Laxmi Narayan Dubey College, Motihari

Internal Assessment Examination-2023

1st SEMESTER

SUBJECT: PHYSICS (Major Course MJC-1)

Name of Course: Introduction to Mathematical Physics & Classical Mechanics

Full Marks: 15

PART –A

Answer any FIVE **(5 ×1=5)**

A. Objective/ Multiple Choice Type Questions:

1. What is the derivative of the function $f(x) = 3x^2 + 2x + 1$ with respect to x?
a) $3x^2 + 2x + 1$
b) $6x + 2$
c) $6x + 2 + 1$
d) $3x + 2$

2. The slope of the tangent line to the curve $y = x^2$ at the point (2, 4) is:
a) 1
b) 2
c) 4
d) 8

3. What is the second derivative of the function $f(x) = 3x^3 - 2x^2 + x - 4$?
a) $18x - 4$
b) $6x^2 - 4x + 1$
c) $6x - 2$
d) $3x^2 - 2x + 1$

4. Which of the following is the indefinite integral of $\int(5\cos(x) - 2\sin(x))\, dx$?
A) $5\sin(x) + 2\cos(x) + C$
B) $5\sin(x) - 2\cos(x) + C$
C) $-5\sin(x) - 2\cos(x) + C$
D) $-5\sin(x) + 2\cos(x) + C$

5. Which of the following is the indefinite integral of $\int(\ln(x))\, dx$?
A) $\ln(x) + x + C$
B) $\ln(x) - x + C$
C) $x \ln(x) + C$
D) $x \ln(x) - x + C$

6. What is the integral of $\int(3\sin(x) + 2\cos(x))\, dx$?
A) $3\cos(x) - 2\sin(x) + C$
B) $3\cos(x) + 2\sin(x) + C$
C) $-3\cos(x) - 2\sin(x) + C$
D) $-3\cos(x) + 2\sin(x) + C$

7. What is the magnitude of vector, $A = 1/\sqrt{3}\, i + 1/\sqrt{3}\, j + 1/\sqrt{3}\, k$?
A) 0 B) 1 C) 2 D) 3

8. If two vectors are orthogonal, then their dot product is:
A) 0 B) 1 C) -1 D) Undefined

9. Coriolis force causes objects to deflect in a rotating frame due to:

A) Gravity.
B) Centripetal force.
C) Inertia.
D) Friction.
10. The Coriolis force is directly proportional to:
A) The object's mass.
B) The object's velocity.
C) The object's displacement.
D) The object's acceleration.

PART –B

Answer any FIVE **(5 ×1=5)**

B. Fill in the blanks:

1. The Coriolis Effect is responsible for the deflection of moving objects due to……
2. In a rotating reference frame, the Coriolis force is zero at ……..
3. The gradient of a constant scalar function is……..
4. The critical point of the function $f(x) = x^2 + 4x - 7$ occurs at ……
5. The second derivative of the function $f(x) = 3x^3 - 2x^2 + x – 4$ is …….
6. If f(x) = sin(x), f'(x) is ……

PART –C

Answer any FIVE **(5 ×1=5)**

C. Short Answer Type Questions:

1. What is centrifugal force?
2. Define divergence of a vector field and provide its mathematical representation.
3. What are a scalar field, and a vector field?
4. Give an example of a scalar field.
5. If vector A = i + 2j + 3k and vector B = 2i - j + k, what is the dot product A • B?
6. What is the scalar product of 5i + j – 3k and 3i – 4j + 7k ?
7. Evaluate $\int(2x^3 + 5x^2 - 3x + 7)\,dx$
8. If $f(x) = \frac{[\cos x - \sin x]}{[\cos x + \sin x]}$, then prove that $f'(x) + [f(x)]^2 = -1$
9. Differentiate the following function: $\frac{(3x+2)}{(x+5)(2x+1)+3}$
10. If x = sin u and y = sin bu, where b is any real constant. Prove that

$$(1 - x^2)\frac{d^2y}{dx^2} - x\frac{dy}{dx} + b^2y = 0$$