GURUDAS COLLEGE
Semester-4 Internal Examination, 2020
CC-4-8-P

Answer <u>ANY ONE</u> of the following questions. **[Marks: 15, Time: 1 hour]**

1. (a) Write a computer program in *Python* for solving the following second order ordinary differential equation using script.integrate.odeint:

$$\frac{\mathrm{d}^2}{\mathrm{d}t^2}\theta(t) + b\,\frac{\mathrm{d}}{\mathrm{d}t}\theta(t) + c\,\sin\theta(t) = 0$$

for given initial conditions $\theta(0)$ and $[\mathrm{d}\theta(t)/\mathrm{d}t]_{t=0}$ at n equally spaced times t in the interval $0 \le t \le T$. The values of b and c and the two initial conditions are to be read as inputs to the program. **[8]**

(b) Write a computer program in *Python* using matplotlib.pyplot to plot the graph of the solution to the above differential equation. **[4]**

(c) Which physical system does this differential equation represent? What is the mathematical form of the solution to this equation. **[1+2]**

2. (a) Using the method of finite differences to represent derivatives, derive the discrete form of the following partial differential equation: **[4]**

$$\frac{\partial^2}{\partial t^2}\phi(x,t) = \lambda\,\frac{\partial^2}{\partial x^2}\phi(x,t)$$

(b) Write a computer program in *Python* for solving the above partial differential equation with fixed boundary conditions $\phi(0,t) = 0$ and $\phi(L,t) = 0$ and given initial conditions $\phi(x,0)$ and $[\partial\phi(x,t)/\partial t]_{t=0}$. [8]

(c) Which physical system does this differential equation represent? What is the mathematical form of the solution to this equation. [1+2]

3. (a) Using the method of finite differences to represent derivatives, derive the discrete form of the following partial differential equation: [4]

$$\frac{\partial}{\partial t}\phi(x,t) = \alpha \frac{\partial^2}{\partial x^2}\phi(x,t)$$

(b) Write a computer program in *Python* for solving the above partial differential equation with fixed boundary conditions $\phi(0,t)$ and $\phi(L,t)$ and given initial condition $\phi(x,0)$. [8]

(c) Which physical system does this partial differential equation represent? What is the mathematical form of the solution to this equation. [1+2]