THE UNIVERSITY OF CHENAB

Department of Physical Sciences
Master of Philosophy in Mathematics (MPhil)

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Programs Offered by the Department of Physical Sciences (Mathematics)	
Degree Name	**Degree Details/Eligibility Criteria**
Bachelor of Science in Mathematics	The Bachelor of Science in Mathematics is of 4-years duration program, spread over 8 regular semesters, consisting of 134 credit hours after completing 12 years of education, Higher School Secondary Certificate /intermediate, FSc, ICS, (with Mathematics), DAE (Diploma in Associate Engr.) with minimum 45%. Pass institutional admission test.
Associate Degree Program in Mathematics	ADP program is of 2-years duration, spread over 4 regular semesters, and consisting of 68 credit hours after completing 12 years of education, Higher School Secondary Certificate /intermediate, FSc, ICS, (with Mathematics), DAE (Diploma in Associate Engr.) with minimum 45%. Pass institutional admission test.
Bachelor of Science in Mathematics (5th Semester Induction)	For Students with an ADP Degree: ADP in Mathematics: ▪ Direct admission to the 5th semester. ▪ Minimum CGPA: 2.0/4.0. ▪ Total number of credit hours # 68. ADP in Other Disciplines: ▪ Must have studied Mathematics in FA/FSc or equivalent. ▪ Minimum 60% marks in Mathematics in FA/FSc or equivalent. ▪ Required to complete a bridge semester to address deficiencies. ▪ Total number of credit hours # 78. For Students with BA/BSc or Equivalent Degree: ▪ Must have completed a BA/BSc or equivalent 14-year education. ▪ Minimum 45% marks in BA/BSc. ▪ Must have studied Mathematics in FA/FSc or equivalent. ▪ Minimum 60% marks in Mathematics in FA/FSc Mathematics or equivalent. ▪ Required to complete a bridge semester to address deficiencies. ▪ Total number of credit hours # 78.
MASTER OF PHILOSOPHY IN MATHEMATICS	Master of Philosophy is a 2-year program with 30 credit hours. 24 credit hours consist of course work and 6 credit hours are related to research work. Eligibility criteria is ❖ 16 years of education with Mathematics as a

	major subject having at least 2.0/4.0 CGPA or 50% marks in annual system. ❖ Secure at least 50% marks in the test conducted at university or in GAT test. For the interdisciplinary programs it is as follows: a. The applicant has a strong interest in pursuing an MPhil degree in mathematics. b. The applicant must pass GRE-Subject or equivalent test held in the university with minimum 50% marks. c. The applicant needs to take 6-9 CH of deficiency courses of level 5 and 6 decided by the Departmental admission committee.
PhD Mathematics	Prior to entry into a Ph.D. program, the student should have been awarded MS/M.Phil. or equivalent degree with mathematics as a major subject along with research thesis. Intra-disciplinary Qualifications A student can enroll into Ph.D. Mathematics Program if he/she has completed his/her M.Phil./M.S. degree in any other discipline after fulfilling the following criteria: i. The university policy allows, and ii. The applicant has a strong interest in pursuing a Ph.D. degree in a different discipline. iii. The applicant has passed GRE-Subject with minimum 70% marks in mathematics and has taken 6-9 Credit Hours of deficiency courses of level 7. iv. The admissions committee is satisfied that the applicant's knowledge of primary area (level 7) has sufficiently prepared him or her to undertake the course of studies of the doctoral program (or, in the opinion of the admissions committee, the preparation can be deemed satisfactory by taking a few additional courses after starting the program). a) Minimum CGPA Requirement. For admission in Ph.D. programs, a minimum CGPA of 3.0 (out of 4.0 in the semester system) or First Division (in the annual system) in the most recent degree obtained is required, whether such degree was obtained from Pakistani or foreign universities. b) In case of foreign degree, if the CGPA/Grade is not mentioned on the transcript, the candidate must produce equivalent weightage from the parent university. c) The students having strong demonstrated pursuit for Ph.D. degree, but their CGPA is below 3.00 (out of 4.0 in the semester system) or Second Division (in the annual system) in

	the most recent degree obtained, may be admitted to a Ph.D. program fulfilling the following requirements:
	i. Shall have published one research article in 'X' category journal as a first author. OR
	ii. Shall have studied additional courses of 9-12 Credit Hours of level 7 and have scored a minimum 3 out of 4 CGPA. And
	iii. The admissions committee is satisfied that the applicant's knowledge of primary area (level 7) has sufficiently prepared him or her to undertake the course of studies of the doctoral program.
	Admission Test
	Applicants to Ph.D. program shall be required to fulfill the following testing requirements:
	i. The Graduate Record Examination (GRE)/GAT subject test, administered by the Education Testing Service recognized by HEC with a passing score 60% OR
	ii. Conduct the test equivalent to GRE/GAT/HAT General developed at the University, with the passing score of 70%.
	Statement of Purpose
	As part of the application for admission to Ph.D. programs, applicants shall be required to submit a statement of purpose, which shall form an integral part of the application. The admissions committee shall use the information provided to ascertain the preparedness and interest of the candidate in pursuing doctoral studies, and whether the department has their quasit resources to train and supervise the doctoral candidate in the subspecialty the applicant is interested in.

Multiple Choice Questions

1. If $f(1) = 2$, and $f(n)=f(n-1) +0.5$ for all integers $n > 1$, then $f(101) =$ _____.
   - A) 49
   - B) 50
   - C) 51
   - D) 52
   - E) 53

2. If $\begin{bmatrix} a & -b \\ b & a \end{bmatrix}$ is invertible under matrix multiplication, then its inverse is
   - A) $\begin{bmatrix} a & -b \\ b & a \end{bmatrix}$
   - B) $\frac{1}{a^2+b^2}\begin{bmatrix} a & -b \\ b & a \end{bmatrix}$
   - C) $\frac{1}{a^2+b^2}\begin{bmatrix} a & b \\ -b & a \end{bmatrix}$
   - D) $\begin{bmatrix} a & b \\ -b & a \end{bmatrix}$
   - E) $\frac{1}{a^2-b^2}\begin{bmatrix} -b & a \\ a & b \end{bmatrix}$

3. For what values of m is the vector $(1, 2, m, 5)$ is a linear combination of vectors $(0,1,1,1)$, $(0,0,0,1)$, and $(1,1,2,0)$?
   - A) For no value of m
   - B) -1 only
   - C) 1 only
   - D) 3 only
   - E) For infinite value of m

4. For a function f the finite differences $\Delta f(x)$ and $\Delta^2 f(x)$ are define by
   $\Delta f(x) = f(x + 1) - f(x)$, and $\Delta^2 f(x) = \Delta f(x + 1) - \Delta f(x)$. What is the value of $f(4)$, giving the following partially completed finite difference table

x	$f(x)$	$\Delta f(x)$	$\Delta^2 f(x)$
1	-1	4	
2		-2	6
3			
4			

   - A) -5
   - B) -1
   - C) 1
   - D) 3
   - E) 5

5. If S is a finite set with k elements, then the number of one-to-one functions from S onto S is
   _____
   - A) $k!$
   - B) k^2
   - C) k^k
   - D) 2^k
   - E) 2^{k+1}

6. In the Euclidean plane, point A is on a circle centered at the point O, and O is on the circle centered at A. The circles intersect at points B and C. What is the measure of angle BAC?
   A) 60^0
   B) 90^0
   C) 120^0
   D) 135^0
   E) 150^0

7. Which of the following sets of vectors is the basis for the subspace of Euclidean 4-space consisting of all vectors that are orthogonal to both (0,1,1,1) and (1,1,1,0)?
   A) {(0, -1,1,0)}
   B) {(1,0,0,0), (0,0,0,1)}
   C) {(-2,1,1, -2), (0,1, -1,0)}
   D) {(1, -1,0,1), (-1,1,0, -1), (0,1,-1,0)}
   E) {(0,0,0,0), (-1,1,0, -1),(0,1,-1,0)}

8. Let f be the function define by
$$f(x) = \begin{cases} -x^2 + 4x - 2; & \text{if } x < 1 \\ -x^2 + 2; & \text{if } x \geq 1 \end{cases}.$$
Which of the following statements about f is true?
   A) f has an absolute maximum at $x = 0$.
   B) f has an absolute maximum at $x = 1$.
   C) f has an absolute maximum at $x = 2$.
   D) f has no absolute maximum.
   E) f has local maximum at both $x = 0$ and $x = 2$.

9. If V_1 and V_2 are 6-dimensional subspaces of a 10-dimensional vector space V, what is the smallest possible dimension that $V_1 \cap V_2$ can have?
   A) 0
   B) 1
   C) 2
   D) 4
   E) 6

10. $\sum_{k=1}^{\infty} \frac{k^2}{k!}$
    A) e
    B) $2e$
    C) $(e + 1)(e - 1)$
    D) e^2
    E) ∞

SUBJECTIVE TYPE

Q1. a) In how many ways can painted a row of 2011 houses, using four colors, if any two neighboring houses have different colors?

b) In how many ways can be painted these houses if any four consecutive houses have four different colors?

Q2. Let V be the real vector space of the polynomials $P(X) \in \mathbb{R}[X]$ of degree at most 2 and $f: V \to V$ the function defined by $f(P(X)) = P(X - 1)$, for all $P(X) \in V$.

    a) Show that f is an isomorphism of vector spaces.

    b) Find the polynomial $P(X)$ such that $f(P(X)) = X^2 + X + 1$.

Q3. Find the local maximum, minimum and saddle points of the function:

$$f(x, y) = (x^2 + y)e^{\frac{y}{2}}.$$

Q4. Prove that $\sqrt{3}$ is an irrational number.

Q5. Prove that for any $n \in \mathbb{Z}$ the numbers $n^2 + 4n + 2$ and $2n^2 + 9n + 5$ are relatively prime.