



Air University  
End Semester Examinations: Fall 2025

Student ID: \_\_\_\_\_

Subjective Part  
(To be solved on Answer Books only)

Subject: Calculus and Analytical Geometry  
Class: BSCYS-III  
Section(s): A, B (Morning Session)  
Course Code: MA-110

Time Allowed: 180 Minutes  
Max Marks: 100  
Date: 17-JAN-2026  
Time: 09:00-12:00  
FM's Name: Mr. Umair Habib  
FM's Signature: Umair

### INSTRUCTIONS

- Attempt responses on the answer book only.
- Nothing is to be written on the question paper.
- Rough work or writing on question paper will be considered as use of unfair means.
- Tables/calculators are allowed.

Q1

(CLO-1)

Marks (5+5+5)

a) Find the domain and range of the given function.  $f(x) = \frac{2x-1}{x+4}$

b) Sketch the graph of the following function by using Translation and reflection as appropriate.

$f(x) = 6 - x - x^2$  (NOTE: Sketch all the versions before the final graph).

c) State conditions under which two functions,  $f$  &  $g$ , will be the inverses of one another, and give at least 3 examples of such functions.

Q2

(CLO-2)

Marks (5+5+5+5)

a) Discuss the continuity of the function  $f(x) = \frac{1}{\sqrt{x}}$  on the interval  $[1,9]$ .

b) Interpret the limit.  $\lim_{x \rightarrow +\infty} \sqrt{x^6 + 5x^3} - x^3$

c) If  $f(x) = \frac{\sin(x) - \sin(1)}{x-1}$ . Use the identity  $\sin(\alpha) - \sin(\beta) = 2\cos\left(\frac{\alpha+\beta}{2}\right)\sin\left(\frac{\alpha-\beta}{2}\right)$  to describe  $\lim_{x \rightarrow 1} f(x)$ .

d) Check (demonstrate) whether the function  $f(x) = |x|$  is differentiable or not at  $x = 0$ .

Q3

(CLO-3)

Marks (5+8+5+7)

a) Calculate the area between the graph of the function  $f$  and the interval  $[a, b]$ .

$f(x) = \sqrt{1-x^2}$ ;  $[a, b] = [-1, 1]$  &  $n = 5$

b) Use Integration by Parts to Solve.  $\int e^x \sin(x) \cos(x) dx$

c) Solve the Initial Value Problem  $\frac{dy}{dt} = \sec^2 t - \sin t$ ;  $y\left(\frac{\pi}{4}\right) = 1$

d) Consider  $x_k^*$  as the midpoint of each subinterval to calculate the area under the curve  $y = f(x)$  over the specified interval.  $f(x) = 9 - x^2$ ;  $[0, 3]$ .

**Q4**

**(CLO-4)**

**Marks (10+10)**

- a) Find the radius and height of the right circular cylinder of largest volume that can be inscribed in a right circular cone with radius 6 inches and height 10 inches.
- b) Find the point on the graph of the curve  $y = 4 - x^2$  which is closest to the point (3,4).

**Q5**

**(CLO-5)**

**Marks (7+13)**

- a) Suppose  $f(x)$  is a differentiable function with derivative  $f'(x) = (x - 1)^2(x - 2)(x - 4)(x - 5)^4$ . Find all critical values of  $f(x)$  and determine whether each corresponds to a relative maximum, a relative minimum, or neither.
- b) Sketch a graph of the polynomial and label the coordinates of the intercepts, stationary points, and inflection points.  $p(x) = x(x^2 - 1)^2$