2020/TDC/ODD/SEM/
PHSH–303/096

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

PHYSICS

(Honours)

(3rd Semester)

Course No. : PHSH–303

(Mathematical Physics—II)

Full Marks : 35
Pass Marks : 12

Time : 2 hours

The figures in the margin indicate full marks for the questions

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

UNIT—I

1. *(a)* Explain with example, what are 'order' and 'degree' of a differential equation. What is a singular point? 2+1=3

(b) Solve the following differential equation : 4

$$(1 \quad x^2)\frac{d^2y}{dx^2} \quad x\frac{dy}{dx} \quad y \quad 0$$

2. *(a)* Write the condition when a differential equation is homogeneous. 1

(b) Using Frobenius method, solve the following differential equation : 6

$$x\frac{d^2y}{dx^2} \quad \frac{dy}{dx} \quad xy \quad 0$$

UNIT—II

3. Prove the following :

(i) $nP_n \quad (2n \quad 1)xP_{n \quad 1} \quad (n \quad 1)P_{n \quad 2}$

(ii) $(2n \quad 1)P_n \quad P_{n \quad 1} \quad P_{n \quad 1}$

where P_n represents Legendre polynomials. 4+3=7

4. *(a)* Prove the Rodrigues' formula 6

$$P_n(x) \quad \frac{1}{2^n n!}\frac{d^n}{dx^n}(x^2 \quad 1)^n$$

(b) Write the generating function for Legendre polynomial. 1

UNIT—III

5. For Bessel's function $J_n(x)$ prove the recurrence relation : 3½+3½=7

(i) $J_{n \quad 1}(x) \quad J_{n \quad 1}(x) \quad \frac{2n}{x} J_n(x)$

(ii) $J_{n \quad 1}(x) \quad J_{n \quad 1}(x) \quad 2 J_n(x)$

6. (a) Prove

$$J_{\frac{1}{2}}(x) \quad \sqrt{\frac{2}{x}} \sin x$$ 5

(b) Write the Bessel's function of first kind. 2

UNIT—IV

7. (a) What is a tensor? What is meant by the rank of a tensor? 2+2=4

(b) Show that the Kronecker delta ${}^{i}_{j}$ is a mixed tensor of rank two. 3

8. (a) What are covariant and contra-variant tensors? 4

(b) If A_{ij} and B_{ij} are two tensors, then prove that

$$A^{ij} B_{ij} \quad A_{ij} B^{ij}$$ 3

UNIT—V

9. (a) Express the complex number $\frac{2 \quad i}{3 \quad i}^{2}$ in polar form. 3

(b) Explain 'neighbourhood' and 'continuity'. 2+2=4

10. (a) Explain the condition for a function to be analytic. 2

(b) Deduce the Cauchy-Riemann conditions in complex analysis. 5

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