2020/TDC/ODD/SEM/PHSH–102/092

TDC Odd Semester Exam., 2020
held in July, 2021

PHYSICS

(Honours)

(1st Semester)

Course No. : PHSH–102

(Mathematical Physics—I)

Full Marks : 35
Pass Marks : 12

Time : 2 hours

The figures in the margin indicate full marks for the questions

Answer **five** questions, taking **one** from each Unit

UNIT—I

1. *(a)* What is meant by curvilinear coordinate? Define orthogonal curvilinear coordinates. 2+1=3

(b) Find the expressions for length and volume elements in orthogonal curvilinear coordinate system. 4

2. *(a)* What are meant by right-handed and left-handed Cartesian coordinate systems? 2

(b) Find the expression of unit vectors in curvilinear coordinate system. Show that the unit vectors of cylindrical coordinate system are mutually orthogonal to each other. 2+3=5

UNIT—II

3. *(a)* Define vector triple product. Show that vector triple product is not associative. 1+2=3

(b) Show that

$$[\vec{a}\quad \vec{b}, \vec{b}\quad \vec{c}, \vec{c}\quad \vec{a}]\quad [\vec{a}\vec{b}\vec{c}]$$ 4

4. *(a)* Define the divergence of a vector point function. Interpret its physical meaning. 2+3=5

(b) If $\vec{v}\quad x^2 z\hat{i}\quad 2y^2 z^2\hat{j}\quad xy^2 z\hat{k}$, then find $\vec{\ }\ \vec{v}$ at the point (1, –1, 1). 2

UNIT—III

5. *(a)* Show that the eigenvalues of a Hermitian matrix are all real. 3

(b) Show that any two given vectors corresponding to two distinct eigenvalues of a Hermitian matrix are orthogonal. 4

6. *(a)* Define unitary matrix. 1

(b) Show that the following matrix is unitary : 3

$$\begin{matrix} \frac{1}{\sqrt{2}} & \frac{i}{\sqrt{2}} \\ \frac{i}{\sqrt{2}} & \frac{1}{\sqrt{2}} \end{matrix}$$

(c) Find the inverse of the following matrix : 3

$$\begin{matrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 6 & 7 & 9 \end{matrix}$$

UNIT—IV

7. *(a)* Obtain the relation between beta and gamma functions : 3

$$(m, n) \quad \frac{(m) \quad (n)}{(m \quad n)}$$

(b) Prove that $(n \quad 1) \quad n \; (n)$. 2

(c) Evaluate $\int_0 \sqrt[4]{x}\, e^{\;\sqrt{x}}\, dx$. 2

8. *(a)* Show that

$$\int_0 \frac{y^{m \quad 1}}{(1 \quad y)^{m \quad n}}\, dy \quad \frac{(m) \; (n)}{(m \quad n)}$$ 3

(b) Prove that

$$1 \; 3 \; 5 \; \cdots \; (2n \quad 1) \quad \frac{2^n}{\sqrt{}} \quad n \quad \frac{1}{2}$$ 4

UNIT—V

9. *(a)* What is Fourier series? Evaluate the coefficients of Fourier series. 5

(b) State the Dirichlet's conditions associated with the Fourier series. 2

10. *(a)* Find the Fourier series of $f(x) \quad x$ for $0 \quad x \quad 2 \; .$ 3

(b) Use Fourier theorem to analyze the square wave in terms of its components. 4

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