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AR-19

M. Sc

M. Sc 1ST SEMESTER REGULAR EXAMINATIONS, NOV/DEC 2019-20

PHPC101-MATHEMATICAL METHODS IN PHYSICS

Time: 3 Hours

Max Marks: 80

The figures in the right hand margin indicate marks.

SECTION A

1 Answer any four of the following: [4 x 4 =16]

- a Expand f(z) = 1/((z-1)(z-2)) in Laurent series valid for 1 < |z| < 2. 4
b Find the residues of f(z) = 1/(z^2+1)^3 at z=i. 4
c Prove that two right or left cosets of a subgroup in a given group are either equal or else have no elements in common. 4
d Define the outer product for tensors and show that transformation is valid for outer product. 4
e Prove the Linearity Theorem for Fourier transform. 4
f Show that J_1/2(x) = sqrt(2/pi*x) Sin x. 4

OR

2. Answer all questions from the following [2 x 8 =16]

- a Is z^-1 an analytic function of complex variable? 2
b Define Laplace transform. 2
c What is the orthogonal property of Legendre's polynomial? 2
d Describe the contraction of tensors. 2
e Discuss dummy and real indices of tensors with example. 2
f Find the residue of f(z) = (z^3-z^2+1)/z^3 at infinity. 2
g Prove that a group of order three is always cyclic. 2
h Define the axioms of group. 2

SECTION-B

3. [16 x4 =64]

- a i. Discuss about contravariant and covariant tensors. 6
ii. A covariant tensor has components xy, 2y-x^2, xz in the rectangular co-ordinate system. Find its covariant components in spherical co-ordinate system. 10

OR

b Discuss about symmetric and anti-symmetric tensors. Check the preservation of symmetry property under co-ordinate system transformation. 16

4.

- a i. Use Cauchy's intergral formula to evaluate integral from C of pi/(z^3-3z+2) dz where C is the circle |z - 2| = 1/2 with proper diagram. 6
ii. Evaluate by method of complex variable with suitable diagram, the intergral from -infinity to infinity of x^2/(1+x^2)^3 dx. 10



OR

- b Using method of complex variables, suitable diagram and explanation, to evaluate the integral $\int_0^{2\pi} \frac{\sin^2 \theta}{5-4 \cos \theta} d\theta$. 16
5. a i. Find the Fourier transform of $e^{-|t|}$. 8
ii. Find the Laplace transform of $\sin^2 t$ and $\cos^2 t$. 8

OR

- b Derive any two recurrence formulae of the Legendre polynomial $P_n(x)$ from the following: 16
i. $n P_n(x) = (2n-1) x P_{n-1} - (n-1) P_{n-1}$
ii. $n P_n(x) = x P'_n(x) - P'_{n-1}(x)$
iii. $P'_{n+1}(x) - P'_{n-1}(x) = (2n+1) P_n(x)$

6. a i. State and prove Cayley's theorem. 8
ii. Discuss in detail the representations of group. 8

OR

- b i. Show that three cube roots of unity form an Abelian group under multiplication. 6
ii. Write notes on $SU(2)$ and Group multiplication table with examples. 10