বিদ্যাসাগর বিশ্ববিদ্যালয়
VIDYASAGAR UNIVERSITY

Question Paper

B.Sc. Honours Examinations 2020
(Under CBCS Pattern)
Semester - III
Subject: PHYSICS
Paper: C5T & C5P
(Mathematical Physics - II)

Full Marks : 60
Time : 3 Hours

Candiates are required to give their answer in their own words as far as practicable.
The figures in the margin indicate full marks.

Group - A

THEORY (Marks : 40)

Answer any ***two*** from the following questions : 2×20

1. (a) The fundamental period is the smallest positive period. Find it for $\cos x$, $\cos 2x$, $\sin x$, $\sin \pi x$ and $\cos 2\pi x$. 6

(b) Sketch or graph $f(x)$, of period 2π, which for $-\pi < x < \pi$ is given as follows.

$$f(x) = \begin{cases} -x^3, & \text{if } \pi < x < 0 \\ x^3, & \text{if } 0 < x < \pi \end{cases}$$ 4

(c) Derive the recursion formula from Hermite's differential equation. 6

(d) Derive the Euler's equation of motion for simple harmonic oscillator. 4

2. (a) (i) $\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$, why this equation is called partial differential equation ?

(ii) $u(x, y) = a \ln\left(x^2 + y^2\right) + b$; determine a and b is u satisfied the boundary conditions, $u = 110$ on the circle $x^2 + y^2 = 1$ and $u = 0$ on the circle $x^2 + y^2 = 100$. 3+3

(b) Find kind of Bessel function with order $J_m(x)$: Derive it. 7

(c) Prove that if $f(x)$ is odd function then $a_n = 0$. 7

3. (a) (i) What is singular point of secondary linear differential equations ?

(ii) Represent the Fourier series in complex form. 6

(b) (i) Prove that $\Gamma(n+1) = n\,\Gamma\, n;\ n > 0$

(ii) Prove that $\beta(u, v) = \beta(v, u)$. 8

(c) Generalized momentum p_k is associated with a co-ordinate q_k. Prove that $p_k = \frac{\partial T}{\partial \dot{q}_k}$, T is the kinetic energy of a system of N free particles. 6

4. Answer any ***four*** questions from the following : 5×4

(a) Write the generalized force in terms of generalized velocity.

(b) Write the Lagrange's equation of motion for conservative system.

(c) Write on Parseval's Identity ?

(d) How do you define the odd and even function ?

(e) Define cyclic co-ordinate.

(f) Find out the value of k, where $J_0(x) = kJ_1(x)$.

Group - B

PRACTICAL (Marks : 20)

Answer any ***one*** from the following questions : 1×20

1. (a) Solve the ODE problem

$$\frac{dT}{dt} = -\frac{1}{27}(T - 65),\ T(0) = 200°F$$

Using the Euler method in the range [0.0, 10.0] with step 1.0. Plot the numerical solution together with the exact solution $T(t) = 65 + 135e^{-t/27}$.

(b) Write a Python program to find the solution of three mesh equations of electric circuit.

10+10

$$3I_1 + 2I_2 + 4I_3 = 7$$
$$2I_1 + I_2 + I_3 = 4$$
$$I_1 + 3I_2 + 5I_3 = 2$$

2. (a) Write a Python program to find the inverse of the following matrix

$$\begin{bmatrix} 3 & 5 & 8 \\ 4 & 6 & 9 \\ 8 & 6 & 4 \end{bmatrix}$$

(b) An experiment of spring constant determination is performed and obtained the following information :

Mass (gm)	100	200	300	400	500
Displacement (cm)	2	4	7	8	10

Fit a straight line $w = kx$ (Hooke's law) and plot your fitted graph on the curve with the data. 8+12

3. (a) Write a Python program to generate an ellipse and plot it using matplotlib moudle.

   (b) Write a Python program fo find the solution of a simple harmonic oscillator (no friction) using RK2 method, given k = 1 and plot it using matplotlib module. 8+12
