI? AI technique.


Knowledge representations and mappings, approaches to Knowledge.
Fluid Mechanics

1. Irrotational Motion in Two Dimensions:


Vortex Motion


Viscous Flow:


Magnetohydro Dynamics


Mathematical Methods

Laplace transform, Properties of Laplace transform, Inversion formula, Convolution Application to ordinary and partial differential equation.


Paper-VII, Group-B, Marks-50

Either

Elements of optimization and operation research
Revised simplex method (with and without artificial variables), Post optimality analysis: Change in the objective function, change in the require
Convex programming Dynamic programming. Integer programming Gemory's cutting plane algorithm, (Gemory's mixed integer program algorithm) A branch and bound algorithm, inventory model (deterministic)

OR

Paper-VIII, Group-B, Marks-50

Dynamical Oceanography and Meteorology

Dynamical Oceanography:

Dynamical Meteorology:
Energy in a compressible atmosphere, change in potential energy due to adiabatic interchange of small parcels, dissipation of energy.

General circulation, its schematic description and theory (in outline).

Rate of change of circulation. Geostrophic and thermal wind. The geostrophic balance, the geodynamical paradox, Surface of discontinuity. Classification of fronts. Formation of cyclones. Aerological diagrams, its purpose and use.

SPECIAL PAPER

Paper-IX, Marks-100

Advanced Optimization And Operations Research-1
Optimization:
Revised simple method (with and without artificial variable) Bounded variable Technique Dual Simplex method Modified dual simplex method.

**Parametric and post-optimal analysis:**
Change in the objective function Change in the requirement vector, Addition of a constrain, Change in the coefficient matrix, Parametric analysis of cost and requirement vector.

**Large scale linear programming:**
Decomposition principle of Dantzig and Wolfe, Composite simplex algorithm.

**Non-linear programming.**

**Quadratic Programming:**

**Unconstrained optimization:**
Search Methods: Fibonacci and golden section method.

**Gradient Method:**
Method of conjugate directions for quadratic function, Steepest descent and Daveden-Fletcher-Powell method.

**Constrained Optimization:**
Methods of feasible direction and cutting hyperplane method.

**Integer Programming:**
Gomory's cutting plane algorithm, Gomory's mixed integer problem algorithm, A branch and bound algorithm.

**Goal Programming:**

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**SPECIAL PAPER**
**Paper-IX, Marks-100**
**Dynamical Oceanography**

**Thermodynamics of Equilibrium State:**
Gibb's relation, Thermodynamic potentials, Definition of Salinity, Sea water as two component mixtures. Entropy Internal energy and Chemical potential of sea water, Adiabatic gradient of temperature and coefficient of compressibility of sea water, equilibrium conditions of sea water.

**Thermodynamics of Irreversible Processes:**

Basic concept of turbulence, Reynold's stresses, equation of turbulent energy, Coefficient of turbulent exchange Closer of the system of average equation for the large scale flow, Boundary conditions, Geostrophic motion, Ekman layer on a free surface, Vertical shear layers.

**Homogeneous Midels of the wind-driven steady oceanic circulation:**
Derivation of the wind-driven steady oceanic circulation, Derivation of the Vorticity equation in terms of geostrophic stream function and the relevant boundary conditions. The Svendrup relation, Meridional boundary layers, Bottom friction layer, intertial boundary layer theory. Inertial currents in the presence of friction dissipation integrals for steady circulation, Ekman upwelling circulation.

SPECIAL PAPER

Paper-X, Marks-100

Dynamical Meteorology

Thermodynamics of Red Atmosphere:

Basic laws of thermodynamics, potential temperature, Lapserate Atmospheric water vapour. Equation of state for Dry and Moist air, Dry weather, virtual Temperature, Adiabatic changes in unsaturated Moist Air and in saturated Moist Air, Pseudoadiabatic change, Equivalent Temperature and Equivalent Potential Temperature, Saturated adiabatic Lapse Rate, Stability in saturated adiabatic changes, conditional Instability, Isobaric Cooling, Condensations by Isobaric cooling.

Aerological Diagrams:


The general circulation and monsoon meteorology Atmosphic wave. Numerical wave prediction.

Froats, Cyclones and Anticyclones:

Surface of discontinuity, Pressure distribution near Fronts, Temperature and wind distribution at Fronts, Classification of Fronts. The geostrophic Fronts. The motion of Froants, Tropical Cyclones, CISK, The wave theory of cyclones, Storm Surges.

Atmosphere Turbulence:

Praisits theory of momentum transfer, the vertical variation of the wind in an above the surface layer, Vertical Mixing Air Masses.

Practicals (20+5)=Marks

1. Surface temperature, pressure, humidity, Wind speed and direction measurements.
2. Rainfall and rain measurements.
3. TD charts-analysis.
4. T-Q diagram:
   i) Geopotential height by isotherm/adiabatic method.
   ii) To find dry bulb and wet bulb temperature, potential, virtual, equivalent potential, dew point temperatures and mixing ratio.
6. Field work & Lab Visit-5 marks (compulsory): Students should go at least for few days to one of the University /Institute/ Organisation laboratory (preferably in the Laboratory of IMDIISC, IITM, NPL IIT etc) to understand experiments set-ups in Meteorology (such as Annular experiment for existence of general circulation and Rossby wave, experiment for demonstrating Helmholtz instability, Aerosol measurements. Facrimile recorder for receiving weather charts etc).

SPECIAL PAPER
Paper-X, Marks-100

Advanced Optimization And Operations Research-II

Dynamic Programming:

Stochastic Programming: Chance Constraint programming technique.

Optimal Control:

Sequencing:
Problems within jobs two machines, n-jobs three machines and n-jobs, m-machines.

Theory of Games: Continuous Games, Convex games Separable Games.

Inventory control:
Inventory control deterministic (including price breaks), probabilistic (with and without lead time) fuzzy and dynamic in ventory models.

Queuing Theory:
Poisson and Non-Poisson (M/G/I, G/M/I, M/D/C, Machine-Maintenance etc.) queues steady state.

Geometric Programming:
Geometric Programming (both unconstrained and constrained)

Reliability:
Concept System Reliability. System Failure rate Reliability of the Systems connected in series on and parallel.

Network: PERT and CPM

Introduction, Basic difference between PERT and CPM. Steps of PERT/CPM Techniques, PERT/CPM Network component and precedence relationships, Critical path analysis. Probability in PERT analysis Project Time-Cost, Trade-off, Updating of the project, Resource allocation resource smoothing and resource leveling.

Replacement and Maintenance Models:
Introduction Failure Mechanism of items, Replacement of items deteriorates rates with time, Replacement policy for equipments when value of money changes with constant rate during the period. Replacement of items that fail completely-individual replacement policy and group replacement policy, Other replacement problems-staffing problem, equipment renewal problem.

Simulation:
Introduction Steps of simulation process, Advantages and disadvantages of simulation, Stochastic simulation and random
numbers Monte Carlo simulation. Random number Generation, Simulation of Inventory Problems, Simulation of Queueing problems. Role of computers in Simulation Applications of Simulations.

**Information Theory:**

Introduction Communication Processes-memory less channel, the matrix, Probability relation in a channel, noiseless channel.

A Measure of information Properties of Entropy function, Measure of Other information quantities-marginal and joint entropies, conditional entropies, expected mutual information, Axion for an Entropy function properties of Entropy function.

Chemel capacity efficient and redundancy.

Encoding - Objectives of Encoding.

Shannon-Cano Encoding Procedure, Necessary and sufficient Condition for Noiseless Encoding.