Roll No. ....

41271

B. Sc. Hons. Physics 4th Semester

Examination – May, 2019

MATHEMATICAL PHYSICS IV

Paper : PHY-401

Time : Three hours]   *[Maximum Marks : 40*

Before answering the questions, candidates should ensure that they have been supplied the correct and complete question paper. No complaint in this regard, will be entertained after examination.

Note : Attempt *five* questions in all, selecting at least *one* question from each Unit. Uses of Scientific (non-programmable) calculator is allowed.

UNIT – I

1. (a) Derive the relation between Beta and Gamma function. Also define these functions.   2

    (b) Evaluate $\sqrt{\left(\frac{1}{n}\right)} \sqrt{\left(\frac{2}{n}\right)} \dots \dots \sqrt{\left(\frac{n-1}{n}\right)}$, where n is a positive integer.   3

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    (c) Prove that $(m) \sqrt{\left(m+\frac{1}{2}\right)} = \frac{\sqrt{\pi}}{2^{2m-1}} \sqrt{(2m)}$, where m is positive. Also show that

$$\beta(m, m) = 2^{1-2m} \beta\left(m, \frac{1}{2}\right).$$ 3

2. (a) State and prove the generating function for Bessel's polynomials.   3

    (b) State and prove the Rodrigue's formula for Legendre's polynomials.   2

    (c) Prove the following recurrence relations :   3

      (i) $(2n+1) Pn(x) = P'_{n+1}(x) - P'_{n-1}(x)$

      (ii) $2J'_n(x) = J_{n-1}(x) - J_{n+1}(x)$

3. (a) State and prove the orthonormality property of Hermite polynomials.   4

    (b) Prove that :   2

$$\frac{1-t^2}{(1-2xt+t^2)^{3/2}} = \sum_{n=0}^{\infty} (2n+1) t^n P_n(x)$$

    (c) Show that $J_{-n}(x) = (-1)^n J_n(x)$, where n is any integer.   2

(2)

4. (a) State and prove the orthonormality of Lagu polynomials.

(b) State and prove the Generating function Hermite polynomials.

(c) Prove that :

(i) $M_0(-x) = (-1)^n H_n(x)$

(ii) $l_n'(x) - n\, l_{n-1}'(x) + nL_{n-1}(x) = 0$

UNIT – II

5. (a) Find the displacement of the vibrating string Length 'a' whose ends are fixed. Given $f(x)$ initial displacement and $g(x)$ is the initial veloc of string.

(b) Find the solution of one-dimensional h equation.

6. (a) Solve the wave equation for transverse vibrati of a rectangular membrane with periphery fix Find the allowed angular frequencies.

(b) A thin rectangular plate whose surface impervious to heat flow has t = 0 an arbitr distribution of temperature $f(x, y)$. Its four edg $x = 0$, $x = a$, $y = 0$, $y = b$ are kept at $\varkappa$

temperature. Determine the temperature at a point of plate as t increases. 4

7. (a) Find the solution of equation when heat flow in circular plate. 4

(b) Find out the equation of motion for the vibrating string. 4

8. (a) Determine the possible modes of oscillations of hanging chain. 4

(b) Find out the solution of Laplace equation in Cartesian coordinates. 4

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