UTTAR PRADESH RAJARSHI TANDON OPEN UNIVERSITY SHANTIPURAM, SECTOR-F, PHAPHAMAU, PRAYAGRAJ-2110021

ASSIGNMENT PAPERS

Semester-I (M.Sc./MA Mathematics)

Session: 2026-27		
Program Name: **MSc/MA-Mathematics**		
Course Code: **PGMM-101N**	Course Name**: Advanced Real Analysis and Integral Equations**	
SECTION -A		**2*6=12 marks**
Q. No.	**Short answer type question (approx. 200 -300 words)**	**Marks**
1.	What do you mean by Partition of a closed integral? OR Define Cauchy's criterion for uniform convergence.	2
2.	If f be a continuous function on $[a,b]$ and $F(x)=\int_a^x f(t)\,dt$ for all $x\in[a,b]$ then prove that $F'(x)=f(x)$. OR Explain the Cauchy's theorems on limits.	
3.	Explain the higher order partial derivatives. OR Find the first order partial derivatives $\frac{\partial u}{\partial x}$ and $\frac{\partial u}{\partial y}$ when $u=\tan^{-1}\frac{y}{x}$.	2
4.	Show that $\underset{(x,y)\to(0,0)}{Lim}\ \frac{2x^3-y^3}{x^2+y^2}=0.$ OR Verify that $\frac{\partial^2 u}{\partial x\partial y}=\frac{\partial^2 u}{\partial y\partial x}$ if $u=ax^2+2hxy+by^2.$	2
5.	Define Half Range Fourier series. OR Explain the Fredholm integral equation?	2
6.	Describe the Volterra integral equations. OR Use the method of Laplace Transform to solve the integral equation. $u(x)=x-\int_0^x (x-\xi)u(\xi)d\xi.$	2

	SECTION -B	6*3=18 marks
	Long answer type question (approx. 500 -800 words)	**Marks**
7.	If $u = \tan^{-1}\left[\frac{x^3 + y^3}{x + y}\right]$, then show that $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} = \sin 2u.$. OR If $x^x y^y z^z = c$, then show that $x = y = z$, $\frac{\partial^2 z}{\partial x \partial y} = -(x \log ex)^{-1}$.	3
8.	Prove that $\frac{\partial(u,v,w)}{\partial(x,y,z)} \times \frac{\partial(x,y,z)}{\partial(u,v,w)} = 1.$ OR Verify Euler's theorem, where $u = \frac{x(x^3 - y^3)}{x^3 + y^3}$.	3
9.	Find the Fourier series of the function in interval $f(x) = x^2$ in the interval $(-\pi, \pi)$. OR Reduce the integral equation $\sin x = \lambda \int_0^x e^{x-\xi} u(\xi) d\xi$ to the second kind and hence solve it.	3

Session: 2026-27		
Program Name: **MSc/MA-Mathematics**		
Course Code: **PGMM-102N**	Course Name**: Classical Optimization Techniques**	
SECTION -A		**2*6=12 marks**
Q. No.	**Short answer type question (approx. 200 -300 words)**	**Marks**
1.	Write a short note on classification of optimization problems. OR Determine the maximum and minimum value of the function $y = 3x^5 - 5x^3 + 1.$	2
2.	Find the optimum solution of the constrained multivariable problem: Minimize $z = x_1^2 + (x_2 + 1)^2 + (x_3 - 1)^2$ Such that $x_1 + 5x_2 - 3x_3 = 6$. OR Define the Fibonacci method.	2
3.	Explain the penality function method. OR Describe the Kuhn-Tucker conditions.	2
4.	Define Hooke and Jeeve's method. OR Minimize $f(x) = 2x$, subject to $x \geq 3$ using interior penality method.	2
5.	Explain the Kuhn-Tucker conditions. OR Define the separable programming problem.	2
6.	State the Bellman's Principle of Optimality. OR Write the procedure of minimum spanning tree problem.	2
	SECTION -B	**6*3=18 marks**
	Long answer type question (approx. 500 -800 words)	**Marks**
7.	Using separable programming to solve the following non-linear programming problem: $Max\, Z = x_1 + x_2^4$ such that $3x_1^2 + 2x_2^2 \leq 9,\ x_1, x_2 \geq 0$ OR Solve the following problem using dynamic programming: $Min Z = x_1^2 + x_2^2 + x_3^2 + x_4^2$ s.t. $x_1\ x_2 x_3 x_4 = 16$ and $x_1, x_2, x_3, x_4 \geq 0$.	3
8.	Write a short note on applications of dynamic programming. OR Explain the payoff matrix.	3
9.	Find the all integer solution to the following Integer Linear Programming Problem (ILPP): Max $z = 3x_1 + 2x_2$ s.t. $x_1 + x_2 \leq 4,\ x_1 - x_2 \leq 2,\ x_1, x_2 \geq 0$ and integers. OR What do you mean by Zero-one Integer Linear programming problem?	3

Session: 2026-27		
Program Name: **MSc/MA-Mathematics**		
Course Code: **PGMM-103N**	Course Name**: Discrete Mathematics**	
SECTION -A		**2*6=12 marks**
Q. No.	**Short answer type question (approx. 200 -300 words)**	**Marks**
1.	Find the power set of {1, 2}. OR Let $A = \{1, 2\}$ and $B = \{3, 4\}$. Find $A \times B$ and B × A.	2
2.	What do you means by Cartesian product of sets? OR Define injective and bijective mappings with examples.	
3.	State the principle of inclusion-exclusion. OR Prove that each of the following is a tautology: (a) $p \wedge q \rightarrow p$ (b) $p \rightarrow (p \vee q)$	2
4.	Prove the following tautological equivalences: (i) $(p \rightarrow q) \vee (p \rightarrow r) \equiv p \rightarrow q \vee r$ OR Explain the principle of mathematical induction.	2
5.	Define Boolean Algebra. OR Define Lattice with examples.	2
6.	What do you mean by graph and simple graph? OR Define the rooted tree.	2
	SECTION -B	**6*3=18 marks**
	Long answer type question (approx. 500 -800 words)	**Marks**
7.	Give an example of a relation that is reflexive but neither symmetric nor transitive. OR In a school, assuming sport participation is compulsory. In a class of 80 students, 60 play football and 40 play basketball. Find: (i) How many play both the games. (ii) Play football only.	3
8.	Define the Hasse diagram with examples. OR Explain cycle, path and circuit with examples.	3
9.	Write a note on graph coloring. OR Explain Kruskal's algorithm.	3

Session: 2026-27

Program Name: **MSc/MA-Mathematics**

Course Code: **PGMM-104N** | Course Name**: Numerical Analysis**

SECTION -A — **2*6=12 marks**

Q.No.	Short answer type question (approx. 200 -300 words)	Marks
1.	What do you mean by finite differences? OR Prove that $\Delta^2 \equiv E^2 - 2E + 1$.	2
2.	If $f(0) = -3, f(1) = 6, f(2) = 8, f(3) = 12$ prepare the forward difference table. OR Determine the missing term in the following table: x: 0, 1, 2, 3, 4 $f(x)$: 1, 3, 9, –, 81	2
3.	Write the Lagrange's Interpolation Formula for unequal intervals. OR Explain the Gauss' Seidel Method.	2
4.	What do you mean by LU Decomposition method? OR Explain the procedure for solving algebraic equation by Newton-Raphson's method.	2
5.	Write the procedure for solving algebraic equation by Bisection method. OR Explain the Regula-Falsi Method.	2
6.	When we use Stirling difference formula for derivatives. OR Use Euler's method compute the value of $y(0.04)$ for the differential equation $\frac{dy}{dx} = -y$ with $y = 1$ at $x = 0$.	2

	SECTION -B	**6*3=18 marks**
	Long answer type question (approx. 500 -800 words)	**Marks**
7.	Use Gauss Backward Interpolation formula to obtain the values of the function $f(x)$ at x=5.8: <table><tr><td>x</td><td>4</td><td>5</td><td>6</td><td>7</td></tr><tr><td>$y = f(x)$</td><td>270</td><td>648</td><td>1330</td><td>2448</td></tr></table> OR Using the Lagrange's formula to find the polynomial which includes the following values of x and y. <table><tr><td>x</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td>$y = f(x)$</td><td>3</td><td>6</td><td>11</td><td>18</td><td>27</td></tr></table>	3
8.	Solve the following system of equation by Gauss elimination method: $2x + y + z = 10$, $3x + 2y + 3z = 18$, $x + 4y + 9z = 16$ OR Apply Crout's method to solve $5x_1 + 2x_2 + x_3 = -12,\ -x_1 + 4x_2 + 2x_3 = 20,$ $2x_1 - 3x_2 + 10x_3 = 3.$	3
9.	Calculate an approximate value of the integral $\int_0^{x/2} \sin x\,dx$ by (i) Trapezoidal rule (ii) Simpson's one third rule (iii) Simpson's three-eighth rule. OR Solve the equation $\frac{dy}{dx} = x + y$ with initial condition y(0) =1 by Runge – Kutta's rule from x = 0 to x = 0.4 with h = 0.1.	3

Session: 2026-27	**Max. Marks: 30**	
Program Name: M.Sc./MA (Statistics/Computer Science/Mathematics/ Biochemistry/ Environmental Science)		
Course Code: PGBR-01	**Course Name: Basics in research**	
SECTION -A		**2*6=12 marks**
Q. No.	**Short answer type question (approx. 200 -300 words)**	**Marks**
1	Write down the meaning and objective of research.	**2**
2	Discuss the need for reviewing literature in brief. What are the types of literature review?	**2**
3	What do you understand by google scholar, science direct?	**2**
4	What do you understand by google Scopus, web of science?	**2**
5	write short notes on the following- a) Journal abstracts b) SciFinder	2
6	Write short notes on the following- a) Citation index b) Peer review and revision.	2
SECTION -B		**6*3=18 marks**
	Long answer type question (approx. 500 -800 words)	**Marks**
7	Discuss in detail about the intellectual property and intellectual property rights (IPR).	**6**
8	write short notes on the following- a) Citation index b) Peer review and revision.	**6**
9	What are the various kinds of report writing in academics and research. Explain in detail.	**6**

Semester-II (M.Sc./MA Mathematics)

Session: 2026-27		
Program Name: **MSc/MA-Mathematics**		
Course Code: **PGMM-106N**	Course Name**: Advanced Algebra**	
SECTION -A		**2*6=12 marks**
Q. No.	**Short answer type question (approx. 200 -300 words)**	**Marks**
1.	What do you mean by sets and relations? OR Define the concept of equivalence relation.	2
2.	Let R_1 and R_2 be two equivalences on A. Show that $R_1 \cap R_2$ is also an equivalence relation on A. OR Let $f: Z \to Z$ be defined by $f(x) = x^2, for\ all\ \ x \in Z$ then show that f is many one.	
3.	Let $f_1 = \begin{pmatrix} a & b & c \\ a & c & b \end{pmatrix}$ and $f_2 = \begin{pmatrix} a & b & c \\ b & c & a \end{pmatrix}$ be two permutations of degree three. To show that $f_1 f_2 \neq f_2 f_1$. OR Let $G = \{1,\ \omega,\ \omega^2\}$ be a finite multiplicative group. Find the order of each element of G.	2
4.	Define the subgroup and complexes. OR Define the normal subgroup with examples.	2
5.	What do you mean by kernel of a homomorphism? OR Explain the concept of subrings and subfields.	2
6.	Define the field extensions. OR What do you mean by Galois theory?	2

	SECTION -B	**6*3=18 marks**
	Long answer type question (approx. 500 -800 words)	**Marks**
7.	Show that set $P = \{1, 2, 3, 4, 5, 6, \times_7\}$ is a finite abelian group of order 7 with respect to multiplication modulo 7. OR Let $G = \{1, -1, i, -i\}$ be a finite multiplicative group. To show that G is cyclic group and find the generators of G.	3
8.	Prove that every finite group G is isomorphic to a permutation group. OR A subgroup H of a group G is a normal subgroup of G if and only if each left coset of H in G is a right coset of H in G.	3
9.	To show that a field has no proper ideals i.e., if F is a field then its only ideals are (0) and F itself. OR Show that the set of numbers of the form $a + b\sqrt{2}$, with a and b as rational numbers is a field.	3

Session: 2026-27		
Program Name: **MSc/MA-Mathematics**		
Course Code: **PGMM-107N**	Course Name**: Complex Analysis**	
SECTION -A		**2*6=12 marks**
Q. No.	**Short answer type question (approx. 200 -300 words)**	**Marks**
1.	What do you mean by Complex Numbers? OR Given that $f(z)=\frac{x^3y(y-ix)}{x^6+y^2}$, $z\neq 0$, $f(0)=0$ prove that $\frac{f(z)-f(0)}{z}\to 0$ as z$\to$0 along any radius vector but not as z$\to$0 in any manner.	2
2.	Show that the function $u=x^3-3xy^2+3x^2-3y^2+1$ is harmonic function. OR Write a short note on Conformal mapping.	2
3.	Explain the connected and multiconnected region. OR Evaluate the integral $\int_0^{1+i} z^2\,dz$.	2
4.	State the Liouville's theorem. OR Prove that when $0<\|z\|<4, \frac{1}{4z-z^2}=\sum_{n=0}^{\infty}\frac{z^{n-1}}{4^{n+1}}$.	2
5.	State the Cauchy Residue theorem. OR Show that $z = 0$ is an isolated essential singularity of the function $\frac{e^{c/(z-a)}}{e^{z/a}-1}$.	2
6.	Show that the function e^{-1/z^2} has no singularities. OR	2

	Find the residue of $\frac{z^3}{(z-1)^4(z-2)(z-3)}$.	
	SECTION -B	**6*3=18 marks**
	Long answer type question (approx. 500 -800 words)	**Marks**
7.	State and prove the Cauchy Riemann equations. OR If $u-v=(x-y)(x^2+4xy+y^2)$, $f(z)=u+iv$ is analytic function of z=*x*+*iy*, find *f*(*z*) in terms of *z*.	3
8.	Find the bilinear transformation which transforms *z*=∞, *i*, 0 into w=0, *i*, ∞ respectively. OR State and prove the Cauchy fundamental theorem.	3
9.	Explain State the Cauchy's Integral Formula. OR Evaluate $\int_0^{2\pi}\frac{d\theta}{a+b\cos\theta}, a>b>0.$	3

Session: 2026-27		
Program Name: **MSc/MA-Mathematics**		
Course Code: **PGMM-108N**	Course Name**: Mathematical Statistics**	
SECTION -A		**2*6=12 marks**
Q. No.	**Short answer type question (approx. 200 -300 words)**	**Marks**
1.	Differentiate between the Quantitative and qualitative data. OR Discuss various methods of measurement of data.	2
2.	What do you mean by Bar diagram and Pie chart? OR Define the frequency polygon and frequency curve.	
3.	Calculation the mean for the following scores: 60, 65, 74, 85, 95. OR Calculate median for the following data: (a) 68, 62, 75, 82, 68, 71, 68, 71, 62, 68, 74, 59, 74, 68, 60, 71, 59, 73, 73, 58.	2
4.	Discuss the types of measures of central Tendency. OR The first four raw moments of a distribution about the value 5 of variable are 2, 20, 40 and 50. Obtain mean and first four central moments.	2
5.	In a frequency distribution Q_1=30, Q_3=70 and median is 38, compute coefficient of skewness. OR Define the correlation Coefficient.	2
6.	Write a short not on regression analysis. OR	2

<table>
<tr><td></td><td>Define the independence and association of attributes.</td><td></td></tr>
<tr><td></td><td>SECTION -B</td><td>6*3=18 marks</td></tr>
<tr><td></td><td>Long answer type question (approx. 500 -800 words)</td><td>Marks</td></tr>
<tr><td>7.</td><td>What do you understand by diagrammatic representation of data? What are its main advantages and disadvantages?

OR
The rainfall of 66 districts in a particular year is given below. Computed the average annual rainfall.
<table>
<tr><td>Rainfall (in inches)</td><td>0-10</td><td>10-20</td><td>20-30</td><td>30-40</td><td>40-50</td><td>50-60</td></tr>
<tr><td>No. of Districts</td><td>22</td><td>10</td><td>8</td><td>15</td><td>5</td><td>6</td></tr>
</table></td><td>3</td></tr>
<tr><td>8.</td><td>Find first four raw moments about x= 5 if the values of variables are 2,3,6,8 and 11.

OR
What are skewness and kurtosis? Give some suitable measures for skewness and kurtosis.</td><td>3</td></tr>
<tr><td>9.</td><td>Calculate the coefficient of correlation for the following pairs of values of x and y.
x: 17 19 21 26 20 28 26 27
y: 23 27 25 26 27 25 30 33

OR
In a partially destroyed record the following data are available.
Variance of x= 25.
Regression equation of x on y : 5x-y=22.
Regression equation of y on x : 64x - 45y= 24.
Find (a) mean values of x and y; (b) coefficient of correlation between x and y. (c) Standard deviation of y.</td><td>3</td></tr>
</table>

Session: 2026-27		
Program Name: **MSc/MA-Mathematics**		
Course Code: **PGMM-109N**	Course Name**: Topology**	
SECTION -A		**2*6=12 marks**
Q.No.	**Short answer type question (approx. 200 -300 words)**	**Marks**
1.	What do you mean by Pseudo metric space. OR Let $A = \{1, 2,\}$ and $B = \{3, 4\}$. Find $A \times B$ and B × A.	2
2.	Let $X = \{0,1,2,3,4,5\}$ and $A = \{2,3,4\}$. Find the distance between 1 and A. OR What do you mean by Bounded and Unbounded Metric Spaces.	2
3.	Define the sequence in metric space. OR What do you mean by Bounded and Unbounded Metric Spaces.	2
4.	Let X= {a, b, c} and $\Im$={X, ϕ, {a}, {b}, {a, b}}. Then show that $\Im$ is a topology on X. OR Define the Interior points and the interior of a set.	2
5.	Let $X = [a,b,c,d,e]$ and $\Im = \{X,\phi,\{a\},\{a,b\},\{a,c,b\},\{a,b,c,d\},\{a,b,e\}\}$ be a topology for X. Let $A = \{a,c,e\}$ be a subset of X. Find the relative topology for A. OR What do you mean by Open and Closed mapping.	2
6.	Define the T_2 space with examples. OR What do you mean by T_3 and T_4 spaces?	2

	SECTION -B	6*3=18 marks
	Long answer type question (approx. 500 -800 words)	**Marks**
7.	Let (X,d) be a metric space and consider $d^*(x,y)=\frac{d(x,y)}{1+d(x,y)} \quad \forall x,y \in X.$ Show that d^* is a bounded metric on X. OR Prove that every convergent sequence in a metric space is a Cauchy sequence.	3
8.	Prove that the finite intersection of two topology on X is again a topology on X. OR Let $(X,\Im)$ be a topological space. Let $X=\{a,b,c\}$ and $\Im=\{X,\phi,\{a\},\{b,c\}\}$. To show that $(X,\Im)$ is normal and regular space but not T_3 and T_4-space.	3
9.	Two closed subsets of a topological space are separated if and only if they are disjoint. OR Prove that any continuous mapping of a compact metric space into a metric space is uniformly continuous.	3

Session: **2026-27**	**Max. Marks: 30**
Program Name: M.Sc./MA (Statistics/Computer Science/Mathematics/ Bio chemistry/ Environmental Science)	
Course Code: PGED-02	**Course Name: Entrepreneurship development**

SECTION -A		**2*6=12 marks**
Q. No.	**Short answer type question (approx. 200 -300 words)**	**Marks**
1	What is entrepreneurship? What are the main characteristics of an entrepreneur to do entrepreneurship?	**2**
2	Differentiate between Entrepreneur, Intrapreneur and Manager.	**2**
3	What are the problems faced by women entrepreneurs in doing business?	**2**
4	Explain the characteristics of projects with various types of project?	**2**
5	Highlight the need of technology for entrepreneurs.	2
6	What is the various assistance of financial Institutions to entrepreneurs?	2
SECTION -B		**6*3=18 marks**
	Long answer type question (approx. 500 -800 words)	**Marks**
7	Explain various type of entrepreneurship.	**6**
8	What are the needs and Objectives of Entrepreneurship Development Programs. Explain eight stages of Entrepreneurship Development Cycle.	**6**
9	Explain any four all India Financial Institutions who aid to entrepreneur.	**6**

Semester-III (M.Sc./MA Mathematics)

Session: 2026-27		
Program Name: **MSc/MA-Mathematics**		
Course Code: **PGMM-111N**	Course Name**: Advanced Differential Equations**	
SECTION -A		**2*6=12 marks**
Q. No.	**Short answer type question (approx. 200 -300 words)**	**Marks**
1.	What do you mean by ordinary points? OR Write a short note on regular singular method.	2
2.	Show that $(2n+1)xP_n(x) = (n+1)P_{n+1}(x) + nP_{n-1}(x)$. OR From the relation $\frac{1}{\sqrt{1-2xh+h^2}} = \sum_{n=0}^{\infty} P_n(x)h^n$ obtain $P_0(x)$, $P_1(x)$, $P_2(x)$, $P_3(x)$, and $P_4(x)$.	
3.	Form a partial differential equation by eliminating the constants a and b from $(x-a)^2 + (y-b)^2 + z^2 = c^2$ OR Solve $p + q = z + \tan(y - 3x)$.	2
4.	Define the Clairaut form with examples. OR Solve: $p + q = 0$.	2
5.	What do you mean by Charpit Method? OR Classification of Second-Order Partial Differential Equations.	2
6.	Form the difference equation from the equation $y_x = A \cdot 5^x + B \cdot 2^{2x}$ by eliminating the arbitrary constants $A$and B. OR Define the Euler's equation.	2

	SECTION -B	6*3=18 marks
	Long answer type question (approx. 500 -800 words)	**Marks**
7.	Find the series solution of the linear differential equation $4xy'' + 2y' + y = 0.$ OR Solve in series the following linear differential equation $2x(1 - x)y'' + (1 - x)y' + 3y = 0$	3
8.	Solve in series $xy'' + y' + xy = 0$ OR Show that $xJ_n'(x) = -nJ_n(x) - xJ_{n-1}(x).$	3
9.	Obtain a solution of the partial differential equation $$\frac{\partial^2 z}{\partial x^2} = \frac{\partial z}{\partial y}$$ subject to the boundary conditions $z = 0$ when $x = 0$ or $x = \pi$, and $z = \sin 3x$ when $y = 0,\ 0 < x < \pi.$ OR Determine the curve $y(x)$ which extremizes the functional $$J[y] = \int_0^1 [(y')^2 + 12xy]\, dx$$ subject to the boundary conditions $y(0) = 0$, $y(1) = 1$.	3

Session: 2026-27		
Program Name: **MSc/MA-Mathematics**		
Course Code: **PGMM-112N**	Course Name**: Functional Analysis**	
SECTION -A		**2*6=12 marks**
Q. No.	**Short answer type question (approx. 200 -300 words)**	**Marks**
1.	What do you mean by vector subspace? OR In a normed linear space, every convergent sequence is a Cauchy sequence.	2
2.	If N be a normed linear space and let $x, y \in N$, then $\|\|x\| - \|y\|\| \leq \|x - y\|$ OR Define a complete metric space.	2
3.	Let T be a non-singular linear operator on a linear space. Then the inverse function T^{-1} is also a linear operator on L. OR What do you mean by Linear Functional?	2
4.	If x, y are any two vectors in a Hilbert space H, then $\|(x, y)\| \leq \|x\|\|y\|$ OR Explain the Banach's fixed point theorem.	2
5.	State the Kannon contraction theorem. OR Finite dimensionality of M in theorem 10.3-1 is essential. Let M be the set of all polynomials on $[0,\frac{1}{2}]$ of any degree, considered as a subspace of $C[0, \frac{1}{2}]$. Then the dimension of M is infinite.	2
6.	Write a short note on Gateaux derivative. OR Define the Fréchet derivative.	2

	SECTION -B	**6*3=18 marks**
	Long answer type question (approx. 500 -800 words)	**Marks**
7.	The intersection of two subspace W_1 *and* W_2 of a vector space V(F) is also a subspace of *V(F)*. OR Show that the system of three vectors (1,3,2), (1, -7, -8), (2,1, -1) of $V_3(R)$ is L.D.	3
8.	A norm linear space N is a Banach space iff every absolutely summable series in N is summable. OR Find the solution of $y' = 2y + 3$, $y(0) = 1$.	3
9.	If M is a finite dimensional subspace of a normed space X = (X, ‖.‖), then for each x ∈ X there exists a best approximation to x by elements of M. OR Let X be complex Banach space and T ϵ B(X).If $\|T\| < 1$,then $(I - T)^{-1} \in B(X)$ and $(I-T)^{-1} = \sum_{k=0}^{\infty} T^k = I + T + T^2 + \ldots\ldots\ldots\ldots$ Where the series $\sum_{k=0}^{\infty} T^k$, converges in the norm of B(X).	3

Session: 2026-27		
Program Name: **MSc/MA-Mathematics**		
Course Code: **PGMM-113N**	Course Name**: Measure Theory and Integration**	
SECTION -A		**2*6=12 marks**
Q. No.	**Short answer type question (approx. 200 -300 words)**	**Marks**
1.	Write a short note on Sets and its types. OR Discuss the equivalence relation.	2
2.	What do you mean by cardinal numbers? OR For any three sets A, B and C, we have $A \times (B - C) = (A \times B) - (A \times C)$	
3.	If $A = [0,4[$ and $B =]1,5[$, then find $A \cap B$. OR Discuss the Bolzano-Weierstrass theorem.	2
4.	Discuss the Measurable space and Measurable sets. OR Every interval in $\mathbb{R}$ is a Lebesgue measurable set.	2
5.	Let $E \subseteq \mathbb{R}$. Then $\mu_i(E) \leq \mu_e(E)$ OR Explain the Lebesgue point and Lebesgue set	2
6.	Write a short not on product measures. OR Let (X, Σ, μ)be a measure space. Let f be a bounded real-valued Σ-measureable functions on a set $E \in \Sigma$ with $\mu(E) < \infty$. If $\alpha \leq f(x) \leq \beta$ for all $x \in E$, then $\alpha\mu(E) \leq \int_E f \leq \beta\mu(E)$	2
	SECTION -B	**6*3=18 marks**
	Long answer type question (approx. 500 -800 words)	**Marks**
7.	If every chain in a nonempty partially ordered set $(A, \preccurlyeq)$ has an upper bound, then A contains a maximal element. OR **1**Let X be a set and $\wp(X)$ be theσ-algebra of all subsets of X. Let μ^* be an outer measure defined on X. Let $\mathfrak{M}(\mu^*)$ be the collection of all	3

	μ^*-measurable sets in $\wp(X)$. Then (i) $E_1, E_2 \in \mathfrak{M}(\mu^*) \Longrightarrow E_1 \cup E_2 \in \mathfrak{M}(\mu^*)$ (ii) If $E_1, E_2 \in \mathfrak{M}(\mu^*)$ such that $E_1 \cap E_2 = \emptyset$, then $\mu^*(E_1 \cup E_2) = \mu^*(E_1) + \mu^*(E_2)$	
8.	Let $\langle E_n \rangle$ be a sequence of disjoint measurable sets in $\mathbb{R}$. Then $$\mu_L\left(\bigcup_{n=1}^{\infty} E_n\right) = \sum_{n=1}^{\infty} \mu_L(E_n)$$ i.e. the Lebesgue measure is countably additive. OR Let (X, Σ, μ) be a measure space. Let $\langle f_n : n \in \mathbb{N} \rangle$ be a sequence of extended real-valued Σ-measurable functions defined on a set $D \in \Sigma$, where $\mu(D) < \infty$ and let f be a real-valued Σ-measurable function on D. If $f_n \to f$ almost everywhere on D, then for every $\varepsilon > 0$, there exists $E \subset D$ and $E \in \Sigma$ with $\mu(E) < \varepsilon$ such that $f_n \to f$ almost uniformly on $D \backslash E$.	3
9.	Let (X, Σ, μ) be a measure space. Let f and g be two complex-valuedΣ-measurable functions on X such that $\lvert f \rvert, \lvert g \rvert < \infty$ a.e. on X. Then $$\lVert fg \rVert_1 \leq \lVert f \rVert_2 \lVert g \rVert_2$$ provided the product $\lVert f \rVert_2 \lVert g \rVert_2$ exists. Also if $0 < \lVert f \rVert_2 < \infty$ and $0 < \lVert g \rVert_2 < \infty$, then $\lVert fg \rVert_1 = \lVert f \rVert_2 \lVert g \rVert_2$ if and only if $P\lvert f \rvert = Q\lvert g \rvert$ a.e. on X for some $P, Q > 0$. OR Let (X, Σ, μ) and (Y, Ω, ν) be two σ-finite measure spaces and $(X \times Y, \Sigma \times \Omega, \mu \times \nu)$ be the product measure space. Let f be any nonnegative extended real-valued $\Sigma \times \Omega$-measurable function defined on $X \times Y$. Then (i) f_x is a Ω-measurable function on Y and f^y is a Σ-measurable function on X (ii) The function $x \mapsto \int_Y f(x, y) d\nu(y)$ is Σ-measurable function on X (iii) The function $y \mapsto \int_X f(x, y) d\mu(x)$ is Ω-measurable function on Y and $$\int_{X \times Y} f(x, y) d(\mu \times \nu)(x, y) = \int_X \int_Y f(x, y) d\nu(y) d\mu(x)$$ $$= \int_Y \int_X f(x, y) d\mu(x) d\nu(y)$$	3

Session: 2026-27		
Program Name: **MSc/MA-Mathematics**		
Course Code: **PGMM-114N**	Course Name**: Theory of Probability**	
SECTION -A		**2*6=12 marks**
Q.No.	**Short answer type question (approx. 200 -300 words)**	**Marks**
1.	What do you mean by Sample space. OR A bag contains 10 coins out of which five coins of type 1 are unbiased and remaining five coins are biased. Among the biased coins, four coins of type II have probabilities of head 1/3 are remaining one coins of type III have probability of head 9/10. A coin is selected at random and tossed three times. If we get heads in a row, what is the probability that the coin is of type III.	2
2.	Suppose f(x) defined below is the pdf of a random variable. We obtain (i) the constant k (ii) the cdf of X, (iii) P(X>5), (iv) P(X>5|X>3). $f(x) = \begin{cases} ke^{-x/10}, 0 < x < \infty \\ 0, \quad otherwise \end{cases}$ OR What do you mean by Multiplicative theorem of Probability.	2
3.	Define the Cauchy-Schwartz Inequality. OR What do you mean by Moments Generating Function.	2
4.	If x=a, a constant then E(x) = a. OR Define the Hyper Geometric distribution.	2
5.	Let X denotes the number obtained on tossing of an unbiased die. Then prove that Chebyshev inequality gives. $P[\|X - E(X)\| > 2.5] < 0.47$ While the actual probability is nearly zero. OR What do you mean by Point Estimation.	2
6.	Define the Test of Significance OR What do you mean by Non-Parametric Tests?	2

	SECTION -B	6*3=18 marks
	Long answer type question (approx. 500 -800 words)	**Marks**
7.	For a non-negative r.v. X having finite mean, we have $$\Pr(X \geq \lambda) \leq \frac{E(X)}{\lambda}$$ Where λ is any real positive number. OR Use Chebyshev's inequality to determine how many times an unbiased coin must be tossed in order that the probability will be at least 0.9 that the ratio of observed number of heads to the number of tosses will be between 0.4 and 0.6.	3
8.	The mean and variance of binomial distribution are 3 and 3/4 respectively. Find P[X ≥1]. OR Explain the moments of the normal distribution.	3
9.	Explain the t- distribution. OR The value of sample correlation coefficient obtained from a sample of size 19 drawn a bivariate normal population is 0.8. Is this value consistent with the hypothesis that the correlation in the population is 6 at 5% level of significance?	3

Session: 2026-27	Max. Marks: 30
Program Name: M.Sc./MA (Statistics/Computer Science/Mathematics/ Bio chemistry/ Environmental Science)	
Course Code: PGRT-03	**Course Name: Research Tools and Practices**

SECTION -A		**2*6=12 marks**
Q. No.	**Short answer type question (approx. 200 -300 words)**	**Marks**
1	Write down the types and methods of data collection.	**2**
2	What are the different types of sample design?	**2**
3	What do you understand by data presentation?	**2**
4	Briefly describe errors in hypothesis testing.	**2**
5	Discuss the application of ICT in research.	2
6	Discuss the application of MS office in research.	2
SECTION -B		**6*3=18 marks**
	Long answer type question (approx. 500 -800 words)	**Marks**
7	Discuss sample designing detail. What are the characteristics of a good sample design?	**6**
8	What is research hypothesis and formulation of hypothesis? Discuss the concept of hypothesis testing.	**6**
9	What do you understand by Data classification and tabulation?	**6**