

**Bs/PHYM-101(T)**

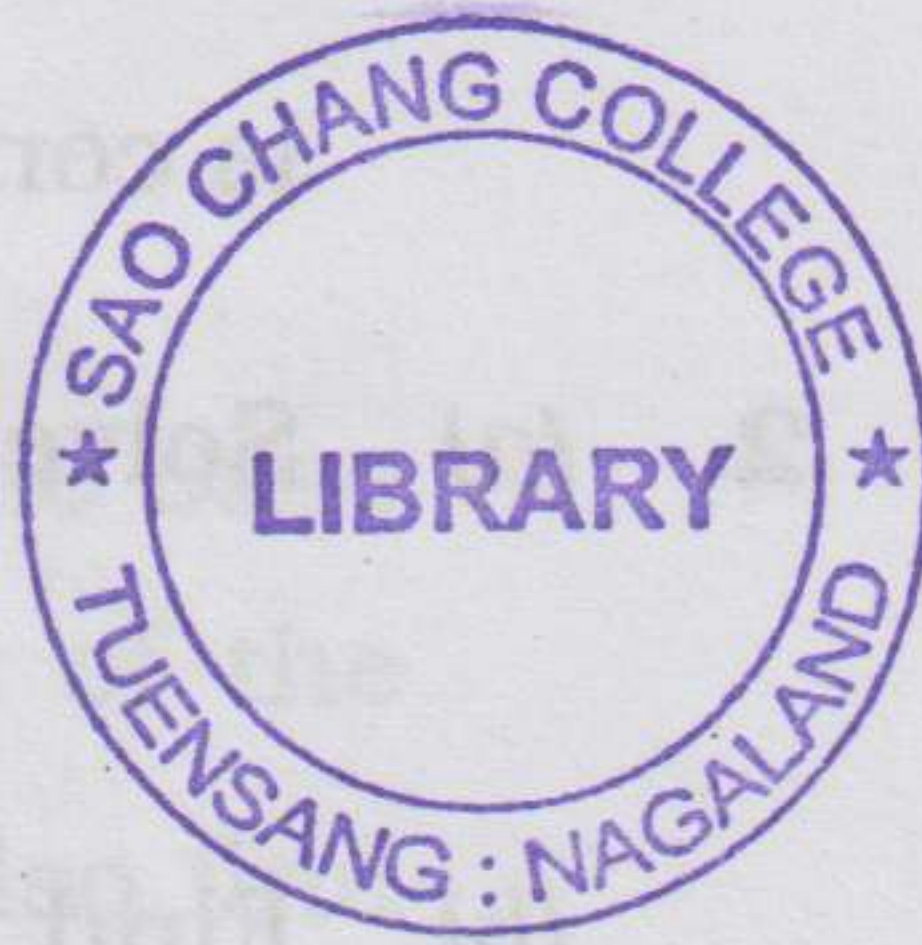
**2025**

**( FYUGP )**

**( 1st Semester )**

**PHYSICS**

**( MINOR )**



**Paper : PHYM-101(T)**

**( Mathematical Physics—1 )**

**Full Marks : 75**

**Pass Marks : 40%**

**Time : 3 hours**

**( PART : B—DESCRIPTIVE )**

**( Marks : 50 )**

*The figures in the margin indicate full marks  
for the questions*

**Answer *one* question from each Group**

**GROUP—A**

- 1. (a)** Check if the function defined by  
 $f(x) = x^2 - \sin x + 5$  is continuous at  
 $x = \pi$  or not.

**4**

**26L/49a**

**( Turn Over )**

( 2 )

(b) Check if the function

$$f(x) = x^3 - 3, \text{ if } x \leq 2 \\ = x^2 + 1, \text{ if } x > 2$$

is continuous and differentiable or not. 6

2. (a) Solve the homogeneous equation

$$(x^2 + y^2)dx - xydy = 0 \quad 6$$

(b) Find the integrating factor of the following differential equation and solve it : 4

$$\frac{dy}{dx} + y = x$$

GROUP—B

3. (a) Solve the following differential equation by the method of separation of variable

$$3 \frac{\partial u}{\partial x} + 2 \frac{\partial u}{\partial y} = 0 \quad 5$$

(b) Solve the differential equation

$$(8y - x^2y) \frac{dy}{dx} + (x - xy^2) = 0 \quad 5$$

4. (a) If the probability of target hitting a target is  $1/5$  and two bombs are enough to destroy a bridge, what is the probability that bridge is destroyed, if 4 bombs are aimed at the bridge? 5

26L/49a

( Continued )

( 3 )

(b) Assuming 10000 random digits, how many cases do we expect that the digit 3 appears at almost 950 times? 5

GROUP—C

5. (a) Find the area of the triangle whose base is given by  $\vec{A} = \hat{i} + \hat{j} + \hat{k}$  and one of the other two sides by  $\vec{B} = 2\hat{j} + 3\hat{k}$ . Also find the third side. 5

(b) Show that vectors  $\vec{A} = 3\hat{i} - 2\hat{j} + \hat{k}$ ,  $\vec{B} = \hat{i} - 3\hat{j} + 5\hat{k}$  and  $\vec{C} = 2\hat{i} + \hat{j} - 4\hat{k}$  form a right-angled triangle. 5

6. (a) Find **grad log r**, where **r** is a position vector. 2

(b) Find a unit vector normal to the surface  $z = x^2 + y^2$  at the point (1, 2, 5). 3

(c) Show that  $\vec{\nabla}^2 f(r) = \frac{2}{r} f'(r) + f''(r)$  5

GROUP—D

7. (a) Define line integral, surface integral and volume integral. 1+1+1=3

(b) State and prove Green's theorem. 7

26L/49a

( Turn Over )

129  
5648  
128

( 4 )

8. (a) Evaluate  $\iint (z+3x-x^2) \cdot dS$  with  $S$  being the part of  $z=2-3y+x^2$  that lies over the triangle in the  $xy$ -plane with vertices  $(0, 0)$ ,  $(2, 0)$  and  $(2, 4)$ . 6
- (b) Evaluate  $\iint \vec{F} \cdot dS$  where  $S$  is the surface of the cube bounded by  $x=0$  to  $1$ ,  $y=0$  to  $1$  and  $z=0$  to  $1$  if  $\vec{F} = xz\hat{i} - y^2\hat{j} + 2yz\hat{k}$ . 4

GROUP—E

9. (a) Show that for cylindrical coordinate system  $\nabla \cdot \vec{R} = 3$  and  $\nabla \times \vec{R} = 0$ . 6
- (b) Find the cross product for unit vectors in cylindrical coordinate system. 4
10. (a) Express  $\delta$  function as a limit of Gaussian distribution function. 6
- (b) Show that the wave function  $\psi(x) = Ae^{-k(x)}$  satisfies the differential equation  $\frac{d^2\psi}{dx^2} - k^2\psi(x) = -2Ak\delta(x)$ . 4

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Subject Code : Bs/PHYM-101(T)

Booklet No. A

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Date Stamp .....

To be filled in by the Candidate

BA / BSc / BCom / BBA / BCA  
1st Semester End Term  
Examination, 2025 (FYUGP)

Subject .....

Paper .....

INSTRUCTIONS TO CANDIDATES

1. The Booklet No. of this script should be quoted in the answer script meant for descriptive type questions and vice versa.
2. This paper should be ANSWERED FIRST and submitted within 1 (one) Hour of the commencement of the Examination.
3. While answering the questions of this booklet, any cutting, erasing, overwriting or furnishing more than one answer is prohibited. Any rough work, if required, should be done only on the main Answer Book. Instructions given in each question should be followed for answering that question only.

Signature of  
Scrutiniser(s)

Signature of  
Examiner(s)

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1st Semester End Term  
Examination, 2025 (FYUGP)

Roll No. ....

Regn. No. ....

Subject .....

Paper .....

DESCRIPTIVE TYPE

Booklet No. B .....

Signature of  
Invigilator(s)

2025

( FYUGP )

( 1st Semester )

**PHYSICS**

( MINOR )

Paper : PHYM-101(T)

( **Mathematical Physics—1** )

( PART : A—OBJECTIVE )

( Marks : 25 )

*The figures in the margin indicate full marks for the questions*

SECTION—I

( Marks : 15 )

Put a Tick (✓) mark against the correct answer in the brackets provided :

1×15=15

1. Classify the differential equation  $e^x \frac{dy}{dx} + 3y = x^2y$ .

- (a) Separable and nonlinear ( )
- (b) Linear and non-separable ( )
- (c) Both separable and linear ( )
- (d) Neither separable nor linear ( )

2. The order and degree of the differential equation

$$\frac{d^2y}{dx^2} + \left(\frac{dy}{dx}\right)^2 + 3y = 0$$

are

(a) order 2 and degree 2 ( )

(b) order 2 and degree 1 ( )

(c) order 1 and degree 1 ( )

(d) order 1 and degree 2 ( )

3. For exact differential equation of the form  $Mdx + Ndy = 0$ , which one is correct?

(a)  $\frac{\partial M}{\partial y} = \frac{\partial N}{\partial x}$  ( )

(b)  $\frac{\partial M}{\partial y} \neq \frac{\partial N}{\partial x}$  ( )

(c)  $\frac{\partial M}{\partial x} = \frac{\partial N}{\partial y}$  ( )

(d)  $\frac{\partial M}{\partial y} + \frac{\partial N}{\partial x} = 0$  ( )

4. The mean of Poisson's distribution  $P(r) = (m^r e^{-m}) / r!$  is

(a)  $m$  ( )

(b)  $r$  ( )

(c)  $\frac{m}{r}$  ( )

(d)  $\frac{m}{r!}$  ( )

5. In a normal distribution, the ratio of mean deviation from mean and its standard deviation is nearly

(a) 1 ( )

(b)  $\frac{1}{2}$  ( )

(c)  $\frac{1}{3}$  ( )

(d)  $\frac{1}{5}$  ( )

6. The mean of binomial distribution is

(a)  $\frac{p+q}{2}$  ( )

(b)  $np$  ( )

(c)  $npq$  ( )

(d)  $\sqrt{npq}$  ( )

7. The magnitude of the vector product of two vectors  $\vec{A}$  and  $\vec{B}$  cannot be

- (a) equal to  $AB$  ( )
- (b) less than  $AB$  ( )
- (c) zero ( )
- (d) greater than  $AB$  ( )

8. The maximum value of angle between two vectors is

- (a) 0 ( )
- (b)  $\frac{\pi}{2}$  ( )
- (c)  $\pi$  ( )
- (d)  $2\pi$  ( )

9. Two vectors  $\vec{A}$  and  $\vec{B}$  are equal to each other, if

- (a)  $\vec{A} \times \vec{B} = 0$  ( )
- (b)  $\vec{A} \cdot \vec{B} = 0$  ( )
- (c)  $\vec{A} \cdot \vec{B} = 1$  ( )
- (d)  $\vec{A} \times \vec{B} = 1$  ( )

10. A vector field is conservative if

(a)  $\vec{A} = \vec{\nabla} \cdot \phi$  ( )

(b)  $\vec{A} = \vec{\nabla} \times \phi$  ( )

(c)  $\vec{A} = \vec{\nabla} \phi$  ( )

(d)  $\vec{A} = \vec{\nabla}^2 \phi$  ( )

11. Del ( $\vec{\nabla}$ ) operator behaves like

(a) a scalar quantity

(b) a vector quantity ( )

(c) a scalar or a vector ( )

(d) None of the above ( )

12. The divergence of curl of a vector is always

(a) 1 ( )

(b) 0 ( )

(c)  $\frac{1}{2}$  ( )

(d)  $\frac{\pi}{2}$  ( )

13. In spherical coordinate system,  $x$ ,  $y$  and  $z$  are related to  $r$ ,  $\theta$  and  $\phi$  as

(a)  $x = r \cos \theta \cos \phi$ ,  $y = r \cos \theta \sin \phi$ ,  $z = r \sin \theta$  ( )

(b)  $x = \theta \sin r \cos \phi$ ,  $y = \theta \sin r \sin \phi$ ,  $z = \theta \cos r$  ( )

(c)  $x = r \sin \theta \cos \phi$ ,  $y = r \sin \theta \sin \phi$ ,  $z = r \cos \theta$  ( )

(d)  $x = r \sin \theta \sin \phi$ ,  $y = r \cos \theta \cos \phi$ ,  $z = r \cos \theta$  ( )

14. What is the Fourier transform of  $\delta(t)$ ?

(a)  $\sqrt{2\pi}$  ( )

(b)  $\frac{1}{\sqrt{2\pi}}$  ( )

(c) 0 ( )

(d) 1 ( )

15. What is the Laplace transform of  $\delta(t)$ ?

(a)  $\sqrt{2\pi}$  ( )

(b)  $\frac{1}{\sqrt{2\pi}}$  ( )

(c) 0 ( )

(d) 1 ( )

SECTION—II  
( Marks : 10 )

Answer any *five* of the following :

2×5=10

1. What are meant by order and degree of a differential equation?

2. What are linear and non-linear differential equations?

Answer any five of the following:

1. What are meant by order and degree of a differential equation?
2. Solve the differential equation  $x \frac{dy}{dx} + y = x^2 \sin x$ .
3. Solve the differential equation  $x \frac{dy}{dx} + y = x^2 \sin x$ .
4. Solve the differential equation  $x \frac{dy}{dx} + y = x^2 \sin x$ .
5. Solve the differential equation  $x \frac{dy}{dx} + y = x^2 \sin x$ .

14. What is the Fourier transform of  $\delta(x)$ ?

- (a)  $\sqrt{2\pi}$
- (b)  $\frac{1}{\sqrt{2\pi}}$
- (c) 0
- (d) 1

15. What is the Laplace transform of  $\delta(t)$ ?

- (a)  $\sqrt{2\pi}$
- (b)  $\frac{1}{\sqrt{2\pi}}$
- (c) 0
- (d) 1

3. How can an inexact differential equation be converted to exact differential equation?

4. What is binomial distribution?

5. Define normal and directional derivative.

6. What is the physical application of a gradient?

7. State Gauss divergence theorem.

8. State Stokes theorem.

9. Define Dirac delta function. 10. State two properties of

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9. Define Dirac delta function. 10. State two properties of

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10. State two properties of a delta function.

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