U.G. 5th Semester Examination-2020

PHYSICS

[HONOURS]

Discipline Specific Elective (DSE)

Course Code : PHY-H-DSE-T-01

(Applied Dynamics)

Full Marks : 40 Time : $2\frac{1}{2}$ Hours

The figures in the right-hand margin indicate marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP-A

1. Answer any **five** questions : 2×5=10

   a) Define two dimensional phase space.

   b) Explain Population model.

   c) Define thermal conductivity of a fluid.

   d) What do you mean by turbulent flow of a fluid?

   e) What is nonlinear science?

   f) What is a degree of freedom?

   g) How are maps related to flows (differential equations)?

   h) Define a Fluid.

GROUP-B

2. Answer any **two** questions: 5×2=10

   a) What are general computational resources?

   What is generic? What is a Strange Attractor? 2+1+2

   b) Using linear stability analysis, determine the stability of the fixed points for $\dot{x} = \sin x$. 5

   c) Construct the differential equation of damped harmonic vibration and solve it. Hence sketch the trajectories in the phase space. 2+3

   d) Differentiate a solid and a fluid in terms of their shearing stress. Derive the dimension of the coefficient of viscosity. 3+2

GROUP-C

3. Answer any **two** questions: 10×2=20

   a) What are fractals? What do fractals have to do with chaos? Give a simple experiment to demonstrate chaos. 2+3+5

   b) Define incompressible fluid. Draw a phase portrait that has exactly three closed orbits and one fixed point. Classify the fixed point at the origin for the system $\dot{x} = -y + ax^3, \dot{y} = x + ay^3$ for all real values of the parameter a. 2+3+5

   c) Classify the fixed points of the logistics equation, using the linear stability analysis, and

find the characteristic time scale in each case.

Graph the potential for the system $\dot{x} = x - x^3$ and identify the all equilibrium points. 5+5

d) Write down the requirement for fractal dimension to describe self-similar structure. Compare deterministic fractal and self-similar fractal structure. What is spatio-temporal chaos? What is a Bifurcation? 3+3+2+2

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