M.Sc. (MATHEMATICS)

(Through Distance Education)

ASSIGNMENTS

Session 2023-2025 (3rd Semester)

&

Session 2024-2026 (1st Semester)

CENTRE FOR DISTANCE AND ONLINE 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 have to 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. Define the following along with an example:
(i) Ring
(ii) Prime Field
(iii) Algebraic number and Transcendental
(iv) Separable polynomial
(v) Symmetric rational function (5)

Q.2. Let K be an extension of the field F and the elements α and β of K are algebraic over F. Then α and β are said to be conjugate over F if and only if they have the same minimal polynomial. (5)

Q.3. Let characteristic of F is p ($\neq 0$). Then every algebraic extension K of F is separable if and only if the mapping $\sigma : F \rightarrow F$ given by $\sigma(a) = a^p$ is an automorphism of F. (5)

ASSIGNMENT-II

Q.1. (i) For every positive integer n the polynomial $\emptyset_n(x)$ is irreducible over the field of rational numbers.
(ii) If G is a finite abelian group with the property that the relation xn = e is satisfied by at most n elements of G, for every integer n. Then G is cyclic group. (5)

Q.2. If group G has a composition series then prove that
(i) Every factor group has a composition series
(ii) Every normal subgroup of G has a composition series. (5)

Q.3. Let G be a finite group. Then the following conditions are equivalent.
(i) G is nilpotent.
(ii) All maximal subgroup of G are normal.
(iii) All Sylow p-subgroup of G are normal
(iv) Element of co-prime order commutes
(v) G is direct product of its Sylow p-subgroups (5)

Nomenclature of Paper: Real Analysis

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

ASSIGNMENT-I

Q.1 If f is bounded on [a,b], f has only finitely many points of discontinuity on [a,b], and α is continuous at every point at which f is discontinuous then prove that f belongs to $R(\alpha)$. (5)

Q.2 Prove that the function $f(x, y) = \sqrt{|xy|}$ is not differentiable at the point (0,0) but f_x and f_y both are exists at the origin. (5)

Q.3 Let α be monotonically increasing on [a,b], suppose $f_n \to f$ uniformly on [a,b], then prove that f belongs to $R(\alpha)$ on [a,b] and $\int_a^b f\, d\alpha = \lim_{n\to\infty} \int_a^b f\, d\alpha$. (5)

ASSIGNMENT-II

Q.1 If f maps [a,b] into R^k and if $f \in R(\alpha)$ for some monotonically increasing function α on [a,b] then $|f| \in R(\alpha)$ and $|\int_a^b f\, d\alpha| \leq \int_a^b |f| d\alpha$ (5)

Q.2 Prove that the sequence { f_n }, where $f_n(x) = \frac{x}{1+nx^2}$, x is real, converges uniformely on any closed interval I. (5)

Q.3 Prove that the volume of the greatest rectangular parallelepiped that can be inscribed in the ellipsoid $\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1$ is $\frac{8abc}{3\sqrt{3}}$. (5)

Nomenclature of Paper: Mechanics

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

ASSIGNMENT-I

Q.1 Prove that, in general, there are three principal axes through any point of a rigid body,which are mutually orthogonal. (5)

Q.2. A square of a side "2a" has particles of masses "m/2, 2m, 3m, 4m" at its vertices. Find the principal axes and principal moments of inertia at the centre of the square. (5)

Q.3 State and prove Jacobi Poisson Theorem. (5)

ASSIGNMENT-II

Q.1 Show that Poisson's bracket is Invariant Under Canonical transformation. (5)

Q.2. Show that a family of right cercular cones with z-axis as common axes and Vertexas origin, is a possible family of equipotential surfaces. Also obtain the Potential function. (5)

Q.3. Find the expression for potential at any point outside a thin-spherical shell. (5)

Nomenclature of Paper: Ordinary Differential Equations-I
Paper Code: MAL-514 **Total Marks = 15 + 15**

ASSIGNMENT-I

Q.1 Transform the IVP $\frac{d^2y}{dt^2}$ - 5 $\frac{dy}{dt}$ + 6 y(t) =0, y(0) =0 , $\frac{dy}{dt}$(0)=1 to an equivalent integral equation. (5)

Q.2 Obtain a power series solution in powers of x – 1 of each of the initial value problems by (a) the Taylor series method and (b) method of undetermined coefficients.

(a) $\frac{dy}{dx} = x^2 + y^2$, y(1) = 4

(b) $\frac{dy}{dx} = x^3 + y^3$, y(1) = 1

(c) $\frac{dy}{dx} = x + \cos y$, y(1)=π. (5)

Q.3. Obtain power series solution in the power of x by Taylor' series method
$\frac{dy}{dx} = siny + x$, $y(0) = 0$ (5)

ASSIGNMENT-II

Q.1 Convert the following equations into equivalent first order systems:

(a)$y''' = y'' - x^2{y'}^2$
(b)$y'' - 2xy' + 2ny = 0$
(c) $y''(1 - x^2) - 2xy' + n(n + 1)y = 0$, $-1 < x < 1$ (5)

Q.2. Use Taylor' series method to obtain power series solution of IVP $\frac{dy}{dx} = x^2 + y^2$, $y(0) = 1, in\ the\ power\ of\ x.$ (5)

Q.3. Show that the function f (t, x) = (x+x^2) $\frac{\cos t}{t^2}$ satisfies Lipschitz condition in $|x|\leq 1$, $|t - 1| = \frac{1}{2}$ and find the Lipschitz constant. (5)

Nomenclature of Paper: Complex Analysis-I

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

ASSIGNMENT-I

Q.1 Show that the function $f(z)$ defined by $f(z) = \sqrt{|Re\, Z. Im\, Z|}$ satisfy the C-R equation at the origin, but not differentiable at this point. (5)

Q.2. Find $\int_C \frac{\sin e^z}{z} dz;\quad C: |z| = 1.$ (5)

Q.3. If $f(z) = \frac{3}{(2+z-z^2)}$, then find all different Laurent series expansion. (5)

ASSIGNMENT-II

Q.1. Show that $r^n \cos n\theta$ and $r^n \sin n\theta$ are harmonic for positive integer. (5)

Q.2. Evaluate: $\int_C \frac{z^2-1}{z^2+1} dz;\quad C: |z| = 2.$ (5)

Q.3. Find the Laurent Expansion of $f(z) = \frac{7z-2}{(z+1)z(z-2)}$ in the region $1 < z + 1 < 3.$ (5)

Nomenclature of Paper: Programming with Fortran (Theory)

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

ASSIGNMENT-I

Q.1. Discuss the variable declaration, Syntax of a Fortran program, and list directed input/output statements. (5)

Q.2. Define and explain all Format specifications at the time of output statements. (5)

Q.3. Explain with flow charts the concept of nested-if in detail and discuss the Select Case. (5)

ASSIGNMENT-II

Q.1. Describe with examples the Assignment statement, Arithmetic operators, Logical operators, and Relational operators. (5)

Q.2. Define Arrays and their features. Also, describe the String and operations of the string. (5)

Q.3. Define recursion and explain in brief the intrinsic functions. (5)

Nomenclature of Paper: Programming with Fortran (Practical)

Paper Code: MAL-517 **Total Marks = 15 + 15**

ASSIGNMENT- I

Q.1. Write a program to find the roots of a Quadratic Equation using arithmetic if statement. (5)

Q.2. Write a program to check whether a given number is prime or not. (5)

Q.3. Write a program for Bubble Sorting of an array. (5)

ASSIGNMENT-II

Q.1. Write a program to calculate factorial of a number N using Function. (5)

Q.2. Write a program for fitting of a straight-line $y = mx + c$. (5)

Q.3. Write a program to find transpose of a matrix. (5)

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

Important Instructions

(i) Attempt both questions from each assignment given below. Each question carries marks mentioned in a brace and the total marks are 15 each.

(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 = 15 + 15**

ASSIGNMENT-I

Q.1. Given an example of two topological space X and Y and a mapping $f : X \rightarrow Y$ which is

(i) Open but not closed mapping.

(ii) Closed mapping but not open.

(iii) Both open as well as closed mapping.

(iv) Neither open nor closed mapping.

(v) Homeomorphism (5)

Q.2. (a) Let (X,d) be a metric space. Then the following are equivalent:

(i) X is compact (ii) X is complete and totally bounded.

(b) A toplogical space X is compact iff every collection of closed subset of X with the finite intersection property is fixed, that is, has a non-empty intersection.

(2+3)

Q.3. Let *(X, T)* be the product space of topological space $\{(X_i , T_i)\}\ i \in I$. If *(X, T)* is First Axiom space then each (X_i, T_i) are First Axiom space. (5)

ASSIGNMENT-II

Q.1. (a) Prove that composition of two continuous functions is continuous.

(b) Let $f : (X,\tau) \to (Y,\tau')$ be a function, then the following statement are equivalent:

(i) Inverse image of closed sets in Y is closed in X.

(ii) $f(\overline{A}) \subset \overline{f(A)}\ \forall\ A \subset X$ (2+3)

Q.2. Define the following along with an example:

(i) Derived Set
(ii) Isolated Point
(iii) Induced Topology
(iv) Open Cover
(v) Closure Operator (5)

Q.3. State and establish Kuratorwski's Closure Axioms. (5)

Nomenclature of Paper: Partial Differential Equation
Paper Code: MAL-632 **Total Marks = 15 + 15**

ASSIGNMENT-I

Q.1. Show that $u(x,t) = g(x - tb)$ is required solution of the initial value problem (5)

$$u_t + b.Du = 0 \text{ in } \mathbb{R}^n \times (0,\infty) \quad \text{and}$$
$$u = g \text{ on } \mathbb{R}^n \times \{t = 0\}$$

where $b \in \mathbb{R}^n$ and g is the prescribed function.

Q.2. If f is twice differentiable with compact support, then show that (5)

$$u(x) = \int_{\mathbb{R}^n} \emptyset(x-y) f(y) dy$$
$$= \begin{cases} -\frac{1}{2\pi} \int_{\mathbb{R}^n} \log|x-y| f(y) dy, & n = 2 \\ \frac{1}{n(n-2)\alpha(n)} \int_{\mathbb{R}^n} \frac{f(y)}{|x-y|^{n-2}} dy, & n \geq 3 \end{cases}$$

is a solution of Poisson's equation

$$\Delta = -u\, f \text{ in } \mathbb{R}^n$$

Q.3. Write short note on the followings: (5)

a) Kirchoff's formula,
d) Green's Function.

ASSIGNMENT-II

Q.1. Find the solution of heat equation (5)

$$u_t - \Delta u = 0 \quad \text{in} \times (0, \infty),$$
$$u = 0 \text{ on } \partial U \times [0, \infty)$$
$$u = g \text{ on } U \times \{t = 0\}$$

where $g: U \to \mathbb{R}$ is given,

Q.2. Applying Fourier transform, solve the partial differential equation (5)

$$-\Delta u + u = f \text{ in } \mathbb{R}^n$$

where $f \in C^2(\mathbb{R}^n)$.

Q.3. Solve the Hamilton Jacobi equation (5)

$$u_t + H(Du) = 0 \text{ in } \mathbb{R}^n \times (0, \infty)$$

where H is the Hamilton function.

Nomenclature of Paper: Mechanics of Solid-I

Paper Code: MAL-633 **Total Marks = 15 + 15**

ASSIGNMENT-I

Q.1 Define Kronecker tensor (δ_{ij}) and alternate tensor (ϵ_{ijk}) show that (5)

$$\epsilon_{ijm}\epsilon_{klm} = \delta_{ik}\delta_{jl} - \delta_{il}\delta_{jk}$$

Q.2. Interpret geometrically the strain component e_{13}. (5)

3. The state of stress at any point is given by $\begin{pmatrix} 1 & 1 & 0 \\ 1 & -1 & 0 \\ 0 & 0 & 1 \end{pmatrix}$

Show that the normal component of the stress vector on a plane with normal in thedirection (1, 1, 2) has unit magnitude. Also, obtain the shear stress. (5)

Assignment – II

Q.1. Prove that

$$\nabla^2\theta = -\frac{1+\sigma}{1-\sigma}\, div\, \vec{F}$$

where symbols have their usual meanings. **(5)**

Q.2. Explain the physical significance of elastic constants, Poisson ratio(σ) and Bulkmodulus (κ) in case of a uniform isotropic elastic medium. (5)

Q.3. State generalized Hooke's law. Derive its form for a medium with one-plane of elastic symmetry. (5)

Nomenclature of Paper: Advance Lab-II (MATLAB Programming & Applications)
Paper Code: MMP-634 **Total Marks = 15 + 15**

ASSIGNMENT- I

Q.1. The hyperbolic sine for an argument x is defined as $\sinh(x) = (e^x - e^{-x})/2$. Write an anonymous function to implement this. Use the function to make a plot of the function $\sinh(x)$ for $-6 \leq x \leq 6$. (5)

Q.2. Write MATLAB code to find the curve of best fit of the type $y = be^{mx}$ to the following data

x	0.0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0
y	6.00	4.83	3.70	3.15	2.41	1.83	1.49	1.21	0.96	0.73	0.64

Q.3. Plot the function defined by $f(x) = x^3 - 12x^2 + 40.25x - 36.5$ on the domain $3 \leq \quad x \leq 8$. Find the values and locations of the maxima and minima of the function. (5)

ASSIGNMENT-II

Q.1. Write Use MATLAB's built-in function ode45 with a suitable step size to solve the problem

$$\frac{dy}{dx} = \frac{x^3 - 2y}{x} \text{ for } 1 \leq x \leq 3 \text{ with } y = 4.2 \text{ at } x = 1.$$

Q.2. Solve the simultaneous equations $x - y = 2$ and $x^2 + y = 0$ using solve. Plot the corresponding functions, $y = x - 2$ and $y = -x^2$, on the same graph with x range from -5 to 5. (5)

Q.3. Write MATLAB codes based on Gauss Elimination for solving a system of linear equations. (5)

Nomenclature of Paper: **Fluid Mechanics**

Paper Code: MAL 636 **Total Marks = 15 + 15**

ASSIGNMENT-I

Q.1. The velocity components for a two-dimensional fluid system can be given in the Eulerian system by $u = 2x + 2y + 3t; v = x + y + \frac{t}{2}$.Find the displacement f a fluid particle in the Langrangian system.
(5)

Q.2. Find the streamlines and paths of the particles when

$$\boldsymbol{u = \frac{x}{1+t}, v = \frac{y}{1+t}, w = \frac{z}{1+t}}$$

(5)

Q.3. Show that the kinetic energy of a volume V of liquid of constant density ρ that is moving irrotationally with velocity potential $\phi \;\; is \; -\frac{1}{2}\int_S \phi \frac{\partial\phi}{\partial n} \, dS$ where S denotes the surface of V and n the normal into the liquid. (5)

ASSIGNMENT-II

Q.1. State and prove Milne-Thomson Circle theorem. (5)

Q.2. State and prove the theorem of Blasius. Hence discuss the flow past an infinite circular cylinder in a uniform stream with circulation. (5)

Q.3. Show that under conformal transformation a uniform line source maps into another uniform line source of the same strength. (5)

Nomenclature of Paper: Advance Discrete Mathematics

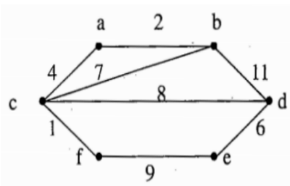
Paper Code: MAL-637 **Total Marks = 15 + 15**

ASSIGNMENT-I

Q.1. Show that the following Boolean expressions are equivalent to one another. Obtain their sum-of-product canonical form.

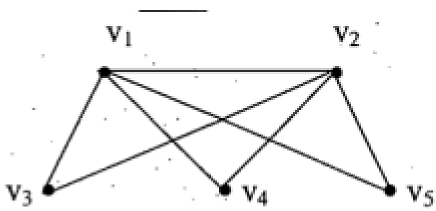
(a) $(x+y)(x'+z)(y+z)$
(b) $(xz)+(x'y)+(yz)$
(c) $(x+y)(x'+z)$
(d) $xz+x'y$. (5)

Q.2. Find a minimal spanning tree for the graph shown below:



(5)

Q.3. Find the adjacency matrix of the graph show below:



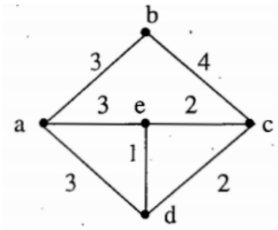
(5)

ASSIGNMENT-II

Q.1. Find the prime implicants and a minimal sum -of-products.

(a) $E_1 = xyz + xyz' + x'yz' + x'y'z$
(b) $E_2 = xyz + xyz' + xy'z + x'yz + x'y'z$

Q.2. Using prim algorithm, find the minimal spanning tree of the following graph:



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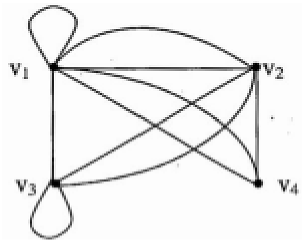

(5)