G 3523 (Pages : 2) Reg. No.....

Name.....

M.Sc. DEGREE (CSS) EXAMINATION, AUGUST 2015

Second Semester

Faculty of Science

Branch II – Physics – A – Pure Physics

PH 2C 05 – MATHEMATICAL METHODS IN PHYSICS – II

(2012 Admission onwards)

Time : Three Hours Maximum Weight : 30

Part A

Answer any **six** *questions.*

Weight 1 each.

1. Evaluate : $\int_i^1 (2+1)^2 \, dz$.
2. What is meant by an analytic function of a complex variable? Give the necessary and sufficient conditions for a function to be analytic.
3. State Cauchy's Residue theorem.
4. State the conditions under which a function can be expressed in the form of a Fourier series.
5. State and prove convolution theorem of Fourier transform.
6. What is meant by point group? Give examples.
7. Define a cyclic group. Show that cyclic groups are abelian.
8. What are reducible and irreducible representation of a group?
9. Write down the Laplacian in spherical polar co-ordinates.
10. Write down Helmholtz differential equation. What are the different methods that can be used to solve this?

(6 × 1 = 6)

Part B

Answer any **four** *questions.*

Weight 2 each.

11. Show that the function $z\,|z|$ is not analytic anywhere.
12. Evaluate $\int_c \frac{e^z}{z^2+1} dz$ over the circular path $|z| = 2$.

Turn over

13. Find the finite sine transform of e^{ax}.

14. If every element of a group is its own inverse, then show that the group is an abelian group.

15. Construct the symmetry groups of an equilateral triangle.

16. Explain the solution of Poisson's equation $\nabla^2 = \phi = \frac{-\rho}{\in o}$ using Green's function.

(4 × 2 = 8 marks)

Part C

Answer **all** *questions.*

Weight 4 each.

17. (a) If $W = \phi + i\,\Psi$ represents the complex potential for an electric field and

$$\Psi = x^2 - y^2 + \frac{x}{x^2 + y^2}$$

determine the function ϕ.

Or

(b) Find the Taylor series expansion of a function of the complex variable

$$f(z) = \frac{1}{(z-1)(z-3)}$$

about the point $z = 4$. Find its region of convergence.

18. (a) A sinusoidal voltage E Sin wt is passed through a half wave rectifier which clips the negative portion of the wave. Develop the resulting portion of the function $u(t) = 0$ when, $-\frac{T}{2} < t < 0$.

$u(t)$ = E Sin wt when $0 < t < \frac{T}{2}$ where T is the period.

Or

(b) Obtain the Laplace transform of full wave rectified sine wave given by :

$$f(t) = \text{Sin wt} \quad 0 < t < \frac{\pi}{w}.$$

19. (a) Prove the orthogonality theorem in group theory.

Or

(b) If a matrix commutes with all the matrices of an irreducible representation, show that the matrix is a constant.

20. (a) Using method of separation of variables, solve $x\frac{\partial 4}{\partial x} + y\frac{\partial 4}{\partial y} = 0$.

Or

(b) Define Green's function. Discuss the solution of Poisson's equation using Green's function.

(4 × 4 = 16)