

F 5132

(Pages : 3)

Reg. No.....

Name.....

M.Sc. DEGREE (C.S.S.) EXAMINATION, JANUARY/FEBRUARY 2017

First Semester

Faculty of Science

Branch II-Physics-A-Pure Physics

PH 1C 01—MATHEMATICAL METHODS IN PHYSICS-I

(2012 Admission onwards)

Time : Three Hours

Maximum Weight : 30

Part A

Answer any six questions.

Weight 1 each.

1. Define Levi-Civita Tensor.
2. What is the physical interpretation of curl of a vector ?
3. If x^i and x^j are independent co-ordinate of a point, show that $\frac{\partial x^j}{\partial x^i} \frac{\partial x^i}{\partial x^j} = \delta_i^j$.
4. Define Hilbert space.
5. Verify Green's theorem for $\int_C [(xy + y^2) dx + x^2 dy]$ where C is bounded by $y = x$ and $y = x^2$.
6. Define mixed tensor. Show that kronecker delta is a mixed tensor of order two.
7. Write different forms of β function.
8. Write a note on Schwartz inequality.
9. Define random variable in probability distribution.
10. Define normal matrices.

(6 × 1 = 6)

Part B

Answer any four questions.

Weight 2 each.

11. Find the matrix P which transforms the matrix $\begin{pmatrix} 1 & 1 & 3 \\ 1 & 5 & 1 \\ 3 & 1 & 1 \end{pmatrix}$ to the diagonal form.

Turn over

12. If $f = (x^2 + y^2 + z^2)^{-n}$, find $\text{div grad } f$ and determine the value of n if $\text{div grad } f = 0$.
13. Express $J_5(x)$ in terms of $J_0(x)$ and $J_1(x)$.
14. Prove that $H'_n(x) = 2nH_{n-1}(x)$.
15. Show that Legendre polynomial can be expressed as $P_n(X) = \frac{1}{2^n n!} \frac{d^n}{dx^n} (x^2 - 1)^n$.
16. Obtain the expression for metric tensor in cylindrical co-ordinate system. (4 × 2 = 8)

Part C

Answer all questions.
Weight 4 each.

17. (A) Explain :

- (i) Addition of tensors.
- (ii) Outer product of tensors.
- (iii) Contraction of tensors.
- (iv) Inner product of tensors.

Or

- (B) (i) Define Christoffel's symbols. Explain Riemann-Christoffel symbol.
- (ii) Define geodesic. Obtain differential equation of geodesic in a space.

18. (A) (i) Prove that $\int_{-\infty}^{\infty} e^{-x^2} H_m(x) H_n(x) dx = 2^n n! \sqrt{\pi}$.

- (ii) Obtain generating function of Legendre polynomial.

Or

- (B) (i) Prove that beta function is symmetric.
- (ii) Obtain the relation between beta and gamma function.

19. (A) Derive the solution of Bessel differential equation.

Or

(B) (i) What are unitary and orthogonal transformation ?

(ii) Explain normal modes of vibration.

20. (A) (i) Explain Poisson and Gaussian distribution.

(ii) Derive the theorem corresponding to relation between line and surface integral.

Or

(B) Explain cylindrical co-ordinate system. Prove that this co-ordinate system is orthogonal. Express $z\mathbf{i} - 2x\mathbf{j} + y\mathbf{k}$ in cylindrical polar co-ordinate system.

(4 × 4 = 16)