**APM03B3/3B10 Final Examination**

**November 2021**

**90 Marks is full marks.**

**Question 1 [20]**

Is there a difference between behaving ethically and behaving with integrity? **Explain you answer**. Hint:- Explain what ethical behaviour is and then explain what behaving with integrity means. Provide examples of both. Then explain similarities between the two before discussing the differences. **Please note that to answer the question fully, i.e. you have to give an answer (Yes/No).**

**Question 2 [10]**

An object of mass m=2 kg, moving with velocity $v_1$= 12 m/s, collides head-on with a stationary object whose mass is $m_2$=6 kg. Given that the collision is elastic, what are the final velocities of the two objects. Neglect friction. **Show all working.**

**Question 3 [10]**

Explain the first law of thermodynamics. Give an example of a system that satisfies the first law of thermodynamics.

**Question 4 [20]**

What is the difference between a chaotic system and a random system? **Provide a full explanation**. Hint:-Firstly describe a chaotic system. Then describe a random system. Then give example(s) of a chaotic and random system. Describe the similarities between the two systems. Then discuss the differences between a chaotic and random system.

**Question 5 [10]**

Derive the equation describing the period of a pendulum.

**Question 6 [10]**

Solve the initial value problem

$$2x\frac{dy}{dx} + y = 6x, \qquad y(4) = 20.$$

**Show all working**.

**Question 7 [10]**

Determine a solution to the partial differential equation

$$\frac{\partial u}{\partial t} = k\frac{\partial^2 u}{\partial x^2}, \qquad u(x,0) = f(x), \qquad u(0,t) = 0, \qquad u(L,t) = 0.$$

**Show all working.**