NOVEMBER/DECEMBER 2018

MPH21 — MATHEMATICAL PHYSICS – II

Time : Three hours Maximum : 75 marks

SECTION A — (5 × 6 = 30 marks)

Answer ALL questions.

1. (a) Find the values of C_1 and C_2 such that the function $f(z) = x^2 + c_1\, y^2 - 2xy + i\, \left(c_2 x^2 - y^2 + 2xy\right)$ is analytic.

Or

(b) Find the first three terms of the Taylor series expansion of $f(z) = \dfrac{1}{z^2+4}$ about $z = -i$.

2. (a) Obtain a wave equation for vibration of rectangular membrane.

Or

(b) Find the solution of heat flow equation $\nabla^2 u = \dfrac{1}{h^2}\dfrac{\partial u}{\partial t}$ • ←.

3. (a) Obtain the Laplace transformation of the function $F(t) = t^n$, where, n is integer $n \geq 0$.

Or

(b) State and prove convolution theorem of Fourier transform.

4. (a) Construct the character table for C_{3v} point group.

Or

(b) Discuss the symmetry rotations of $SO(2)$ and $SO(3)$ groups.

5. (a) Prove the relation $E^2\ p^2c^2 = mo^2c^4$ where p is the relatiristic momentum.

Or

(b) Discuss Minkowski's four dimensional space.

SECTION B — (3 × 15 = 45 marks)

Answer any THREE questions.

6. (a) State and prove Cauchy's integral formula.

(b) Find the value of $\int_c \frac{z^2+1}{z^2-1} - dz$, if c is circle of unit radius with centre at $z = 1$.

7. Write down Laplace equation is rectangular, cylindrical and spherical coordinates, solve it in cylindrical coordinate.

8. Use Laplace transform method to solve

$$\frac{d^2x}{dt^2} - 2\frac{dx}{dt} + x = e^{-t} \text{ with } x = 2, \frac{dx}{dt} = -1 \text{ at } t = 0.$$

9. State and prove great orthogonality theorem.

10. Derive relativistic Lagrangian and Hamiltonian for a free particle.
