M.Sc.—Phy-IS(101)

2019

(January)

Time : 3 hours

Full Marks : 80

Answer from **both** the Sections as per direction

The figures in the right-hand margin indicate marks

Candidates are required to answer in their own words as far as practicable

(MATHEMATICAL METHODS IN PHYSICS)

SECTION—A

1. Answer any *four* questions of the following : 4 × 4

(*a*) Find the residue of

$$f(z) = \frac{z\cos z}{(z-\pi)^3} \quad \text{at} \quad z = \pi$$

(*b*) Evaluate

$$\int_0^\infty \frac{x^{p-1}}{1+x^2}\,dx,\ 0<p<2$$

by contour integration.

(*c*) Explain about different types of tensors.

(*d*) Show that the covariant derivatives of fundamental tensors vanish.

(*e*) Construct the character table for the group D_3.

(*f*) Find the Laplace transform of sin (*at*) and cos*h* (*at*).

Or

2. Answer *all* questions from the following : 2 × 8

(*a*) Define contour integral.

(*b*) What are single and multivalued functions ?

(*c*) Define Pseudo tensor.

(*d*) What is contravariant tensor ?

(*e*) Define group.

(*f*) What do you mean by irreducible representation ?

(*g*) What is polynomial ? Explain.

(*h*) Define Fourier transform.

SECTION– B

Answer **all** questions : 16 × 4

3. (*a*) Obtain Cauchy-Riemann conditions of a function of a complex variable and evaluate

$$\oint_C \frac{\sin\pi z^2+\cos\pi z^2}{(z-1)(z-2)}\,dz,$$

where C is a circle $(z) = 3$.

Or

(*b*) State and prove Cauchy's Residue theorem and evaluate the integral

$$\int_0^{2\pi} \frac{d\theta}{(a+b\cos\theta)^2}, \quad a>b>0.$$

4. (*a*) Explain invariant tensor and epsilon tensors and show that δ^i_j is invariant and transforms as mixed tensor of rank two.

Or

(*b*) Explain about the Fundamental tensor and show that all the fundamental tensors $g_{\mu\nu}$, $g^{\mu\nu}$ and g^{ν}_{μ} are associated tensors.

5. (*a*) Explain subgroup and show that the order of a subgroup of a finite group is a divisor of the order of the group.

Or

(*b*) Explain about the classes in group theory and find the classes of D_3' group.

6. (*a*) Obtain the series solution of Bessel's differential equation.

Or

(*b*) Obtain Laplace transform of a derivative and show that

$$L\{t\cos t\} = \frac{s^2-1}{(s^2+1)^2}.$$