PROGRAMME PROJECT REPORT

PROGRAMME – MASTER OF ARTS/SCIENCE (M. A./ M.Sc.) IN MATHEMATICS: SEMESTER MODE

PREPARED BY CIQA, DODL, DIBRUGARH UNIVERSITY FOR THE ACADEMIC SESSION 2020-21 ONWARDS

PRESENTED BEFORE

- **The Second Meeting of CIQA Committee on 29.11.2019 for onward process**

Forwarded under report to the forthcoming meeting of BoM and BoS to recommend to the statutory bodies

PLACED BEFORE

- **The 150th Meeting of the Post Graduate Board on 05.12.2019**
- **The 118th Meeting of the Academic Council on 10.12.2019**

APPROVED BY THE

- **The 150th Meeting of the Post Graduate Board on _____**
- **The 118th Meeting of the Academic Council on _____**

Under report to the BoS in Mathematics and Approved by the Local BoS members

(Dr. Arun Kr. Baruah) **(Dr. Bishwaram Sharma)** **(HoD)**

PROGRAMME PROJECT REPORT (PPR)
PROGRAMME:- M.A./M.SC. IN MATHEMATICS (SEMESTER MODE)
PREPARED BY CIQA, DODL, DIBRUGARH UNIVERSITY FOR THE ACADEMIC SESSION 2020-21 ONWARDS

(a) Programme's mission & objectives:

Mission:

To provide quality higher education in the field of Mathematics enabling learners to develop analytical aptitude and deep knowledge in the subject through open and distance learning mode without having to worry about the constraints of time and place.

Objectives:

The following are the main objectives of the Programme:

- To produce educated manpower for undertaking teaching, research and related activities in Mathematics and allied branches of basic or applied sciences by offering time flexibility needed to balance work and studies.
- To provide opportunities for continuing and developmental education by offering "second chance" to those who have had to discontinue their formal education in Mathematics or could not join regular colleges or universities owing to social, economic and other constraints.
- To provide opportunities to the large segments of the population who could not take admission in regular colleges or universities due to limitation of seat capacity and to other groups such as working people, women and persons who wish to acquire and upgrade their knowledge and skills in Mathematics.
- To provide opportunities to the Science and Engineering graduates passing Mathematics as one of the subjects who want to upgrade their qualification while being in their present jobs for career advancement.

(b) Relevance of the program with HEI's Mission and Goals:

The programme is highly relevant with the mission and goals of Dibrugarh University which aims to provide learners with an environment for critical thinking, for negotiating multiple perspectives and for creative problem solving.

(c) **Nature of prospective target group of learners:**

The target group of learners for the programme is those who have completed their graduation in Science, Engineering or other disciplines having Mathematics as one of the subjects. This group includes working people who want to upgrade their qualification for career advancement, learners who could not get the opportunity to pursue the programme in regular colleges and universities and other interested persons of different age groups who had to discontinue education after graduation.

(d) **Appropriateness of programme to be conducted in open and distance learning mode to acquire specific skills and competence:**

The programme is very much aligned with the vision of open and distance learning, particularly affirming the interconnection of self-learning and counselling to reach the unreached. Since, Mathematics is a subject which requires learners to spend a lot of time working independently to solve problem sets with occasional support from the counsellors, so it is highly suitable for Open and Distance Learning. After successfully completing the programme, the learners can compete for employment or research positions in government, industry and non-profit organizations.

(e) **Instructional design:**

The Programme in Mathematics is offered through Open and Distance Learning mode. The Programme has the required Self Learning Materials for each Course/Paper. Apart from the Self Learning Materials, Video CD and Recorded Lectures and Discussion are provided through Radio Broadcasting Programme '*Gyanmalinee*'. Moreover, face to face counselling, telephonic support and mobile app are also used in the teaching/learning mechanism.

The two year (four semester) M.Sc in Mathematics programme consist of fourteen (14) core courses and two (2) elective courses having four (4) credits in each, leading to a total of sixty four (64) credits. In the fourth semester out of four courses, two courses will be compulsory and two will be optional. Each course will include 2 assignments. The learners will have to earn 64 credits over a period of 2 to 4 years to successfully complete this programme.

COURSE STRUCTURE:

FIRST SEMESTER
(All courses are compulsory)

Course code	Course Name	No. of Assignments	Practical Sessions	Size of SLMs Range	No. of Counselling Sessions Theory (10% of total study hours	Study input (in terms of hours)	Credit Value of the course
Math-101	Real Analysis	2	---	14 units	12	120	4
Math-102	Algebra and Logic	2	---	16 units	12	120	4
Math-103	Differential Geometry	2	---	14 units	12	120	4
Math-104	Mechanics	2	---	15 units	12	120	4

SECOND SEMESTER
(All courses are compulsory)

Course code	Course Name	No. of Assignments	Practical Sessions	Size of SLMs Range	No. of Counselling Sessions Theory (10% of total study hours	Study input (in terms of hours)	Credit Value of the course
Math-201	Complex Analysis	2	---	14 units	12	120	4
Math-202	Tensor	2	---	14 units	12	120	4
Math-203	Differential Equation and Integral Equation	2	---	16 units	12	120	4
Math-204	Inviscid Fluid Mechanics	2	---	15 units	12	120	4

THIRD SEMESTER
(All courses are compulsory)

Course code	Course Name	No. of Assignments	Practical Sessions	Size of SLMs Range	No. of Counselling Sessions Theory (10% of total study hours	Study input (in terms of hours)	Credit Value of the course
Math-301	Topology	2	---	14 units	12	120	4
Math-302	Measure theory	2	---	14 units	12	120	4
Math-303	Advanced Fluid Dynamics	2	---	16 units	12	120	4
Math-304	Numerical Analysis	2	---	15 units	12	120	4

FOURTH SEMESTER

Course code	Course Name	No. of Assignments	Practical Sessions	Size of SLMs Range	No. of Counselling Sessions Theory (10% of total study hours	Study input (in terms of hours)	Credit Value of the course
Math-401	Functional Analysis	2	---	15 units	12	120	4
Math-402	Computer programme	2	---	14 units	12	120	4
Optional paper (Any one group – 'A', 'B' or 'C')							
Math-403(A)	Number Theory	2	---	14 units	12	120	4
Math-404(A)	Graph Theory	2	---	15 units	12	120	4
Math-403(B)	Abstract Algebra	2	---	14 units	12	120	4
Math-404(B)	Operator Theory	2	---	16 units	12	120	4
Math-403(C)	Magneto-hydrodynamics	2	---	14 units	12	120	4
Math-404(C)	Non-linear Dynamical System	2	---	16 units	12	120	4

Detailed syllabus:

Course Math - 101
Real Analysis
Credits: 4

Block I : Metric Spaces **Marks-25**

Metric space and its toplogy, Weistrass theorem, Compactness, Connectedness, Heine Borel theorem, Continuity and Compactness, Continuity and Connectedness, Uniform Continuity, Completeness.

Block II : Riemenn - Stielties Integral **Marks-25**

Definition and Existence of Riemann - Steiltijes Integral, Properties of the Inegral, Integration and Differentiation, the fundamental theorem of calculus, Integration of vector-valued functions.

Block III: Uniform Convergence **Marks-30**

Sequences and series of functions, Point wise and Unoform convergence, Cauchy criterion for uniform Convergence, Supremum test, Wetrastras : M test, Uniform Convergence and Continuity, Uniform Convergence and Riemann-Steiltijes integration, Uniform Convergence and Differentiation, Welerstrass's approximation, theorem, Power series and uniqueness theorem for power series.

Recommended Books:

1. S.C. Malik and S. Arora, Mathematical Analysis, New Age International (P) Ltd.
2. Walter Rudin, Principles of Mathematical analysis, McGrawHil.
3. T.M. Apostol, Mathematical Analysis, Narosa Publishing House, New Delhi.

Course Math - 102
Algebra and Logic
Credits: 4

Algebra

Block I : **Marks-16**

Conjugate Elements, Class equations of finite groups, Structure Theory of Groups, Sylow's theorem, Cauchy's theorem on order of a finite group, Finite Abelian groups, Solvable Groups.

Block II : **Marks-20**

Polynomial rings, Factorization in R(x), Factorization theory in Integral Domains, Euclidian Domain, Unique Factorization Domain, Algebraic Extension of Fields.

Block III: **Marks-20**

Vector Spaces and Subspaces, Basis and Dimensions, Linear Mappings, matrices and linear operators, Linear functionals and the dual space.

Logic

Block IV: **Marks-12**

The prepositional Calculus sentential connectives, truth tables, tautologies, adequate sets of connectives, Validity, consequence, applications of the statement calculus.

Block V : **Marks-12**

Symbolizing everyday language, quantifiers, interpretations, satisfiability and truth, Models validity, consequences.

Recommended Books:

1. Basic Abstract Algebra by P.B. Bhattacharya, S.K. Jain, S.R. Nagpaul, Cambridge University Press.
2. Modern Algebra by Surjeet Singh and quazi Zamiruddin, Vikash Publications.
3. Scahum's Outline of Theory and Problems of Linear algebra by S. Lipschutz. Mc Graw - Hill Book Co.
4. Introduction to Mathematical logic by Van Nostrand.
5. Set Theory and Logic by Robert R. Stoll.

Course Math - 103
Differential Geometry
Credits: 4

Block 1: Space curves, tangent plane, Normal Plane, Osculating plane, principal normal, binormal, rectifying plane, curvature, torsion, screw curvature, Serret Frenet formula, helices. **Marks-12**

Block 2: Fundamental of space curves, uniqueness theorem, osculating circule, osculating sphere, involute and evolute, spherical indicatrix and Bertrand curves. **Marks-12**

Block 3: Different forms of surfaces, order of contact between, curves and surfaces. Class of a surface, regular and singular points on a surface, curvilinear, co-ordinates, parametric curves, tangent plane and normal. **Marks-14**

Block 4: One parametric family of surfaces, characteristics, envelope, edge of regression.
Ruled surface, developable surface, developable associated with a surface curve, osculating developable, polar developable, rectifying developable, two parameters family of surface. **Marks-14**

Block 5: Fundamental Forms : First order magnitude, first fundamental form, second fundamental forms, geometric interpretation of the second fundamental form, Weinarten equation. Family of curves, angle between two directions, orthogonal trajectories. **Marks-14**

Block 6: Curves on a Surface: Normal section, Normal curvature, Meusnier's theorem, principal directions, principal curvature, mean curvature, Gaussian curvature, lines of curvature, Rodrigues's formula, Euler theorem.
First fundamental form, conjugate directions, asymptotic lines theorem of Beltramiand, geodesics, geodesic tangent, torsion and curvature of a geodesic, geodesic curvature and geodesic torsion, normal angle, kg = kn tan w, k2 = kg2 + ku2. Liouville's formula for kg. **Marks-14**

Recommended Books :
1.Differential Geometry by Weatherburn, Radha Publishing House.
2.Differential Geometry by Eisenhart, Pribceton University Press.

Course Math - 104
Mechanics
Credits: 4

Block I **Marks-16**

Rigid Body Motion : Eulerian Angles, Angular momentum and Kinetic Energy of the rigid body, motion about a point, method of solving problems of rigid body motion, Euler's equation of motion, torque free motion of a rigid body. Poinsot's geometrical description of motion of rigid body.

Block II **Marks-16**

Lagrangian Formulation : Holonomic and non holonomic dynamical systems, rhenomic and scleronomic dynamical systems, generalized co-ordinates and degrees of freedom; generalised velocity, generalised forces.
Momenta and kinetic energy in terms of generalised velocities; D'Alembert's principle and Lagrange's equation of motion; generalised momenta and kinetic energy in terms of generalised velocities.

Block III **Marks-24**

Technique of calculus of variation. Euler's Equation, the brachistochrone problem. The configuration space and the Hamilton's principle of least action, Derivation of Lagranges equation from Hamilton's principle, Lagranges equation of motion for nonholonomic systems. Conservation theorems and symmetry properties, the Routhian function, Lagrange's equation for small oscillation.

Block IV **Marks-24**

Hamilton's Equiation : Hamilton's canonical equation of motion, canonical variable, cyclic co-ordinates, canonical transformation, generating functions, Lagrange's and Poission's brackets. Integral invariants of Poincare. Hamilton Jacobi Theory : Hamilton's Principle function, Jacobi's complete integral, time-independent Hamilton Jacobi equation, separation of variables.

Recommended Books:

1. Classical Mechnics : by H Goldstein, Narosa publishing house, Delhi.
2. Classical Mechanics : by C.R. Mandal, Prentice Hall, New Delhi.
3.Dynamics Part II : by A.S. Ramsay, CBS Publisher, Delhi.
4.Classical Mechanics : by Gupta Kumar and Sharma, Meerut.

Course Math - 201
Complex Analysis
Credits: 4

Block I : Complex Integration **Marks-35**

Complex integration, Cauchy-Goursat theorem, Morera's theorem, Cauchy's integral formula, Higher order derivatives, Cauchy's inequality, Lieuville's theorem, Fundamental theorem of algebra, Maximum modulus theorem, Schwarz lemma.

Block II : Series **Marks-30**

Taylor series, Laurent series, Classification of singularities, residues, Cauchy's residue theorem, Evaluation of integrals, Rouchis theorem, argument principle .

Block III: Conformal Mappings **Marks-15**

Bilinear transformation and its properties, conformal mappings and their properties.

Recommended Books:

1. R.V. Churchill & J.W. Browh, Complex Variables and Applications, 5th edition, 1990.

2. Murray R. Spiegel, Theory and problems of Complex variables (Schaum's Outline series), SI (Meric) edition, 1981.

Course Math - 202
Tensor
Credits: 4

Block 1: Basic Concepts : Summation convention, Kronecker delta, Generalized Kronecker delta.
Permutation symbols, Determinants in tensor notation, General curvilinear co-ordinates, Basic vectors and reciprocal base vectors, Examples. **Marks-16**

Block 2: Tensor Algebra : Absolute and relative tensors, Symmetric and skew-symmetric tensors, Addition and subtraction of tensors, Outer product, Contraction, Inner product, Quotient rule, Examples. **Marks-16**

Block 3: The line element, Metric tensor, Associated tensors, Length of a curve, magnitude of a vector, Angle between two vectors, Vector algebra in tensor notation, Physical components of a tensor, Examples. **Marks-16**

Block 4: Christoffel symbols: Definition of Christoffel symbols, Christoffel symbols in terms of metric tensors, Christoffel symbols in orthogonal co-ordinate systems, Examples. **Marks-16**

Block 5: Covariant differentiation : The covariant derivatives of tensors, Rules of covariant derivative, Gradient, Divergence, Curl and Laplacian in tensor notation, Riemann-Christoffel tensor, Examples. **Marks-16**

Recommended Books :

1.Vector and Tensor Analysis by Harry Lass, Mc Graw Hill Book Company.
2.Tensor calculus by Barry Spain, Radha Publishing House.
3.Vectors, Tensor and Basic equations of Fluid Dynamics by R. Aris, Dover Publication.

Course Math - 203
Differential Equations and Integral Equations
Credits: 4

Block I : Differential Equations **Marks-44**

Ordinary Differential Equations : Intial-value problems. Boundary value problems, Existence and uniqueness theorem of the solution of $dy/dx = f(x,y)$. Strum-Liouville boundary-value problems, Wronskian.

Partial Differential Equations of First & Second Order : Partial differetial equations, Origins of first-order partial differential equations, Cauchy's problem for first-order equations, Linear equations of the first order, Integral surface passing through a given curve. Surface orthogonal to a given system of surfaces.

Nonlinear partial differential equations of the first order, Compatible systems of first-order equations, Chapit's method. Special types of first-order equations, Jacobi's method, Linear partial differential equations of second order with constant co-efficient, Characteristic curves of second-order equations, Reduction to canonial forms, Separation of variables, Solutions of nonlinear equations of the second order by Monge's method.

Laplace's Equation, The Wave Equation, The Diffusion Equation : The occurence of Laplace's equation in Physics, Boundary value problems, Solution of Lapace's equation by separation of variables, The theory of Green's function for Laplace's equation.

The occurence of the Wave equation in Physics, Elementary solutions of the one dimensional Wave equation, The occurrence of the Diffusion equation in Physics, Elementary solution of the Diffusion equation, Solution of the Diffusion equation by separation of variables.

Block II : Integral Equations **Marks-36**

Volterra Integral Equations : Basic concepts, Relationship between linear differential euqations and Volterra integral equations, Resolvent kernel of Volterra integral equation, Solution of integral equation by resolvent kernel. The method of sucessive approximations, Convlution-type equations, Volterra integral equations with limits (x - a), Volterra integral equations of the first kind, Euler integrals, Abel's problem, Able's integral equation and its generalizations, Volterra integral equations of the first kind of the convolution type.

Fredholm Integral Equations : Fredholm equations of the second kind. The method of Fredholm determinants, Iterated kernels, Constructing the resolvent kernel with the aid of iterated kernals, Integral equations with degenrate kernel, Characteristic numbers and eigenfunctions, Solution of homoeneous integral equations with degerate kernel, Nonhomogeneous symmetric euqations.

Recommended Text Books :

1. Differential equations by Shepley L. Ross, John Wiley & Sons.
2. Elements of partial differential equations by Ian. N. Sneddon, Mc Graw - Hill Book Company.
3. Problems and exercises in integral equations by George Yankovsky, MIR Publishers.
4. Differential Equations by George F. Simmons, Tata McGraw-Hill Publishing Company Limited, New Delhi.

Course Math - 204
Inviscid Fluid Mechanics
Credits: 4

Block I **Marks-12**

KINEMATICS : Real and ideal fluid, velocity of a fluid at a point, stream lines and path lines, steady and unsteady flows, velocity potential, rotational and irrotational motions, local and particle rate of change, equation of continuity, examples, acceleration of a fluid at a point, general analysis of fluid motion.

Block II **Marks-12**

EQUATIONS OF MOTION : Euler's equation of motion, Bernoulli's equation, steady motion under conservative forces, impulsive motion. circulation, Kelvin's circulation theorem.

Block III **Marks-20**

GENERAL THEORY OF IRROTATIONAL MOTION :Potential flow, mean value of velocity potential, deductions from Green's theorem, kinetic energy of a liquid, Kelvin's minimum energy theorem, uniqueness theorems.

Block IV **Marks-20**

MOTION IN TWO DIMENSION :Meaning of two dimensional flow, stream function complex potential for standard two dimensional flows, sources sinks and doublets, two dimensional image systems, Milne-Thomson circle theorem and its applications, Magnus effect, Blasius theorem, infinite circular cylinder in uniform stream with circulation.

Block V **Marks-16**

AXI-SYMMETRIC MOTION IN THREE DIMENSION : Axi-symmetric flows, Stoke's stream function and its physical meaning, stationary sphere in a uniform stream, pressure on the surface of a sphere, thrust on a hemisphere, d'Alembert's paradox, stream lines, sphere moving with constant velocity in a liquid which is otherwise at rest, kinetic energy of the fluid.

Recommended Text book and reference books :

1. Text book of Fluid Dynamics by F. Chorlton, CBS Publishers & Distributions, 1999, 4596/1A, 11 Darya Ganj, New Delhi-1100052 (India).
2. A Treatise on Hydrodynamics Part by W.H. Besant and A.S.Ramsey, The English Language Book Society and G.Bell and Sons, Ltd., London.
3. Theoretical Hydrodynamics, by L.M. Milne Thomson, Macmillan & Co.
4. Modern Fluid Dynamics by N. Curle and H. J. Davies, Van- Nostrand Reinhold Company, 1968.

COURSE : MATH - 301
TOPOLOGY
Credits: 4

Block 1: Topological spaces: Definition and examples of topological spaces. Closed sets, Closure, Dense subsets, Neighbourhoods, Interior, exterior and boundary, accumulation points and derived sets, Bases and sub-bases Subspaces and relative topology, Product topology (only finite case), quotient topology, Continuous functions and homeomorphism. **Marks-25**

Block 2: Separation and countability: First and second countability spaces, Lindeof's space. Separable spaces, Second countability and separability. Separation axioms T0, T1, T2, T3, T4; their characterization and basic properties. **Marks-20**

Block 3: Compactness: Compactness, Continuous function and compact sets, basic properties of compactness, compactness and finite intersection properties. **Marks-18**

Block 4: Connectedness: Connetedness spaces, connetedness on the real line, components, Pathwise connectedness. **Marks-17**

Recommended Books:

1. K. D. Joshi, Introduction to General Topology, Wiley Eastern Ltd.
2. M. G. Murdeswar, General Topology, Wiley Eastern Ltd.
3. James R. Munkres, Topology, A first course, Prentice Hall of India Pvt. Ltd., New Delhi.
4. George F. Simmons, Introduction to topology and Modern Analysis, Mc Graw-Hill Book Company.
5. B. C. Chatterjee, S. Ganguly, M.R. Adhikari, A textbook of Topology, Asian Books Pvt. Ltd.

COURSE : MATH - 302
MEASURE THEORY
Credits: 4

Block 1: Measurable Sets: Algebras and s-algebras generated by a class of subsets, Outer measure, Lebesgue measure, measurable sets and their properties. Borel sets, Cantor's ternary set, characterization of measurable sets non measurable sets, Idea of measure in R2 and R3. **Marks-30**

Block 2: Measurable Functions: Properties of measurable functions, step functions, characteristic functions, simple functions, continuous functions, set measure zero, Borel measurable function.
Egoroff theorem, realization of non negative measurable functions as the Limit of an increasing sequence of simple functions: Lucin's theorem, Frechet theorem, convergence in measure. **Marks-30**

Block 3: Lebesgue Integral: Reimann Integrals, comparison to Lebesgue and Reimann integrable functions, Lebgesgue integral of a simple function, Bounded convergence theorem. Integral of a non negative measurable Lebesgue integral, dominated convergence theorem. **Marks-20**

Recommended Text Book and Reference Books:

1. Real Analysis (ed -3) by H.L. Royden, Mc Millan, New York, 1988.
2. Measure and Integration by G.D. Berra, New Age International Publication, 1992.
3. Principles of Mathematical Analysis (ed-3) by W. Rudin, Mc Graw Hill, Khogakusha, International Students Edition, 1976.

COURSE : MATH - 303
ADVANCE FLUID DYNAMICS
Credits: 4

Block - I **Marks-15**

Vortex Motion: the vorticity vector, vector, vortex lines, Helmholtz's vorticity theorems, equation for the rate of change of corticity, line vortices, image of a line vortex in an infinite plane, single infinite row of line vortices, Karman vortex street.

Block- II **Marks-20**

Equations of Motion for Viscous Flow: Stress components in a real fluid, relation between Cartesian components of stress, translational motion of fluid element, stress analysis in fluid motion, relation between stress and rate of strain, the coefficient of viscosity and laminar flow.

The Navier-Stokes equation of motion of a viscous fluid, rate of change of circulation, diffusion of vorticity, energy dissipation due to viscosity, dimensional analysis, Reynolds number.

Block - III **Marks-25**

Exact Solutions Of Navier-Stokes Equation: Parallel flow, Parallel flow through a straight channel, Couette flow and generalized Couette flow, Hagen-Poiseuille flow through a pipe, the flow between tow concentric rotating cylinders. Flow due to a plane wall suddenly set in motions, unsteady flow between two parallel plates, Flow due to an oscillating plate.

Block - IV **Marks-20**

Two Dimensional Boundary Layer: The boundary layer concept, boundary layer thickness, displacement, energy and momentum thickness, the phenomenon of separation and vortex formation.

Pradtl's boundary layer equations, similar solutions of the boundary layer equations, the boundary layer along a flat plate, the momentum and energy integral equations for the boundary layer.

Recommended Books:

1. Text book of Fluid Dynamics by F. Chorlton, CBS Publishers & Distributers, 4596/1-A, 11 Daryaganj, New Delhi-110002. Pages: 75, 76, 126, 127, 174, 207, 208, 310-314, 318-324338-345 for unit I &II.
2. Boundary Layer Theory written by Dr. Hermann Schilichting translated by Dr. J. Kestin, McGraw Hill Book Company Inc., New York.
3. An Introduction to Fluid Dynamics by R.K. Rathy, Oxford & IBH Publishing Co. Calcutta for Unit -V.
4. Viscous Fluid Dynamics by J.L. Bansal Oxford & IBH Publishing Co, New Delhi,Bombay, Calcutta.
5. Theoretical Hydrodynamics by L.M. Milne Thomson, McMillan, London.
6. Viscometric flows of Non-Newtonian Fluids by B. D. Coleman, H. Markkovitz and W. Nell, Springer-Verlag New York Inc. 1996.

COURSE : MATH - 304
NUMERICAL ANALYSIS
Credits: 4

Block – 1 **Marks-16**

Matrix Algebra: Matrix inversion, solution of simultaneous equation by Gauss method of elimination, Gauss-Jordan method, Gauss-Siedal iteration methods. Gauss Jacobi, Crouts Methods.

Block - 2 **Marks-16**

Solution of algebraic and Transcendental Equations: The method of false position. Newton-Raphson method, method of iteration, bisection method, secant method.

Block - 3 **Marks-16**

Numerical Quadrature: Cote's formula, Trapezoidal quadrature, Simpson's quadrature, Weddle's quadrature. Gauss quadrature.

Block - 4 **Marks-16**

Solution of Differential Equations: Euler's method, Milne's Predictor-corrector method Runga-Kutta methods, finite difference method for first order equations, wave equations and diffusion equation.

Block – 5 **Marks-16**

Curve Fitting: Normal equations, least square method, Chebychev polynomials and curve fitting.

Recommended Books:

1. Computer Based Numerical Algorithms by E.V. Krishnamurthy and S.K. Sen, East-West Press Pvt.Ltd.
2. Numerical Mathematical Analysis by J.B. Scourbourough.
3. Introduction to Numerical Analysis by F. B. Hildebrand, Tata McGraw Hill.

COURSE : MATH - 401
FUNCTIONAL ANALYSIS
Credits: 4

Block 1: Normed Linear Spaces and Branch Spaces : Definition, examples and basic properties, the Euclidean space E^n, the unitary space Cn, The space (n), 1p; The space; The Sequence Space; The Function Space C[a, b]; Theorems; Subspaces; Quotient Spaces. **Marks-15**

Block 2: **Bounded Linear Operators on Normed and Banch Space**: Definitions, Examples and Properties of Bounded Linear Operators, Spaces of Bounded Linear Operators, Open Mapping Theorem (Statement only) and its consequences; Closed Graph Theorem and its consequences. **Marks-20**

Block 3: Bounded Linear Functionals on Normed and Banch Space: Examples and properties of bounded linear functions; Dual Spaces; Hanh- Banach Theorem and its Consequences. **Marks-15**

Block 4: Inner Product and Hilbert Spaces : Definitions and basic properties of inner product spaces; and Hilbert spaces, orthogonality of vectors orthogonal complements and projection theorem; orthonormal set of vectors and Fourier analysis, complete orthonormal set. **Marks-15**

Block 5: Linear Functionals and Linear Operators on Inner Product and Hilbert Spaces : Bounded Linear functions, Hilbert-adjoint operators, self-adjoint operators; normal operators; unitary operators; Orthogonal Projection Operators. **Marks-15**

Recommended Books:

1. P. K. Jain, O.P. Ahuja, and K. Ahmed, Functional Anaysis, New Age International (P) Limited.
2. B. Choudhary and S. Nanda, Functional Analysis with Applications. New Age International (P) Limited.
3. E. Kreyszing, Introductory Functional Analysis with Applications, John Wiley & Sons, New York.
4. B. V. Limaye, Function Analysis Wiley Eastern Ltd.
5. I. J. Maddox, Elements of Functional Analysis, Cambridge University Press.

COURSE : MATH - 402
COMPUTER PROGRAMME
Credits: 4

Block 1 **Marks-10**
Introduction to C- Programming.
Basic Programming concept.
The programming to solving problem : Flowcharts, Algorithm.

Block 2 **Marks-10**
Variables : Data types.
Input and output statements.
Samples of Simple C- programme Errors.

Block 3 **Marks-15**
Operators : Arithmetic Operators, comparison operators, Logical operators, precedence among the different types of operators, the parenthesis.

Block 4 **Marks-10**
If statement, IF ..... ELSE statement, multiple criteria using AND and OR, nested Ifs, The DO case statement.

Block 5 **Marks-15**
Loops: The WHILE loop, DO..... WHILE loop, REPEAT..... UNTIL loop, the FOR loop. Nested Loop, Breaking out of a loop, skipping a part of a loop.

Block 6 **Marks-10**
Function : Subprograms, functions, standard functions, function Libraries.

Block 7 **Marks-10**
Arrays : Declaring an array, Array elements strings as arrary, multidimensional away.

Recommended Text Book and Reference Books:

1. Programming in C. V. Rajaraman, Prentice Hall of India.

COURSE : MATH - 403(A)
NUMBER THEORY
Credits: 4

Block – I **Marks-20**

Quadratic Residues: Quadratic residues, primitive roots, the Legender symbol, Euler's criterion.
Gauss' lemma, the Law of quadratic reciprocity, Jacobi symbol.

Block – II **Marks-20**

Diophantine equations: Equation ax+by=c, the equation $x^2+y^2=z^2$ and $x^4+y^4=z^4$ Fermal's last theorem. Representation of a number by sum of two squares, sum of three squares, Four square problem.

Block – III **Marks-20**

Farey Fractions and Continued Fractions: Farey Sequence, Continued Fractions, Notion of Convergent and infinite Continued Fractions. Application to Equations, Quadratic Irrationals, Pell's equation, Fibbonaci Numbers.

Block – IV **Marks-20**

Algebraic Number: Algebraic number, Algebraic Number field, Algebraic integers.
Quadratic Field: Quadratic Fields, Units in Quadratic Field, Prime in Quadratic Field; Definition, units in quadratic field, prime in quadratic field.

Recommended Books:

1. A First Course in Theory of Numbers, By K. C. Chowfhury, Asian Books Pvt. Ltd. 2004.
2. An Introduction to the Theory of Numbers 3rd Edition by I. Niven an H.S. Zuckerman, Wiley Eastern Limited, 1972.

COURSE : MATH - 404(A)
GRAPH THEORY
Credits: 4

Block - I **Marks-16**

Graph : Definition of Graph, Finite and infinite graphs, Incidence and degree, Isolated vertex, Pendant vertex, Null graph, a brief history of graph theory, Isomorphism 01' graphs Subgraphs, Walks, Paths, Circuits, Connected graphs, Disconnected graphs, Component, Euler graphs, Hamiltonian paths and circuits.

Trees, Some properties of trees, Pendant vertices in tree, Distance and centers in a tree, Rooted and binary trees, Labeled graph, Spanning tress, Finding all spanning trees of a graph.

Block - II **Marks-16**

Operations On Graphs: Cut-sets, Some properties of a cut-set, Connectivity and separability, Blocks, Planar and non-planar graphs, Kuratowshi's two graphs.

Different representations of a graph, Matrix representation of graphs, Incidence matrix, Adjacency matrix, Graph matchings, Graph coverings.

Block - III **Marks-16**

Directed Graphs: 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 tress.

Block - IV **Marks-16**

Algorithms, Shortest-path algorithms, Shortest path form a specified vertex to another specified vertex, Shortest path between all pairs of vertices, Transitive closure of a digraph. Activity network, Topological sorting, Critical path, Graphs in Computer programming (basic concepts).

Block - V **Marks-16**

Data Structures: Concept of Data structures, Data structure operations, Time-space tradeoff, Complexity of algorithms (Analysis of algorithms), Strings, String constants, String, variables, String operations, Word processing. Linear arrays, Representation of linear arrays in memory', Traversing linear arrays, Inserting and deleting in linear arrays. Pointers, Pointer arrays, Records, Record structures, Linked lists, Representations of linked lists in memory, Stacks, Array represetentation of stacks, Arithmetic expressions using stacks, Recursion, Oueues.

Recommended Text and Reference Books:

1. Graph theory with applications to engineering and computer science by Narshing Deo, Prentice-Hall of India Private Limited, New Delhi.
2. Theory and problems of data structures by Seymour Lipschutz, Schaum's online series, McGraw-Hill Book Company.
3. Graph Theory of F. Harary, Addison Wesley, 1969.
4. Data Structure and Algorithms by A. V. Aho, J.E. Hopcroft & J. D. Ulman, Addison Wesley, 1983.

COURSE : MATH - 403(B)
OPERATOR THEORY
Credits: 4

Block – I **Marks-20**

Spectral Theory of linear operators in Normed Spaces: Spectral theory in Finite dimensional Normed spaces.

Basic concepts, Spectral properties of bounded linear operators Banach Algebra.

Block - II **Marks-20**

Compact Linear operators and their spectrum: Compact linear operators in normed spaces.

Spectral properties of compact linear operators

Block - III **Marks-20**

Spectral theory of bounded self-adjoint linear operators self-adjoint linear operators, positive operators, projection operators and their spectrum.

Block – IV **Marks-20**

Unbounded Linear operator in Hilbert Spaces : Unbounded Linear operators and their Hilbert adjoint operators.

Symmetric and self adjoint operators, Closed linear operators and closures, Multiplication and Differentiation Operators.

Recommended Books:

1. Introductory Functional Analysis with Applications by Erwin Keryszing, John Wiley & Sons.

COURSE : MATH - 404(B)
ABSTRACT ALGEBRA
Credits: 4

Block - I **Marks-20**

Modules and Vector Spaces : Definition and examples, Submodules and direct sums, Rhomomrphisms and quotient modules. Completely reducible modules; Fee modules, Representation of linear mappings, Rank of a linear mapping.

Block - II **Marks-20**

Normal and separable exensions: Splitting fields, Normal extensions, multiple roots, finite fields, Separable extensions.

Block - III **Marks-20**

Galois Theory: Automorphism of Groups and fixed, field, Fundamental theorem of Galois theory, Fundamental theorem of Algebra. Applications of Galois theory to classical problems: Roots of unity and cyclotomic polynomials, Cyclic extensions, Polynomials solvable by radicals, Ruler and compass constructions.

Block - IV **Marks-20**

Chain condition on rings: Noetherian modules and rings, Hilbert basis theorem. Artinian modules and rings.

Recommended Books:

1. P.B. Bhattacharya, S.K. Jain, S.R. Nagpaul, Basic abstract algebra, Cambridge University Press, Indian edition.
2. I. N. Herstein, Topics in Algebra, Wiley eastern Ltd., New Delhi.
3. S. Singh and Q. Zameeruddin, Modern algebra, Vikas Publising House Pvt. Ltd.
4. University Algebra, N.S. Gopalakrishna Wiley Eastern Ltd.

COURSE : MATH 403(C)
MAGNETOHYDRO DYNAMICS
Credits: 4

Block - I **Marks-16**

MHD APPROXIMATIONS: The electrical properties of fluid: the electric and magnetic field, Lorentz force, action at a distance, the low frequency approximations, energetic aspect of MHD, Magnetic energy.

Block- II **Marks-20**

The Kinemantic Aspects of MHD: The magnetic induction equation, the analogy with vorticity, Diffusion, and convection of magnetic field, Magnetic Reynolds number, the dynamo problem, Alfven's theorems, Cowlings problem, Ferraro's law of isorotation.

The two dimensional kinematic problem with field in the direction of no variation, the two dimensional kinematic problem with field in the direction of variation, the two dimensional kinematic problem with Current in the direction of no variation.

Block- III **Marks-18**

The Magnetic Forces and Its Effects: The magnetic force and the interia force, Magnetic stresses, Principal directions and stress.

Magnetohydorstatic, the linear pinch confinement scheme, the force free field, the magnetic force in moving fluid, invalidation of Kelvin's theorem on vorticity, the case of irrotational force per unit mass.

Block - IV **Marks-16**

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

Block - V **Marks-10**

Linear Magnetohydrodynamics: Linearised MHD equations for (i) one dimensional case: The Steady Hartmann flow problems, Posiseuille type flow, Couth type flow, Linear Alfven Waves.

Recommended Text and Reference Books:

1. A Text Book of Magnetohydrodynamics by J. A. Schercliff. Academic Press.
2. An Introduction to Magneto-fluid Mechanics by V.C.A. Ferraro and C. Plumton Oxford, University Press.

COURSE : MATH - 404 (C)
NONLINEAR DYNAMICAL SYSTEM
Credits: 4

Block - I **Marks-16**

Nonlinear Systems and Bifurcation: Introduction to nonlinear system, origin of bifurcation theory, transcritical bifurcation, pitchfork bifurcation, Hopf bifurcation.

Classification of bifurcation of equilibrium points, classifications of bifurcation in one dimension, imperfections, classification of bifurcations in higher dimensions.

Block - II **Marks-32**

Difference Equations: Introduction to difference equations, stability of fixed points, periodic solutions and their stability.

Attractors and volumes. The logistic equation, lterated maps of complex plane, logistic map, square map, Julia Set, Mandelbrot set.

Block - III **Marks-32**

Ordinary Differential Equations: Autonomous system, nonautonomous system, Duffing equation, Hamiltonian systems, geometry of orbits, stability of periodic solution. Second order autonomous differential systems, linear systems.

The Liapounv's method of Proving stability and instability of equilibrium points, Liapounv's theorem. The Lindstedt-Poincare method, Limit cycles. The Poincare Bendixson theorem, vanderpol's equation.

Recommended text Book:

1. Nonlinear Systems by P. G. Drazin, Cambridge University Press, 1992.

Reference Books:

1. Nonlinear Dynamics and Chaos Geometric Methods for Engineers and Scientists. J. M. J. Thompson, H. B. Stewart John Willey And Sons. New York.

Research and Media Support Service

The Research and Media Support Service wing has been established with a twofold objective to facilitate in house research Distance Education as well as supplement the distance learners with multi-media facilities. It includes information about the various events organized by the Directorate, assisting in administrative works, support with ICT tools etc.

Media Support Service provides supplementary support to the Learners as follows:

*Radio Programmes GYANMALINEE***:** On every Thursday at 8pm from All India Radio, Dibrugarh Centre, (M/W- 521.1)

Multi-media CDs: The Directorate has decided to provide its learners with course related Video CDs, which may give a good support to the learning process of the learners.

Bulk SMS: The Bulk SMS to the learners providing information regarding Counselling programmes, Personal Contact programmes, Assignments, Date and Results of Examination, other Administrative and Examination related information and so on. Updating all the necessary information in the website www.dodl.dibru.ac.in

Internet facility:

All enrolled learners of the Directorate can avail the facility of the computer laboratory with internet facility in the HQs of the Directorate. Moreover, they can update themselves by logging in the website of the Directorate.

Faculty and support staff requirement:

There is one full-time faculty for this programme at DODL, DU and will take the help and services from the faculties of parent department and from the faculties of nearby Colleges.

Office Staff: One office assistant, One peon.

Learner Support Service:

- *Study Materials*

  The Directorate has prepared all the study materials in the Self learning material (SLM) format in coordination with the course writers and editors through the help of the workshops sponsored by Distance Education Council, IGNOU, New Delhi.

- *Personal Contact Programes / Counselling Programmes*

  Directorate conducts weekend counselling for its learners. Theses weekend counsellings can be availed by willing learners on payment of minimal fees which will be notified by the directorate in the induction meeting. The personal contact programmes for undergraduate courses shall be provided by the study centers and the coordinators will inform the schedules to the learners enrolled at their respective study centers.

- *Induction Meet*

  The DODL organizes one day Induction Meet for the learners before commencement of counselling Sessions of first semester to give a clear map of the open and distance learning . It is a two way interactive meet.

- *Learners meet*

  The DODL organizes one day learners meet to address their different problems related to their process of learning.

- *Assemblaze*

  The Cultural and Sports confluence are organized at DODL for the learners annually.

(f) Procedure for admissions, curriculum transaction and evaluation:

- ***Admission procedure****:*
  - (i) Graduates (10 + 2 + 3 pattern) from any recognized university in the Major or Honours or General courses may apply for admission into a post-graduate course offered in Distance Education, D.U. and get themselves registered as learners of Distance Education, D.U.
  - (ii) Provisionally admitted learners shall have to produce the transcript issued by the institution last attended or, the original mark sheet and other testimonials for verification at the Office of the DODL, D.U. as and when call for. On production of transcript/original mark sheet and other testimonials, their admission to the DODL, D.U. will be confirmed latest by January.
  - (iii) Students admitted shall be issued enrolment no.
  - (iv) Notwithstanding any rules and procedures, a student may be refused admission if his/her past conduct in the educational institution last attended has not been satisfactory. A student who has been expelled/ rusticated or disqualified by the university may also be refused admission.
  - (v) Admission of a student can be cancelled at any stage if it is found that he/she furnished incorrect information or has suppressed facts to secure admission. If any dispute arises out of such refusal/ cancellation, the decision of the Vice-chancellor, D.U. shall be final.
  - (vi) The fees for the Post-Graduate Programmes in Distance Education shall be fixed by the university from time to time. Such fee shall include Admission Fee, Counseling Fee, Course Material Fee, Postal charges etc., payable in single installment at the time of admission. No cash deposition of fees shall be considered. Fees shall be accepted only in the form of a demand draft. Otherwise online payment mode of fees is highly recommended.
  - (vii) The subject taken for M. A. / M. Com. programme may not necessarily be one of the subjects in his/her degree course. The candidate may be allowed to appear in any subject having relevant/ allied subject at the degree level.
  - (viii) Mathematics in Degree level is a mandatory requirement for the learner who wants to take admission into the M.A. / M.Sc. Programme in Mathematics.
  - (ix) A Master Degree holder under Distance Education may be allowed to appear at the Master Degree Examination again in a different programme or group if otherwise eligible. But two simultaneous degree of any kind in any mode of education in the same institution or /and in different institution shall not be allowed.
  - (x) Medium of Instruction (course materials & counseling) and Examination for the courses shall be English except for M.A. in language subjects.
  - (xi) Study materials with Guidelines will be supplied to a student within a month from the last date of admission.

Admission notices/advertisements for various programmes of the Directorate of Open and Distance Learning, Dibrugarh University, are published in leading newspapers, both English and Assamese, at least forty-five days prior to the date of admission. Other than the DODL website www.dodl.dibru.ac.in, it is also notified in the Dibrugarh University website, www.dibru.ac.in. Candidates are to apply in the prescribed Application form only. Apart from the online admission process, the admission form along with the Prospectus for offline mode can be downloaded from the website www.dodl.dibru.ac.in.

- **Admission Fees:**

Rs 2500 (Course Fee / Semester) + 900 (Counseling Fee / Semester) + 400 (Enrolment Fee for the entire period of study to be paid only at the time of first entry level) + 300 (Gymkhana Fee for the entire period of study to be paid only at the time of first entry level)*.

* The Gymkhana Fee of Rs. 300/- is meant only for the learners of Dibrugarh University DODL Study Centre and the same goes to the University General Fund use explicitly for Student Activities.

- **Schedule of Programme:**

A Post-Graduate programme under Distance Education shall be conducted in four parts – (Semester I, Semester II, Semester III and Semester IV). The schedule for the Distance Education System shall be as shown below:

(i)	Odd Semesters (i.e., First and Third) :	July to December (including End Semester Examinations)
(ii)	Even Semesters (i.e., Second and Fourth):	January to July (including End Semester Examinations)

The total marks in a Post-Graduate Programme in Distance Education shall be as follows:

a) All the M.A. /M.Sc. / M.Com. Programmes of DODL, D.U. are of 2-years duration and the total credit ranges from 64-72.
b) Total marks for the two years M.A. /M.Sc. / M.Com. Programmes of DODL, D.U. shall be 1600 per programme.
c) 20% of the marks in each course shall be assessed through assignments.
d) Rest 80% of the marks in each course (paper) shall be assessed through University End Semester Examination.

The syllabus for each course (paper) shall be divided into block and units keeping in view the Credit value of the course. The norms for delivery of courses through distance mode are as under:

Credit Value of the course	**Study input (hours)**	**Size of SLMs (unit)**	**No. of Counselling Sessions Theory (10% of total Study hours)**	*** Practical Session (hours)**
2 credits	60	6 – 8	6	60
3 credits	90	10-12	9	90
4 credits	120	14 – 16	12	120
6 credits	180	20 – 24	18	180

* Some Programmes have practical component also. Practicals are held at designated institutions/ study centres for which schedule is provided by the study centre. Attendance at practical is compulsory.

- **Assignment:**

(i) Assignment shall be a compulsory component of the evaluation process.

(ii) 20% of the each course (paper) shall be assessed through Assignments (Inter Assessment – In Semester Examination). Rest 80% of the marks in each course (paper) shall be assessed through University End Semester Examination

(iii) The assignments to be submitted by a student would depend upon the Credit value of the Course, as follows:

Credit value of the course	No. of Assignments
2 Credits	1
3 credits	2
4 credits	2
6 credits	2

(iv) A candidate may submit assignments in the office of the Directorate of Distance Education or at the Study Centres within the stipulated time. Subsequently the study centres shall transmit all the assignments programme-wise and course-wise to the office of the DODL for assessment.

(v) Marks secured on the assignments by the candidates, who appeared in the examinations but failed, shall be carried over to the next permissible chances.

(vi) Marks secured on the assignments by the candidates who filled in the examination forms but did not appear in the examination, shall also be carried over the next permissible chances.

(vii) A candidate who fails to submit the assignments as per clauses shall be awarded zero in the In Semester Examination in the course where assignment(s) is (are) not submitted.

(viii) The Internal Assessment evaluation system for the Post Graduate Programme under DODL, Dibrugarh University shall also be assessed and evaluated in OMR (Optical Marks Response) Sheet through Multiple Choice Objective Type Questions and Answers by conducting mid-term examinations.

- ***Examination and Evaluation***

(i) Examination and Evaluation shall be done on a continuous basis.

(ii) There shall be 20% marks for internal assessment (In Semester) and 80% marks for End Semester Examination in each course during every Semester.

(iii) There shall be no provision for re-evaluation of the answer-scripts of the End Semester Examinations. However, a candidate may apply for re-scrutiny.

(iv) Internal assessment is assignment based or OMR based.

(v) End Semester Examination:

(a) There shall be one End Semester Examination carrying 80% marks in each course of a Semester covering the entire syllabus prescribed for the course. The End Semester Examination is normally a written / laboratory-based examination.

(b) The Controller of Examinations shall then make necessary arrangements for notifying the dates of the End Semester Examinations and other procedures as per Dibrugarh University Rules (at least 20 days in advance) and the Academic Calendar / Date Sheet notified by the University / DODL, Dibrugarh University.

(c) The End Semester Examination for each course shall be of three hours duration.

(d) Setting of question papers, moderation of question papers, evaluation of answer scripts, scrutiny, tabulation of marks etc. and announcement of result of results, shall be governed by the Dibrugarh University Examination Ordinance 1972 (as emended up to date).

(vi) Betterment Examination:

(a) A learner shall be entitled to take the "Betterment Examination" in any two theory courses of any of the four semesters after passing the Fourth Semester Examination only once. In this case the higher marks secured by the student shall be retained. The learner shall have to apply for betterment examination within one year after passing the Fourth Semester Examination.

(b) No betterment shall be allowed in the practical examination.

(vii) A learner shall be declared as passed a course, provided he / she secures –

(a) at least 45% marks in each course (paper) in the End Semester Examination.

(b) at least 45% marks in the course (paper) in aggregate in the In-and End-Semester Examination.

(viii) A learner shall be declared as passed a Semester, provided he / she passes all the courses of a Semester independently.

(ix) The marks of In – Semester Examinations (i.e., Internal Assessment) obtained by the learner shall be carried over for declaring any result.

(x) A learner who fails or does not appear in one or more courses of any End Semester Examinations up to Fourth Semester shall be provisionally promoted to the next higher Semester with the failed course(s) as carry over course(s). Such learners will be eligible to appear in the carry over course in the next regular examinations of those courses. However, the following restrictions shall be applicable:

"A learner shall be entitled to avail the chance for a maximum of 5 consecutive years from the date of admission to clear a course or courses as well as the whole programme".

(xi) If a learner clears the Fourth Semester Examination before clearing all the courses of the previous semesters, the result of such candidate shall be kept withheld and his / her results shall be announced only after he / she clears the courses of the previous semesters.

(xii) A learner must pass all his / her Semester Examinations within 5 years from the date of admission to the First Semester of any programme.

(xiii) A learner shall be declared to have passed the Fourth Semester M.A. / M. Sc. / M. Com. Degree Programme provided he / she has passed all the Semesters and in all the course separately.

(xiv) The system of evaluation in DODL, D.U. is different from that of the Conventional Department of the University. It has a multi-tier system of evaluation:

(a) Self-assessment exercise within each unit of study.

(b) Continuous evaluation mainly through assignments and/or Internal Assessment Examination through Multiple Choice Questions (MCQ) using OMR sheet.

(c) Term-end examination.

(d) Project work (Programme specific).

(xv) The marks secured by a student in the Assignment / IA – In Semester Examination (20% of each course) is added with the marks secured in that course in End Semester examination which is 80% of the course.

(xv) The following scale of grading system shall be applied to indicate the performance of students in terms of letter grade and grade points as given below:

% of marks obtained in a course (Assignment + Term End)	Letter Grade	Grade Point	Qualitative Level
Above 95	O	10	Outstanding
85 – < 95	A^+	9	Excellent
75 – < 85	A	8	Very Good
65 – < 75	B^+	7	Good
55 – < 65	B	6	Above Average
50 – <55	C	5	Average
45 – < 50	P	4	Pass
Below 45	F	0	Fail
0	Abs/I	0	Absent / Incomplete

(xvi) The letter Grade 'B^+' and above shall be considered First Class; the Letter Grade (s) 'B' to 'P' shall be considered as Second Class. However, letter Grade 'B' shall be considered as Second Class with minimum of 55% marks.

(xvii) A learner is considered to have completed a course successfully and earned Letter Grade other than 'F' (Failed) or Abs / I (Absent / Incomplete).

(xviii) If a learner secures 'F' Grade in a Course, he / she shall have to reappear in the Course in the next legitimate chance.

(xix) Result of the learners appeared in the 'Betterment' examination shall not be counted for the award of Prizes / Medals / Rank or Distinction.

(xx) A learner shall have to pay a prescribed fee to appear in the 'Betterment' Examination fixed by the University from time to time.

- **Conversion of Marks to Grades and Calculation of GPA (Grade Point Average)**

In the Credit and Grade Point System, the assessment of individual courses in the concerned examinations will be on the basis of marks only, but the marks shall later be converted into Grade by some mechanism wherein the overall performance of the learners can be reflected after considering the Credit Points for any given course. However, the overall evaluation shall be designated in terms of Grade. There are some abbreviations used here that need understanding of each and every parameter involved in grade computation and the evaluation mechanism. The abbreviation and formulae used are as under:

- **Abbreviations and Formula's Used:**

G : Grade
GP : Grade Points
C ; Credits
CP : Credit Points
CG : Credit X Grade (Product of Credit & Grades)
Σ CG : Sum of Product of Credits & Grade Points
Σ C : Sum of Credit Points.

$$GPA = \frac{\Sigma CG}{\Sigma C}$$

GPA : Grade Point Average shall be calculated for each Previous and Final Year Examination.

CGPA : Cumulative Grade Point Average shall be calculated for the entire programme by considering both Previous & Final Year taken together. It shall be calculate by the formula given below:

$CGPA = (\sum\sum C_{ni}\, G_{ni}) / (\sum\sum C_{ni})$

Here,

C_i = number of credit for the i^{th} course,
G_i = grade point obtained in the i^{th} course,
C_{ni} = number of credit if the i^{th} course n^{th} the year,
G_{ni} = grade point of the i^{th} course of the n^{th} year

After calculating the GPA for an individual year and the CGPA for the entire Programme, the value can be matched with the grade in the Grade Point table in (xvi) above

* GPA and CGPA shall be rounded off to 2 decimal points and reported to the Grade Card (Sheet) and Transcript.

- **Conversion Formula**:
  Ordinarily the CGPA earned by a student may be converted to percentage of marks by following the formula mentioned as under:
  CGPA×10 = Percentage of Marks

- **Grade Card / Sheet (Reporting of Learners Performance):**
  The Grade Card / Sheet issued at the end of end term examination to each learner shall contain the following:
  a. The marks obtained by a learner in each course,
  b. The credit earned for each course registered for that year,
  c. The performance in each course indicated by the letter grade,
  d. The Grade Point Average (GPA),
  e. The cumulative Grade Point Average (CGPA) and
  f. Conversion formula.

- **Transcript:**
  The University may issue consolidated Transcript on request to the Controller of Examinations which shall contain letter grades, grade points, GPA and CGPA mentioning the Course Title in detail, medium of instruction and programme duration.

- **Rules for admission of Unsuccessful and Absentee Candidates**
  Unsuccessful learners fails to complete programme within the stipulated time may take re admission in the programme by paying fees fixed by the University from time to time.

- **General:**

For any matter not covered under these Regulations for the Directorate of Open and Distance Learning, the existing Dibrugarh University Rules, Ordinances and the Dibrugarh University Act, 1965 (as amended), The Dibrugarh University Examination Ordinance, 1972 (as amended up to date) and the Dibrugarh University Distance Education Ordinance, 2006 (amended up to date) shall be applicable.

(g) Requirement of the laboratory support and Library Resources:

The requirement of the Laboratory support does not arise as the M.Sc. in Mathematics programme does not have any practical component in the syllabus.

The Library resources are available for the learners in the Directorate of Open and Distance Learning (DODL), Dibrugarh University. There is a central Library (rechristened as Lakshminath Bezbaruah Granthagar) in the University with a present holding of 2, 22,111print volumes including books and rare publications.

There is also a small library at DODL, DU attached with a reading room for the distance learners. It has more than 5,500 textbooks and reference books regarding different subjects including Mathematics.

(h) Cost estimate of the programme and the provisions:

Keeping an eye on the number of applicants applying for the conventional Master Degree in English at Dibrugarh University and the yearly output of Degree learners with major in English from various affiliated Colleges under Dibrugarh University, it can be estimated that around six-seven hundred learners may seek admission to this Programme. If the cost estimate is calculated on 100 learners, the approximate cost is as follows:

Approximate earning (per 100 learners per annum)	= Rs. 720000/-
Development (*SLM writing, editing, review, printing cost, recording, radio slots, remuneration, etc.*):	= Rs. 450000/- (approx.)
Delivery (*Postage, courier, door delivery, etc.*):	= Rs. 20000/- (approx.)
Maintenance (*Syllabus revision, SLM revision, Committee expenses, etc.*):	= Rs. 10000/- (approx.)
Staff Payment and other Expenses	= Rs. 200000/- (approx.)
Total expenditure (approx.)	= Rs. 680000/-
Hence, total earning per 100 learners	= Rs. (720000.00 - 680000.00) = Rs. 40000.00

(i) Quality assurance mechanism and expected programme outcomes:

Need assessment and tracer studies will be conducted for quality assurance in terms of the Centre for Internal Quality Assurance. Moreover, revision and updating of material by obtaining feedback from learners and resource persons will be done. A high powered committee constituted with the Deans, HoDs, Subject Experts from the University Departments and the Directorate will also monitor the syllabus upgradation, curriculum design, and other pedagogical and academic aspects of all programmes of the Directorate of Open and Distance Learning, Dibrugarh University.

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