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Assignment, Oct-2026

M.A. / M.Sc sem I

· paper-I

Algebra -I

Attempt one Question from each Unit.

Unit-1

1. State and prove the Diamond Isomorphism theorem.
2. Prove that a group G is an internal direct product of its subgroups $H_1, H_2, \dots, H_n$, iff
 - (i) $G = H_1 H_2 \dots H_n$
 - (ii) $H_1, H_2, \dots, H_n$ are all normal subgroups of G
 - (iii) $H_i \cap (H_1 H_2 \dots H_{i-1} H_{i+1} \dots H_n) = \{e\}$

Unit-2

3. Define derived series and show that a group G is abelian iff $G' = \{e\}$.

4. Define composition series. State and prove Jordan-Hölder Theorem

Unit-3.

Unit-3

5. If $F \subseteq K \subseteq E$ are fields with $[E:K]$ and $[K:F]$ finite, then prove that $\frac{E}{F}$ is finite and

$$[E:F] = [E:K] \cdot [K:F]$$

6. If F is a field, then every polynomial $f(x) \in F[x]$ has a splitting field.

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Unit-4

7. Let K/F be a field extension. Then the set $G(K/F)$ of all automorphisms of K which leave every element of F fixed is a subgroup of the group $\text{Aut}(K)$.

8. Let $f(x) = x^3 - 2 \in \mathbb{Q}[x]$, then

(i) find the splitting field of $f(x)$ over $\mathbb{Q}$.

(ii) prove that the Galois group of $f(x)$ over $\mathbb{Q}$ is isomorphic to S_3 .

(iii) find the elements of Galois group of $f(x)$ over $\mathbb{Q}$.

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Assignment
M.Sc. Mathematics I Sem
Paper :II - Real Analysis

Note: Attempt one question from each unit.

UNIT-I

1. Let A^* be an algebra of subsets of a set X and let $\langle A_i \rangle$ be a sequence of sets in A^* . Then prove that there exists a sequence $\langle B_i \rangle$ of sets in A^* such that $B_i \cap B_j = \emptyset$ for $i \neq j$ and
- $$\bigcup_{i=1}^{\infty} B_i = \bigcup_{i=1}^{\infty} A_i$$

2. Let $\{E_i | i \in \mathbb{N}\}$ be a sequence of pairwise disjoint measurable sets, then:-

$$m^* \left(\bigcup_{i=1}^{\infty} E_i \right) = \sum_{i=1}^{\infty} m^*(E_i)$$

i.e. m^* is countably additive on disjoint sets of M .

UNIT-II

3. Let $\langle f_n \rangle$ be a sequence of measurable functions defined on a measurable set E . If $\langle f_n \rangle$ converges in measure to a function f , then prove that there exists a subsequence $\langle f_{n_k} \rangle$ of $\langle f_n \rangle$ which also converges to f almost everywhere on E .

4. If f is a measurable function defined on a measurable set E and if $g \sim f$, then prove that g is also measurable on E .

UNIT-III

5. Let f be a bounded measurable function defined on a measurable set E and let $f(x) \geq 0$ almost everywhere on E . If $\int_E f(x) dx = 0$, then prove that $f(x) = 0$ almost everywhere on E .
6. Let f be a continuous real valued function on $[0,1]$ and $\epsilon > 0$. Prove that there is a polynomial function p such that $|f(x) - p(x)| < \epsilon$ for $x \in [0,1]$.

UNIT-IV

7. Let $\{\phi_i\}$ be an orthonormal system in L_2 -space and let $\{a_i\}$ be a sequence of real numbers such that the series $\sum_{i=1}^{\infty} a_i$ is convergent. Then prove that there exists a function $f \in L_2$ such that $\|f\|^2 = \sum_{i=1}^{\infty} a_i^2$ and $a_i = \langle f, \phi_i \rangle$ for each $i \in \mathbb{N}$.

8. State and prove Riesz - Fisher Theorem.

Paper - II

Differential equation - I

Assignment

Attempt one Question from each Unit
Unit - I

1. Solve: $2y \frac{d^3y}{dx^3} + 2\left(y + 3 \frac{dy}{dx}\right) \frac{d^2y}{dx^2} + 2\left(\frac{dy}{dx}\right)^2 = 2$

2. Solve: $\left(\frac{dy}{dx}\right)^2 - y \frac{d^2y}{dx^2} = n \left\{ \left(\frac{dy}{dx}\right)^2 + a^2 \left(\frac{d^2y}{dx^2}\right)^2 \right\}^{1/2}$

Unit - II

3. Solve: $z(z-y)dx + (z+x)zdy + x(x+y)dz = 0$

4. Solve: $2xz(y-z)dx - z(x^2+2z)dy + y(x^2+2y)dz = 0$

Unit - III

5. Solve Legendre's equation

$(1-x^2)y_2 - 2xy_1 + n(n+1)y = 0$ at an ordinary point.

6. Solve Bessel's equation: $x^2y_2 + xy_1 + (x^2 - m^2)y = 0$, when $2m$ is not an integer (general solution)

Unit-IV

7. Solve: $px - q^s = q^3$

8. Solve: $2s + (xt - s^2) = 1$

M.Sc. (Mathematics) I Semester

Paper-IV (Differential Geometry)

Assignment

Attempt one question from each unit.

UNIT-I

- Q1. State and prove Serret-Frenet formulae.
- Q2. For a point of the curve of intersection of the surfaces $x^2 - y^2 = c^2$, $y = x \tanh \frac{z}{c}$. Show that $\rho = -\sigma = \frac{2x^2}{c}$.

UNIT-II

- Q3. Find the equation to the inflexional tangents through a point (x, y, z) of the surface $\eta^2 \zeta = 4c\xi$.
- Q4. Derive necessary and sufficient condition that a surface $\rho = f(\xi, \eta)$ must represent a developable surface.

UNIT-III

- Q5. Find the Gaussian curvature at the point (u, v) of the anchor ring $x = (b + a \cos u) \cos v$, $y = (b + a \cos u) \sin v$, $z = a \sin u$, where the domain of u, v is $0 \leq u \leq 2\pi$, $0 \leq v \leq 2\pi$. Verify that the total curvature of the whole surface is zero.
- Q6. Prove that for the helicoid $x = u \cos \theta$, $y = u \sin \theta$, $z = c\theta$, $\rho_1 = -\rho_2 = \frac{u^2 + c^2}{c}$, where $u^2 = x^2 + y^2$, and that the lines of curvature are given by $d\theta = \pm \frac{du}{\sqrt{u^2 + c^2}}$.

UNIT-IV

- Q7. Prove that for the surface $x = 3u(1 + v^2) - u^3$, $y = 3v(1 + u^2) - v^3$, $z = 3u^2 - 3v^2$, the asymptotic line are $u + v = \text{constant}$.
- Q8. For the conoid $z = f\left(\frac{y}{x}\right)$, prove that the asymptotic lines consist of the generators and the curves whose projections on the xy -plane are given by $x^2 = af'\left(\frac{y}{x}\right)$, where a is an arbitrary constant.

Assignment

Paper V: Dynamics of Rigid Bodies

Attempt 4 questions. One question from each unit.

Unit -I

1. (a) A plank, of mass M , is initially at rest a line of greatest slope of a smooth plane inclined at angle α to the horizon and a man, of mass m starting from the upper end walks down the plank so that it doesn't move. Show that he gets to the other end in time

$$\left[\frac{2ma}{(M+m)g \sin \alpha} \right]^{1/2}$$

where a is the length of a plank.

- (a) An uniform rod OA of length $2a$, free to turn about its end O , revolves with an uniform angular velocity ω about the vertical OZ through O , and is inclined at a constant angle α to OZ . Show the value of α is either zero or $\cos^{-1}\{3g/(4a\omega^2)\}$

2. (a) State and prove D'Alembert's Principle.

- (b) A rough uniform board, of mass ' m ' in and length $2a$, rests on a smooth horizontal plane and a man of mass M walks on it from one end to the other. Find the distance through which the board moves in this time.

Unit -II

3. (a) A solid homogeneous cone of height h and vertical angle 2α , oscillates about a horizontal axis through its vertex. Show that the length of the simple equivalent pendulum is $\frac{h}{5}(4 + \tan^2 \alpha)$.

- (b) Find the centre of percussion of a triangle ABC which is free to move about its side BC .

4. (a) A heavy circular disc is revolving in a horizontal plane about its centre which is fixed. An insect, of mass $(1/n)$ th that of the disc, walks from the centre along the radius and then flies away. Show that the final angular velocity is $\left(\frac{n}{n+2}\right)$ times the original angular velocity of the disc.

- (b) A small insect moves along a uniform bar, of mass equal to itself and of length $2a$, the ends of which are constrained to remain on the circumference of a fixed circle whose radius is $\frac{2a}{\sqrt{3}}$. If the insect starts from the middle point of the bar and moves along the bar with relative velocity V ; show that the bar in time t will turn through an angle $\frac{1}{\sqrt{3}} \left(\tan^{-1} \frac{Vt}{a} \right)$.

Unit -III

5. (a) A solid cube is in motion about an angular point which is fixed. If there are no external forces and $\omega_1, \omega_2, \omega_3$ are the angular velocities about the edges through the fixed point, prove that $\omega_1 + \omega_2 + \omega_3 = \text{constant}$
- (b) If $2T = A\omega_1^2 + B\omega_2^2 + C\omega_3^2$ and G be the moment of the impressed forces about the instantaneous axis of rotation and ω be the resultant angular velocities prove that $\frac{dT}{dt} = \omega G$
6. (a) Show that in order that it may be possible for a uniform cone of height h and vertical angle 2α , to spin as a top on its vertex on a rough horizontal plane, it is necessary that $n^2 > \frac{5g(4+\tan^2\alpha)\sin\alpha}{h\tan^4\alpha}$ where $\omega_3 = n$
- (b) A circular disc, of radius a , has a thin rod pushed through its centre perpendicular to its plane, the length of the rod being equal to the radius of the disc. Show that the system cannot spin with the rod vertical unless the angular velocity is greater than $\sqrt{\left(\frac{20g}{a}\right)}$.

Unit -IV

7. (a) Define Hamiltonian function of dynamical system and prove that $\frac{dH}{dt} = \frac{\partial H}{\partial t}$.
- (b) State and prove principle of Least Action.
8. (a) Deduce the principle of Conservation of Energy from the Lagrange's equations.
- (b) An uniform rod of length $2a$ which has one end attached to a fixed point by a light inextensible string of length $\frac{5}{12}a$, performing small oscillations in a vertical plane about its position of equilibrium. Find the position at any time and show that the period of its principal oscillations are $2\pi\sqrt{\frac{5a}{3g}}$ and $\pi\sqrt{\left(\frac{a}{3g}\right)}$

S. S.Jain Subodh P.G. College,jaipur

M.Sc. First Semester

MATHEMATICS

SIXTH PAPER

Calculus of Variation & Special Function-I

Assignment

Attempt one Question from each Unit.

Unit -I

- 1) Derive four special cases of Euler – Lagrange equation as:
 - (i) f is independent of y
 - (ii) f is independent of x
 - (iii) f is independent of y'
 - (iv) f is independent of x and y
- 2) Find the shortest curve joining two points (x_1, y_1) and (x_2, y_2) by the use of variational method.

Unit -II

- 3) Find the extremals of the functional

$$I[y(x), z(x)] = \int_0^{\pi/2} [(y')^2 + (z')^2 + 2yz] dx$$

with the boundary conditions

$$y(0) = 0, \quad y(\pi/2) = -1; \quad z(0) = 0, \quad z(\pi/2) = 1$$

- 4) Show that the curve of a shortest distance (geodesic) on a right Circular cylinder is a helix.

Unit -III

- 5) Find the series solution of Gauss's hyper geometric equation in the neighbourhood of $x = 0$.
- 6) Show that $P_n(x)$ is the coefficient of z^n in the expansion of $(1 - 2xz + z^2)^{-1/2}$.

Unit -IV

- 7) Prove that

$$\int_{-1}^1 x^2 P_{n+1}(x) P_{n-1}(x) dx = \frac{2n(n+1)}{(2n-1)(2n+1)(2n+3)}$$

- 8) Prove that

$$\frac{Q_n(x)}{P_n(x)} = \int_x^\infty \frac{dx}{(x^2-1)\{P_n(x)\}^2}$$

Paper- I

Functional Analysis-I

Assignment

Unit-I

Q.1 Prove that a closed set in a complete metric space is complete.

Q.2. Let (X_1, d_1) and (X_2, d_2) be two metric spaces. For any pair of points $x = (x_1, x_2)$, $y = (y_1, y_2)$ of $X_1 \times X_2$ defined by setting
$$d(x, y) = \sqrt{\{d_1^2(x_1, y_1) + d_2^2(x_2, y_2)\}} \quad \forall x_1, y_1 \in X_1,$$

and $x_2, y_2 \in X_2$ then prove that d is a metric for $X = X_1 \times X_2$.

Unit-II

Q.3. Prove that a non-empty subspace E of $\mathbb{R}$ is connected if and only if it is an interval.

Q.4 Prove that a subset of $\mathbb{R}^n$ is compact if and only if it is closed and bounded.

Unit-III

Q.5 Let T be a linear transformation from a normed linear space X into a normed linear space Y . Then prove that T is continuous if and only if it is bounded.

Q.6. If M is a non-zero normed linear space, then prove that it is a Banach space if and only if the subspace $S = \{x : \|x\| \leq 1\}$ is complete

Unit-IV

Q.7. State and prove Open mapping Theorem.

Q.8. Prove that on a finite dimensional normed linear space, all norms are equivalent.

S.S. Jain Subodh PG College
M.Sc. III Sem, Assignment
Subject - Mathematics
Paper - ~~II~~ II
Viscous fluid Dynamics-I

Note: Attempt one Question ~~at~~ from each Unit.

Unit-I

- Q.1 Derive Equation of Continuity for any kind of fluid Motion.
- Q.2 Derive Equation of Motion.

Unit II

- Q.3 State and Prove Buckingham - ~~II~~ π Theorem.
- Q.4 write Short Note ~~on~~ on:
- (i) Reynolds Number
 - (ii) Prandtl Number
 - (iii) Eckert Number
 - (iv) Mach Number.

Unit III

- Q.5 Discuss Hagen - Poiseuille flow.
- Q.6 Discuss Generalized Plane Couette flow.

Unit-IV

- Q.7 Discuss the flow between two ~~concentric~~ Concentric rotating cylinders.
- Q.8 Define Stagnation ~~at~~ Point. Derive Hiemenz flow.

M.Sc. Third Semester
MATHEMATICS
THIRD PAPER
Integral Transforms

Assignment

Note: Attempt one question from each unit.
Unit -I

- 1 (a) Find $L\{F(t)\}$, where $F(t) = \begin{cases} e^{t-a}, & t > a \\ 0, & t < a \end{cases}$
(b) Find $L^{-1}\left\{\log\left(1 + \frac{1}{p^2}\right)\right\}$
- 2 (a) Prove that $L\{J_0(x); p\} = \frac{1}{\sqrt{p^2+1}}$ and deduce $L\{J_0(ax); p\}$
(b) Use the convolution theorem to find $L^{-1}\left\{\frac{p}{(p^2+a^2)^2}\right\}$

Unit -II

- 3 (a) Find the Fourier Cosine transform of $\frac{1}{1+x^2}$ and hence find the Fourier sine transform of $\frac{x}{1+x^2}$
(b) Find the convolution of $f(x) = \cos x$ and $g(x) = \exp(-a|x|)$, $a > 0$
- 4 (a) Find the Fourier transform of $f(x) = \frac{\sin ax}{x}$, $a > 0$
(b) Find $f(x)$ if its Fourier sine transform is $\frac{e^{-ap}}{p}$. Hence deduce $f_s^{-1}\left\{\frac{1}{p}\right\}$

Unit -III

- 5 (a) Prove that
$$M\left[\left(\frac{d}{dx}x\right)^m f(x); p\right] = (1-p)^m F(p)$$
where $F(p) = M[f(x); p]$ and m is a positive integer.
(b) Prove that $M[(1+x)^{-a}; p] = \frac{\Gamma(p)\Gamma(a-p)}{\Gamma(a)}$, $0 < \text{Re}(p) < \text{Re}(a)$. Hence deduce that
$$M[(1+x)^{-1}; p] = \pi \csc(\pi p)$$
, $0 < \text{Re}(p) < 1$.
- 6 (a) Prove that $M\left[x^\alpha \int_0^\infty u^\beta f(xu)g(u)du; p\right] = M[f(x); p+\alpha]M[g(x); 1+\beta-\alpha-p]$
(b) Prove that $M^{-1}[\Gamma(p)F(1-p)x] = L[f(t); x]$, where $F(p) = M[f(x); p]$ and $L[f(t); x]$ is Laplace transform of $f(t)$.

Unit -IV

- 7 (a) Using the complex inversion formula for the Laplace transform, find the inverse Laplace transform of $\frac{1}{(p^2+1)^2}$.
(b) Find the Hankel transform of $x^\nu e^{-ax}$, taking $xJ_\nu(px)$ as the kernel.
- 8 (a) Find the Hankel transform of $\frac{\cos ax}{x}$ and $\frac{\sin ax}{x}$ taking $xJ_0(px)$ as the kernel.
(b) Find the Hankel transform of the function
(i) $\frac{d^2 f(x)}{dx^2} + \frac{1}{x} \frac{df(x)}{dx}$, where $f(x) = \frac{e^{-ax}}{x}$ and $\nu = 0$.
(ii) $\frac{df}{dx}$, where $f(x) = \frac{e^{-ax}}{x}$ and $\nu = 1$.

Assignment

S.S. Jain Subodh P.G. (Autonomous) College

M.Sc. (Mathematics) III Semester 2026-27

Paper IV Mathematical Programming -I

Attempt one question from each Unit
UNIT-I

Q. 1. Solve the following LPP by Revised Simplex Method

$$\begin{aligned} \text{Max } z &= x_1 + x_2 \\ \text{subject to } 3x_1 + 2x_2 &\leq 6 \\ x_1 + 4x_2 &\leq 4 \\ \text{and } x_1, x_2 &\geq 0 \end{aligned}$$

Q.2. Using the bounded variable technique, solve the following LPP

$$\begin{aligned} \text{Max } z &= x_2 + 3x_3 \\ \text{subject to } x_1 + x_2 + x_3 &\leq 10 \\ x_1 - 2x_3 &\geq 0 \\ 2x_1 - x_3 &\leq 10 \\ \text{and } 0 \leq x_1 \leq 8; 0 \leq x_2 \leq 4; x_3 &\geq 0 \end{aligned}$$

UNIT-II

Q.3. Use Gomory's Method to solve the following LPP:

$$\begin{aligned} \text{Max } z &= 2x_1 + 2x_2 \\ \text{subject to } 5x_1 + 3x_2 &\leq 8 \\ x_1 + 2x_2 &\leq 4 \\ \text{and } x_1, x_2, x_3, x_4 &\geq 0 \text{ are integers} \end{aligned}$$

Q.4. Use the Branch and Bound Algorithm to solve the following LPP:

$$\begin{aligned}
 \text{Max } z &= x_1 + 2x_2 \\
 \text{subject to } x_1 + 2x_2 &\leq 12 \\
 4x_1 + 3x_2 &\leq 14 \\
 \text{and } x_1, x_2 &\geq 0 \text{ and are integers}
 \end{aligned}$$

UNIT-III

Q. 5. Find an approximate optimal solution of the following Separable Programming Problem

$$\begin{aligned}
 \text{Max } z &= 3x_1 + 2x_2 \\
 \text{subject to } 4x_1^2 + x_2^2 &\leq 16 \\
 \text{and } x_1 &\geq 0, x_2 \geq 0
 \end{aligned}$$

Q. 6. Solve the following Fractional Programming Problem:

$$\begin{aligned}
 \text{Max } z &= \frac{2x_1 + 3x_2}{x_1 + x_2 + 7} \\
 \text{s.t. } 3x_1 + 5x_2 &\leq 15 \\
 4x_1 + 3x_2 &\leq 12 \\
 \text{and } x_1, x_2 &\geq 0
 \end{aligned}$$

UNIT-IV

Q.7. Use Dynamic Programming to find maximum value of the product $x_1, x_2, x_3, \dots, x_n$ when $x_1 + x_2 + x_3 + \dots + x_n = b$

$$x_1, x_2, x_3, \dots, x_n \geq 0$$

Q.8. Solve the following LPP by Dynamic Programming:

$$\begin{aligned}
 \text{Max } z &= x_1 + 9x_2 \\
 \text{subject to } 2x_1 + x_2 &\leq 25 \\
 x_2 &\leq 11 \\
 \text{and } x_1 &\geq 0, x_2 \geq 0
 \end{aligned}$$

Assignment Oct-2026
M.Sc. (Mathematics) III sem
Paper - V

Relativistic Mechanics

Attempt One Question from Each Unit.
Unit-I

- Q.1 Derive Lorentz Transformation equation in Special Relativity.
Q.2 Explain Time Dilation with example.

Unit-II

- Q.3 Why velocity of light is called fundamental velocity?

- Q.4 Obtain transformation formula for particle acceleration.

Unit-III

- Q.5 Prove that

$$m = \frac{m_0}{\sqrt{1 - u^2/c^2}}$$

where u is the velocity of particle when its mass is m and m_0 is the mass of the particle when it is at rest.

- Q.6 Derive equivalence of mass and energy formula $E = mc^2$ where the terms have their usual meaning.

Unit-IV

- Q.7 Discuss Null cone with space-like and time-like characters.

- Q.8 State and prove Principle of General Covariance.

M.Sc. Third Semester Assignment

MATHEMATICS

SIXTH PAPER

Numerical Analysis

Attempt one question from each unit.
Unit-I

1. Find the multiple root of the equation

$$27x^5 + 27x^4 + 36x^3 + 28x^2 + 9x + 1 = 0$$

using Newton - Raphson method.

2. Find the root of the equations

$$\log_{10}x - x + 3 = 0$$

by Muller's method, taking initial approximations as

$$x_0 = 0.5, \quad x_1 = 1, \quad x_2 = 1.5$$

Unit II

3. Use synthetic division and perform two iterations by Birge - Vieta method to find the smallest positive root of the equation $x^4 - 2x^3 + 3x^2 - 4x + 1 = 0$

4. Find all the roots of the polynomial $x^4 - x^3 + 3x^2 + x - 2 = 0$ Using the Graeffe's root squaring method.

Unit III

5. Solve the state of equations:

$$2x_1 - 5x_2 - 3x_3 = 17$$

$$3x_1 + 4x_2 + 11x_3 = 28$$

$$7x_1 + 2x_2 - 5x_3 = -14$$

using relaxation method (Perform five iterations)

6. Solve the system of equations.

$$5x_1 - x_2 = 3$$

$$-2x_1 + 7x_2 - x_3 = 4$$

$$-x_2 + 6x_3 = 1$$

Using Cholesky's method.

Unit IV

7. Find all the eigen values and eigen vectors of the matrix

$$\begin{bmatrix} 2 & 1 & 1 \\ 1 & 3 & 1 \\ 1 & 1 & 2 \end{bmatrix}$$

by Jacobi method.

8. Find all the eigen values of the matrix

$$A = \begin{bmatrix} 5 & 2 \\ 2 & 4 \end{bmatrix}$$

using the R  itsauser method.