(6 pages) **Reg. No. :** 

Code No.: 6859 Sub. Code: PPHM 21

M.Sc. (CBCS) DEGREE EXAMINATION, APRIL 2021.

Second Semester

Physics — Core

#### MATHEMATICAL PHYSICS — II

(For those who joined in July 2017 onwards)

Time : Three hours

Maximum : 75 marks

PART A —  $(10 \times 1 = 10 \text{ marks})$ 

Answer ALL questions.

Choose the correct answer.

1. The value of  $\int_C \frac{zdz}{\sin z}$  where C: |z| = 4 is (a)  $2\pi i$  (b)  $-2\pi i$ (c) 0 (d)  $-4\pi i$ 2. The residue of  $\frac{z}{(z-a)(z-b)}$  at infinity is

- (a) 1 (b) -1
- (c) -2 (d) 4

- 3. If A and B are two elements of a group G under multiplication, then the element of group G must be
  - (a) A + B (b) A B
  - (c) AB (d)  $\frac{A}{B}$

4. The factor group of an Abelian group is necessarily

- (a) An Abelian group (b) Cycle group
- (c) Non-Abelian group (d) Permutation group
- 5. The incorrect equation among the following is

(a) 
$$P_0(x) = 1$$

(b) 
$$P_1(x) = x$$

- (c)  $P_n(-x) = (-1)^{n+1} P_n(x)$
- (d)  $P_n(1) = 1$

6. If 
$$\int_{-1}^{+1} P_n(x) dx = 2$$
 then *n* is  
(a) 1 (b) 0  
(c) -1 (d) 2

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7. In heat flow equation  $\nabla^2 u = \frac{1}{h^2} \frac{\partial u}{\partial t}$  the quantity *h* is called

- (a) Planck's constant (b) Conductivity
- (c) Heat flow constant (d) Diffusivity
- 8. The equation of motion of a vibrating string is

(a) 
$$\frac{\partial^2 y}{\partial x^2} = T \frac{\partial^2 y}{\sigma \partial x^2}$$
 (b)  $\frac{\partial^2 y}{\partial x^2} = \frac{T}{\sigma} \frac{\partial^2 y}{\partial t^2}$   
(c)  $\frac{\partial^2 y}{\partial x^2} = \sqrt{\frac{T}{\sigma}} \frac{\partial^2 y}{\partial t^2}$  (d)  $\frac{\partial^2 y}{\partial x^2} = \frac{T}{\rho} \frac{\partial^2 y}{\partial t^2}$ 

- 9. A scalar is a tensor of rank
  - (a) one (b) two
  - (c) three (d) zero
- 10. The velocity of a particle is
  - (a) a scalar
  - (b) a contravariant vector
  - (c) a covariant vector
  - (d) a tensor of rank 2

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PART B —  $(5 \times 5 = 25 \text{ marks})$ 

Answer ALL questions, choosing either (a) or (b).

Each answer should not exceed 250 words.

11. (a) Determine the analytic function, whose real part is  $x^3 - 3xy^2 + 3x^2 - 3y^2 + 1$ .

# Or

- (b) State and prove Cauchy's integral theorem.
- 12. (a) State and prove Lagrange's theorem for finite group.

### Or

- (b) Find the normal (invariant) sub group and factor (quotient) group of  $D_3$  group.
- 13. (a) Show that  $P_n(-x) = (-1)^n P_n(x)$ .

## Or

(b) Show that 
$$e^{2zx-z^2} = \sum_{n=0}^{\infty} \frac{H_n(x)}{n!} z^n$$
.

Page 4 Code No. : 6859 [P.T.O.] 14. (a) The ends A and B of a rod 20 cm long are at temperatures 30°C and 80°C respectively until steady state prevails. The temperatures at the ends are changed to 40°C and 60°C respectively. Find the temperature distribution in the rod at time t.

 $\mathbf{Or}$ 

- (b) Obtain the solution of variable linear flow in an infinite bar.
- 15. (a) Explain contravariant vectors.

Or

(b) Discuss outer product of tensors.

PART C —  $(5 \times 8 = 40 \text{ marks})$ 

Answer ALL questions, choosing either (a) or (b).

Answer should not exceed 600 words.

16. (a) State and prove Cauchy Residue theorem.

 $\mathbf{Or}$ 

(b) Find the poles and residues at the poles for the function  $f(z) = \frac{z}{\cos z}$ .

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17. (a) State and prove the Great Orthogonality Theorem.

Or

(b) State and prove Schur's Lemma-I.

18. (a) Prove that 
$$(1-2xt+t^2)^{\frac{1}{2}} = \sum_{n=0}^{\infty} t^n P_n(x).$$

Or

- (b) Obtain the series solution Hermite differential equation.
- 19. (a) The diameter of a semicircular plate of radius a is kept at 0°C and the temperature at the semicircular boundary is T°C. Find the steady state temperature of the plate.

## Or

- (b) Obtain the solutions of vibrations of a rectangular membrane.
- 20. (a) Discus the application of tensor analysis to the elasticity.

Or

(b) Discuss the application of tensor analysis in dynamics of a particle.

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