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C 83072 (Pages : 2) Name..

Reg. No..

SECOND SEMESTER M.A./M.Sc./M.Com. DEGREE EXAMINATION, JUNE 2020

(CBCSS)

Physics

PHY 2C 06—MATHEMATICAL PHYSICS–II

(2019 Admissions)

Time : Three Hours Maximum : 30 Weightage

Part A

Attempt all *questions.*
1 *weightage per question.*

1. Given that $f(z)=u+iv$ is analytic, show that both u and v satisfy the two dimensional Laplace equation.
2. How many distinct groups are there of order four ? Give the multiplication table for a non-cyclic group of order four.
3. What is the isotopic spin formalism for nucleons ?
4. Show that the shortest distance path in the two dimensional Euclidean plane is the straight line.
5. Write down the integral transform relations between a function and its Laplace transform.
6. Give the general form for the Green's function for the three dimensional Poisson equation.
7. Write down the form of F[(x)] that forms the basis of the Rayleigh-Ritz method for the computation of eigen functions and eigenvalues under a given normalizing condition.
8. Define conjugacy classes in the case of groups.

(8 × 1 = 8 weightage)

Part B

Answer any two *questions.*
5 *weightage per question.*

9. Determine the definite integral $I(\sigma)=\int_{-\infty}^{+\infty}\frac{x\sin x}{x^2-\sigma^2}\,dx$, where σ is real and positive, in two different ways such that a) $I(\sigma)$ represents a standing wave and b) $I(\sigma)$ represents an outgoing wave.

10. Set up the variational problem for getting a stationery value for $\int f\left(y_i, \frac{\partial y_i}{\partial x_j}, x_j\right) dx_j$ under the constraints $\varphi_k\left(y_i, x_j\right) = 0$ and obtain the corresponding Euler -Lagrange equations.

11. For a Fredholm equation of the second kind with a separable kernel outline a method of solution.

12. Given that the operator $\mathcal{L}$ is self-adjoint, obtain the eigen function expansion for the Green's function for the operator $\mathcal{L} - \lambda$.

(2 × 5 = 10 weightage)

Part C

Answer any **four** *questions.*

3 weightage per question.

13. Prove the identity $\left(\frac{ia-1}{ia+1}\right)^{ib} = \exp\left(-2b\cot^{-1}(a)\right)$.

14. Two coaxial wire circles are connected by a surface of minimum area generated by revolving a curve $y(x)$ about the x-axis. The curve is required to pass through fixed end points (x_1, y_1) and (x_2, y_2). Determine the equation for the curve $y(x)$. How are the integration constants of the general solution fixed?

15. Solve the integral equation $f(x) = \int_{-1}^{+1} \frac{\varphi(t)}{\left(1-2xt+x^2\right)^{1/2}} dt, -1 \le x \le +1$ for $\varphi(t)$ if $f(x) = x^{2s+1}$.

16. Determine the Green's function for the operator $\frac{d^2}{dx^2}$ given $y(0) = 0$ and $y'(1) = 0$.

17. Derive the differential equation equivalent to the integral equation $y(x) = x + a^2 \int_0^x (t-x)\, y(t) dt$.

18. If a non-trivial subgroup H of a group G consists of complete classes of G show that H is a normal subgroup of G.

19. Show that the operator for the z component of angular momentum is the generator for rotations about the z-axis.

(4 × 3 = 12 weightage)