M.Sc. (MATHEMATICS)

(Through Distance Education)

ASSIGNMENTS

Session 2021-2023 (IV-Semester)

&

Session 2022-2024 (II-Semester)

DIRECTORATE OF DISTANCE EDUCATION
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Programme: M.Sc. (Mathematics) Semester:-II

Important Instructions

(i) Attempt all three questions from the each assignment given below. Each question carries marks mentioned in brace and the total marks are 30.

(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: Abstract Algebra

Paper Code: MAL-521 **Total Marks = 15 + 15**

ASSIGNMENT-I

Q.1. Define invariants of a nilpotent transformation. Show that a nilpotent transformation has unique set of invariants. (5)

Q.2. Using minimal polynomial of T, $T \in A(V)$ write V as a direct sum of its invariant subspaces. (5)

Q.3. Let T be nilpotent. Then show that 5+T is regular. Find the inverse of $5+T^2+7T^3$, it is giventhat the index of nilpotent of T is 7. (5)

ASSIGNMENT-II

Q 1. Define noetherian module with an example. Show that R module M noetherian iff every submodule and factor module of M is noetherian. (5)

Q 2. Show that R module M is artinian iff every quotient module of M is finitely cogenerated. (5)

Q.3. State and Hilbert basis theorem. (5)

Nomenclature of Paper: Measure & Integration Theory

Paper Code: MAL-522 **Total Marks = 15 + 15**

ASSIGNMENT-I

Q.1. Define measurable function and prove that every continuous function is measurable but converse is not true. (5)

Q.2. State and Prove Bounded Convergence Theorem. (5)

Q.3. Prove that every bounded Riemann integrable function is necessarily Lebsegue integrable but not conversely. (5)

ASSIGNMENT-II

Q.1. Define function of bounded variation. State and prove Jordan Decomposition Theorem. (5)

Q.2. Define bounded linear functional. State and Prove Riesz Representation Theorem. (5)

Q3. State and prove Lebesgue Convergence Theorem. (5)

Nomenclature of Paper: Method of Applied Mathematics

Paper Code: MAL-523 **Total Marks = 15 + 15**

ASSIGNMENT-I

Q.1. Solve using Fourier transformations $\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}$, subjected to u(0, t) = 0, u(x, t) = e^{-2x} : x > 0 and u(x, t) is bounded when x > 0, t > 0. (5)

Q.2. Find the expression for velocity and acceleration in spherical coordinate**s.** (5)

Q.3. Find Fourier sine transform of f(t) = e^{-at}. Also define self-reciprocal function under Fourier transform.

ASSIGNMENT-II

Q.1. What do you mean by Poisson distribution? Also obtain its moment generating function and cumulant generating function. Prove that all cumulant are equal for Poisson distribution. (5)

Q.2. Define Normal distribution. Prove that standard deviation is the distance from the axis of symmetry to the point of inflexion. (5)

Q.3. Let $\vec{A}$ be given vector defined w.r.t. two curvilinear coordinates system (u_1, u_2, u_3) and (u_1, u_2, u_3). Find the relation between the covariant components of the vectors in the two coordinate system. (5)

Nomenclature of Paper: Ordinary Differential Equations-II

Paper Code: MAL-524 **Total Marks = 15 + 15**

ASSIGNMENT-I

Q.1. Define an ordinary homogeneous linear differential equation with variable coefficients and discuss its method of solution (5)

Q.2. If the Wronskian of two functions x_1, x_2 on p is non-zero for at least one point of the interval p, then prove that the functions x_1, x_2 are linearly independent on p. (5)

Q.3. State and prove the necessary and sufficient condition for n solution of the nth order homogeneous differential equation to be linearly independent. (5)

ASSIGNMENT-II

Q. 1. Define Phase, Paths and Critical points with suitable example. (5)

Q. 2. Find the extremals of the functional $\int_0^1 \sqrt{1 + y'^2 + z'^2}\, dx$ that satisfy the boundary conditions $y(0) = 0, y(1) = 2, z(0) = 0, z(1) = 4$. (5)

Q. 3. Prove that sphere is a solid figure of revolution, which for a given surface area, has a maximum volume. (5)

Nomenclature of Paper: Complex Analysis-II

Paper Code: MAL-525 **Total Marks = 15 + 15**

ASSIGNMENT-I

Q.1. State and prove Hurwitz's theorem. (5)

Q.2. Using Weierstrass Factorization theorem show that

$$\sin \pi z = \pi z \prod_{n=1}^{\infty} \left(1 - \frac{z^2}{n^2}\right). \qquad (5)$$

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

ASSIGNMENT-II

Q.1. State and prove Great Picard theorem. (5)

Q.2. Derive Poisson-Jensen formula. (5)

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

Nomenclature of Paper: Advanced Numerical Methods

Paper Code: MAL- 526 **Total Marks = 15 + 15**

ASSIGN MENT- I

Q1. Using Gauss's forward formula, find the value of $f(32)$ given that

$$f(25) = 0.2707, f(30) = 0.3027, f(35) = 0.3386, f(40) = 0.3794$$

Q2. Fit a straight line by the method of least squares to the data:

x:	1	2	3	4	5
y:	14	27	40	55	68

Q3. Find the value of x for which f (x) is maximum, using the table

x:	9	10	11	12	13	14
f (x):	1330	1340	1320	1250	1120	930

Also, find the maximum value of f (x).

ASSIGNMENT-II

Q1. Use Romberg's method to compute $I = \int_0^1 \frac{dx}{1+x}$, correct to three decimal places.

Q2. Solve the system

$$\begin{aligned} 2x + y &= 2 \\ 2x + 1.01y &= 2.01 \end{aligned}$$

Q3. Use Milne-Simpson's method to obtain the solution of the equation $\frac{dy}{dx} = x - y^2$ at $x = 0.8$ given that $y(0) = 0, y(0.2) = 0.0200, y(0.4) = 0.0795, y(0.6) = 0.1762$.

Nomenclature of Paper: Computing Lab-MATLAB

Code: MAP-527 **Total Marks = 15 + 15**

ASSIGN MENT- I

Q1. Determine the eigenvalues and eigenvectors of the following matrices using MATLAB.

A=$\begin{bmatrix} 1 & -2 \\ 1 & 5 \end{bmatrix}$, B=$\begin{bmatrix} 1 & 5 \\ -2 & 7 \end{bmatrix}$

Q2. Create three row vectors:

a = [3 -1 5 11 -4 2] , b = [7 -9 2 13 1 -2] , c = [-2 4 -7 8 0 9]

(a) Use the three vectors in a MATLAB command to create a 3 x 6 matrix in which the rows are the vectors a, b, and c.

(b) Use the three vectors in a MATLAB command to create a 6 x 3 matrix in which the columns are the vectors b, c, and a.

Q3. Write a program to operate elementwise operations on matrices.

ASSIGNMENT-II

Q1. Write MATLAB statements to plot the function $y(x) = 2e^{-0.2\,x}$ for the range 0 ≤ x ≤ 10.

Q2. Write an M-file to evaluate the equation $y(x) = x^2 - 3x + 2$ for all values of x between -1 and 3, in steps of 0.1. Do this twice, once with a for loop and once with vectors. Plot the resulting function using a 3-point-thick dashed red line.

Q3. Write a program to find the multiplication of two matrices by using nested for loop.

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

Important Instructions

1. Attempt all questions from the each assignment given below. Each question carries 05 marks and the total marks are 15.
2. 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: Functional Analysis

Paper Code: MAL-641 **Total Marks = 15 + 15**

ASSIGNMENT-I

Q.1. Prove that every norn induces a metric space. Is the converge true if not provide an Example ? (5)

Q.2. Prove that the linear space of all polynomials defined on [0, 1] denoted by P[0, 1] with the norm $\| x \| = \max \{ |x(t)| : t \in [0, 1] \}$is an incomplete normed linear space. (5)

Q.3. Define conjugate space and show that conjugate space of l_p is l_q where $\frac{1}{p} + \frac{1}{q} = 1$ and $1 < p < \infty$. (5)

ASSIGNMENT-II

Q.1. State and prove closed graph theorem and write one of its application. (5)

Q.2. Prove that in a finite dimensional normed linear space the notion of weak convergence and strong convergence are equivalent. (5)

Q.3. State and prove Projection theorem in Hilbert space. (5)

Nomenclature of Paper: Differential Geometry

Paper Code: MAL-642 **Total Marks = 15 + 15**

ASSIGNMENT-I

Q.1. Find the curvature for the curve, $x = 2a\, cos^3\theta$, $y = 2a\, sin^3\theta$, $z = \frac{3}{2} c \cos 2\theta$. (5)

Q.2. Prove that the tangent to the locus of centre of curvature lies in normal plane of the original curve. (5)

Q.3. The normal at point P of ellipsoid $\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1$, meets the co-ordinate planes in A, B, C. Show that the ratio PA : PB : PC are constant. (5)

ASSIGNMENT 1I

Q.1. Define the formula for torsion of a geodesic in terms of principal curvatures. (5)

Q.2. If ψ is the angle between the two directions given by, $P\, du^2 + Q\, du\, dv + R\, dv^2 = 0$. Show that $\tan \psi = \frac{H\sqrt{Q^2 - 4PR}}{ER - FQ + GP}$, where symbols have their usual meanings. (5)

Q.3. Prove that the surface of revolution given by, $x = u \cos \varphi$, $y = u\sin \varphi$, $z = a \log [u + \sqrt{u^2 - a^2}]$ is minimal surface. Also obtain first and second curvatures. (5)

Nomenclature of Paper: Mechanics of Solid-II

Paper Code: MAL-643 **Total Marks = 15 + 15**

ASSIGNMENT-I

Q.1. Define plane strain case. Give its physical significance and obtain the field equations for it. (5)

Q.2. State and prove correspondence principal of linear viscoelasticity. (5)

Q.3. Formulate the plane strain problem in terms of Airy stress function. (5)

ASSIGNMENT-II

Q.1. Solve the torsional problem of a circular beam and obtain torsional rigidity. (5)

Q.2. Show that during plane motion in an elastic unbounded medium, particle motion is of longitudinal and distortional type. (5)

Q.3. State and prove the theorem of complememtary minimum potential energy. (5)

Nomenclature of Paper: Integral Equation

Paper Code: MAL-644 **Total Marks = 15 + 15**

ASSIGNMENT-I

Q.1. Reduce the Boundary Value Problem: y''(x) + A(x) y'(x) + B(x) y(x) = g(x) subjected to y(a) = y_0, y(b) = y_1 : a ≤ x ≤ b to Fredholm integral equation. (5)

Q.2. Show that the integral equation : y(x) = f(x) + $\frac{1}{\pi}\int_0^{2\pi} \sin(x+t)\, y(t)dt$ possesses no solution for f(x) = x. (5)

Q.3. Explain the method of successive approximation for solution of Fredholm integral equation. (5)

ASSIGNMENT-II

Q.1. Find the resolvent kernel of Volterra Integral Equation with K(x, t) = e^{x-t}. (5)

Q.2. State and prove Hilbert-Schmidt theorem. (5)

Q.3. Determine the method of Green’s function for differential equation:

y''(x) = 0, y'(0) = y'(1) = 0. (5)

Nomenclature of Paper: Advanced Fluid Mechanics

Paper Code: MAL-645 **Total Marks = 15 + 15**

ASSIGNMENT-I

Q.1. If a fluid element is undergoing in displacement, deformation and rotation then find rotation vector and vorticity. (5)

Q.2. Transform the shear stress $\tau_{ij} = \begin{pmatrix} 0 & -1 & 2 \\ 2 & -1 & 1 \\ 1 & 0 & 0 \end{pmatrix}$

in the coordinate exes when the original system of axes has rotates through an angle 30^o. (5)

Q.3. Find velocity and volume flow rate of viscous incompressible fluid flowing through a tube of right angle triangular cross-section. (5)

ASSIGNMENT-II

Q.1. Fluid functional relation to combine the quantities length L, velocity v, surface tension σ, density ρ, thermal conductivity κ and gravitational acceleration with the frictional registance $\mathcal{F}$. (5)

Q.2. Find π- term that are involved in a system characterized by the velocity v, density ρ, bulk modulus K, thermal conductivity κ, viscosity μ, length L and mass M. (5)

Q.3. In the Blasius solution of boundary layer flow over a flat plate find valve of boundary layer thickness, displacement thickness and momentum thickness. Also give relation among these quantities. (5)

Nomenclature of Paper: COMPUTING LAB-III

Paper Code: MAP-648 **Total Marks = 15 + 15**

ASSIGNMENT-I

Q.1. What is use of multiline-environment, show by an example. How IEEE eqnarray – environment is used and what are the advantages. (5)

Q.2. Discuss the commands that can be use to write multiple equations. (5)

Q.3. Write syntax for the following

$$P_A(x) = \begin{cases} 0.5 & if\ \ x = 0 \\ 0 & if\ x = 1 \\ -5.0 & if\ x = \ -1 \end{cases}$$ (5)

ASSIGNMENT-II

Q.1. Write syntax for the following

$$G(x) = \begin{cases} a_1 + a_2 = \sum_{k=1}^{N\backslash 2} f_k(x,u) \\ b = g(x,u) \\ y_0 = h(x) \end{cases} \qquad (5)$$

Q.2. Write system for the following

$$\frac{D\vec{q}}{Dt} = -\nabla p + \mu\nabla^2 q + \vec{J} \times \vec{B}$$
$$\nabla . \vec{q} = 0$$
$$u\frac{\partial T}{\partial x} + v\frac{\partial T}{\partial y} = \alpha\left(\frac{\partial^2 T}{\partial x^2} + v\frac{\partial^2 T}{\partial y^2}\right). \qquad (5)$$

Q.3. Construct following table using table environment of Latex

<table>
<tr><td>X</td><td colspan="2">Y</td><td>Z</td></tr>
<tr><td rowspan="2">A</td><td>C_1</td><td>a</td><td>b</td></tr>
<tr><td>C_2</td><td>c</td><td>d</td></tr>
<tr><td rowspan="2">B</td><td rowspan="2">C_3</td><td>e</td><td>f</td></tr>
<tr><td>f</td><td>h</td></tr>
</table>

(5)