M.Sc. (MATHEMATICS)

(Through Distance Education)

ASSIGNMENTS

Session 2018-2020 (3rd-Semester)

&

Session 2019-2021 (I-Semester)

DIRECTORATE OF DISTANCE EDUCATION

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Important Instructions for submission of Online Assignments

i. Attempt all questions from the following assignments. Each question carries marks mentioned in brace.
ii. All questions are to be attempted in legible handwriting on plane white A-4 size paper along with front page and content table.
iii. Each page of the assignment carries Enrolment No.
iv. The Student will have to scan all pages of his/her handwritten assignment in PDF format size maximum 10 MB per assignment.
v. The students will upload assignments on student's portal.
vi. How to upload online Assignments check the Instructions for online submission of Assignment.

Programme: M.Sc. (Mathematics) Semester:-I

Nomenclature of Paper: Algebra

Paper Code: MAL-511 **Total Marks = 15 + 15**

ASSIGNMENT-I

Q.1. Show that every two composition series of a finite group are isomorphic. Explain the same by an example (5)

Q.2. If a group G is solvable then its k^{th} commutator subgroup is trivial. Hence deduce that symmetric group of degree four is solvable. (5)

Q.3. State and prove three subgroup lemma pf P-Hall. (5)

ASSIGNMENT-II

Q.1. If a and b are algebraic over F, then show that $a - b$ is also algebraic over F. Show that $\sin 5^0$ is algebraic number. (5)

Q.2. Show that K is normal extension of F iff it is splitting field of some polynomial over F. (5)

Q.3. Is $Q(2^{\frac{1}{3}})$ a normal extension of Q. (5)

Nomenclature of Paper: Real Analysis

Paper Code: MAL-512 **Total Marks = 15 + 15**

ASSIGNMENT-I

Q.1. If $\{f_n\}$ is sequence of continuous functions on E, and if $f_n \rightarrow f$ uniformly on E, then f is continuous on E. Is the converse true if not provide a suitable example? (5)

Q.2. If $f \in R(\alpha)$ on [a, b] then prove that $f^2 \in R(\alpha)$. What can you say about its converse?

Prove or disprove your assertion. (5)

Q.3. Show that the function

$$f(x,y) + \begin{cases} \frac{xy}{\sqrt{x^2+y^2}}, (x,y) \neq (0,0) \\ 0, \quad (x,y) = (0,0) \end{cases}.$$

Is continuous at origin. (5)

ASSIGNMENT-II

Q.1. Show that Cantor's set is measurable and its measure is zero. (5)

Q.2. If ϕ(x, y) = 0, show that the determinant

$$\begin{vmatrix} f_{xx} + \lambda\phi_{xx} & f_{xy} + \lambda\phi_{xy} & \phi_x \\ f_{xy} + \lambda\phi_{xy} & f_{yy} + \lambda\phi_{yy} & \phi_y \\ \phi_x & \phi_y & 0 \end{vmatrix}$$

where λ is Lagrange's multiplier, is positive, in case the function attains a maximum. (5)

Q.3. If m*(E) = 0, then show that E is measurable. (5)

Nomenclature of Paper: Mechanics

Paper Code: MAL-513 **Total Marks = 15 + 15**

ASSIGNMENT-I

Q.1. Find the directions of principal axes at one of corners for a uniform rectangular lamina of sides '*a*' and '*b*'. (5)

Q.2. Using Lagrangian approach, when time is explicitly absent, prove the following: $\sum_{j=1}^{n} p_j \dot{q}_j$ = 2T, where symbols have their usual meanings. (5)

Q.3. Define Equimomental systems. State necessary and sufficient condition for two systems to be equimomental. Also prove that a parallelogram is equimomental with particles of masses M/6 at mid-points of sides of parallelogram and M/3 at the intersection of diagonals. (5)

ASSIGNMENT-II

Q.1. State and prove Jacobi-Poisson theorem. (5)

Q.2. Show that a family of right circular cones with a common axis and vertex is a possible family of equipotential surfaces and find the potential function. (5)

Q.3. Find the attraction of a thin spherical shell of radius 'a' and surface density 'ρ', when the point is outside the shell. (5)

Nomenclature of Paper: Ordinary Differential Equations-I

Paper Code: MAL-514 **Total Marks = 15 + 15**

ASSIGNMENT-I

Q.1. Convert the given IVP $y'' + y = \cos x, \quad y(0) = 0, \quad y'(0) = 0$ to an integral equation. (3)

Q.2. State and prove Picard Lindelof Theorem. (7)

Q.3. Solve the initial value problem

$$\frac{dx}{dt} = t(x - t^2 + 2), x(0) = 1,$$

by picard method. (5)

ASSIGNMENT-II

Q.1. Solve the Riccati Equation $x(1-x^3)\frac{dy}{dx} = x^2 + y - 2xy^2$. (3)

Q.2. State and Prove Sturm Comparison Theorem. Provide a suitable example. (7)

Q.3. Prove that eigenvalue of a SLBVP are discrete. (5)

Nomenclature of Paper: Complex Analysis-I

Paper Code: MAL-515 **Total Marks = 15 + 15**

ASSIGNMENT-I

Q.1. Verify Cauchy's theorem for integral of z^3 taken over the boundary of rectangle with vertices as -1, 1, 1 + *i* , -1 + *i*. (5)

Q.2. Find the Taylor expansion about zero for f(z) = $\frac{\sin z}{1+z^2}$ and determine the radius of convergence of the corresponding series. (5)

Q.3. State and prove Morera's theorem. (5)

ASSIGNMENT-II

Q.1. State and prove Cauchy's Residue theorem and find the residues of f(z) = $\frac{z^2-2z}{(z+1)^2(z^2+4)}$ at all its poles in finite plane. (5)

Q.2. Define Translation, Rotation, Stretching and Inversion with example and if w = f(z) = u + *i* v be analytic in region R, prove that $\frac{\partial(u,v)}{\partial(x,y)} = \left|f(z)'\right|^2$. (5)

Q.3 Explain different type of singularities with examples. (5)

Nomenclature of Paper: Programming with Fortran (Theory)

Paper Code: MAL-516 **Total Marks = 15 + 15**

ASSIGNMENT-I

Q.1. List the declaration of variables of various data type including KIND specification with examples. (5)

Q.2. Describe the syntax of formatted and format free output statement with example. Explain the format specifications of various data types used for output purpose. (5)

Q.3. Define conditional loop. Explain BLOCK DO statement with syntax and execution. Using the block Do statement, write a program to calculate

$$\sin x = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!} + \qquad (5)$$

ASSIGNMENT-II

Q.1. Define array. Explain the syntax of declaration and initialization of fixed and variable size one and multidimensional array? (5)

Q.2. Define subprogram and its types and differentiate them. Write a program to multiply two matrices using subprogram. (5)

Q.3. Define file and its types. Explain the OPEN statement to create a file for writing the result in a program. (5)

Programme: M.Sc. (Mathematics) Semester:-3rd

Important Instructions

(i) Attempt both questions from the each assignment given below. Each question carries marks mentioned in brace and the total marks are 10.

(ii) All questions are to be attempted in legible handwriting on plane white A-4 size paper and to be submitted online to the Directorate of Distance Education for evaluation.

Nomenclature of Paper: Topology

Paper Code: MAL-631 **Total Marks = 10 + 10**

ASSIGNMENT-I

Q 1. Show that $\overline{A} = A \cup d(A)$ for all $A \subseteq X$. (5)

Q 2. Prove that topological space is compact iff any family of closed sets having finite intersection property has non-empty intersection. (5)

ASSIGNMENT-II

Q 1. Define separable space. Show that every second countable space is separable but converse is not true. (5)

Q 2. Prove that topological space (X, T) is completely normal iff every subspace of X is normal. (5)

Nomenclature of Paper: Partial Differential Equation

Paper Code: MAL-632 **Total Marks = 10 + 10**

ASSIGNMENT-I

Q.1. Find the solution of non-homogeneous heat equation

$$u_t - \Delta u = f(x,t) \quad \text{on } R^n \times (0,\infty)$$
$$u = 0 \quad \text{on } R^n \times \{t=0\}$$

using Dhumel ‘s principle. (5)

Q.2. Find the solution of boundary value problem

$$\Delta u = 0 \quad \text{in } B^0(0,1) \qquad u = g \quad \text{on } \partial B(0,1)$$

using Green function. (5)

ASSIGNMENT-II

Q.1. Solve the Schroödinger’s equation.

$$iu_t + \Delta u = 0 \quad \text{in } R^n \times (0,\infty)$$
$$u = g \quad \text{on } R^n \times \{t=0\}$$

where *u* and *g* are complex valued functions , using transform technique. (5)

Q.2. Find the solution of

$$u_{tt} - u_{xx} = 0 \quad \text{in} \quad R^n \times (0, \infty)$$

$$u = g \ , \ u_t = h \qquad \text{on} \quad R^n \times \{t = 0\}$$

where g and h are given and n is odd. (5)

Nomenclature of Paper: Mechanics of Solid-I

Paper Code: MAL-633 **Total Marks = 10 + 10**

ASSIGNMENT-I

Q.1. State Contraction theorem. Prove that if a_{ij} and b_{mk} are 2nd order tensors, then $a_{ij}b_{ij}$ is scalar. Also obtain the values of the following: $\varepsilon_{ijk}\ \varepsilon_{ijk}$ and $\varepsilon_{ijk}\ \delta_{ik}$ (5)

Q.2. Explain physical interpretation of Cubical Dilatation. Refer the quadric of deformation to a set of principal axes, discuss the nature of deformation when it is an ellipsoid and hyperboloid. (5)

ASSIGNMENT-II

Q.1. The stress components at a point P are given by

$$\begin{bmatrix} 2 & -1 & 3 \\ -1 & 4 & 0 \\ 3 & 0 & -1 \end{bmatrix}$$

Determine the stress at the point P on a plane with normal in the direction (2, 2, 1). Also obtain the normal and shearing stress at the point P on this plane. (5)

Q.2. Define isotropy and orthotropy. Are the principal axes of strain coincide with those of stress for an anisotropic medium with Hooke's law expressed by $\tau_i = c_{ij}\, e_j$, for an isotropic medium? ; For a medium with one plane of elastic symmetry?; and For an orthotropic medium? (5)

Nomenclature of Paper: Fluid Mechanics

Paper Code: MAL-634 **Total Marks = 10 + 10**

ASSIGNMENT-I

Q.1. Find the velocity field $u = (-\Omega y, \Omega x, 0)$ for Ω constant as a possible flow of an incompressible liquid in a uniform gravitational field F ≡ g = (0, 0, −g). (3)

Q.2. Two infinite rows of vortices are placed one below the other, the upper vortices are positive and lower vortices are negative then derive the velocity components at any point z in the flow. (4)

Q.3. Define circulation and vorticity. Using Euler's equation derive equation of vorticity and explain its advantage. (3)

ASSIGNMENT-II

Q.1. Explain briefly why $DF/Dt = 0$ provides an alternative form of the boundary condition for flow in a region of inviscid fluid bounded by the surface $F(x, y, z, t) = 0$. Find the boundary condition on velocity at a fixed plane $y + mx = 0$ and show that the equation $y = m(x + y - Ut)$ represents a certain inclined plane moving with the speed U in a certain direction. Find this direction and obtain the boundary condition at this plane. (4)

Q.2. Show that $u^2/2 + p/\rho + \Omega$ = constant along a vortex line for steady, incompressible, inviscid flow under conservative external forces. (3)

Q. 3. Derive Helmholtz equation for vorticity and discuss the physical significance of the term $(\omega \,.\, \nabla)$ u. (3)

Nomenclature of Paper: Advance Discrete Mathematics

Paper Code: MAL-635 **Total Marks = 10 + 10**

ASSIGNMENT-I

Q.1. Define conditional and biconditional statements. Give an example of each. Show that $p \leftrightarrow q \equiv (p \vee q) \rightarrow (p \wedge q)$ using truth table (5)

Q.2. If Let A = $\{a_1, a_2, a_3, \ldots, a_n\}$ and B = $\{b_1, b_2, b_3, \ldots, b_n\}$ be any two finite sets with n elements. Then the lattice (P(A), ⊆) and (P(B), ⊆) are isomorphic and so have identical Hasse diagram. (5)

ASSIGNMENT-II

Q.1. Define Graphs, Paths, Circuits, Cycles and Subgraphs with example and prove Euler's formula for connected planar graph. (5)

Q.2. State and prove Warshall's algorithm. (5)