13-12-17

M.Sc. (Mathematics)-I (First Semester)
End Semester Theory Examination 2017-18
Department of Mathematics, SOPS, Doon University Dehradun
Core Course, Mathematical Modelling (MAC-405)

Time: 03 Hour **Total Marks: 100**

Note: (i) Attempt ALL the questions. (ii) Do neat and clean work.

Attempt any TEN: **(10x10=100)**

1. Discuss various ways to study a system. Draw a flow chart explaining various steps involved in mathematical modelling.
2. (a) Explain the modelling for the motion of a satellite.
   (b) Discuss and prove Kepler's law of planetory motion.
3. A particle moves in a plane with an acceleration which is always directed to a fixed point O in the plane; to obtain the differential equation of the path.
4. Write a short note on: (i)Diffusion Glucose or medicine in the blood stream (ii) Competition model. (iii) Inventory control model.
5. Show that the motion of a projectile is parabolic and also show that it will attains the maximum height $\frac{V^2 sin^2\alpha}{2g}$ $at\ \ time$ $\frac{V\ sin\alpha}{g}$.
6. (a)Draw some trajectories for the model $\frac{dx}{dt} = x(1 - 0.1y)$; $\frac{dy}{dt} = -y(1 - 0.1x)$
   (b) In an archeological wooden specimen, only 25% of original radio carbon-12 is present. When was it made?
7. (a)Explain the Mathematical Modelling of diffusion of glucose or a medicine in the blood stream.
   (b) Solve SIS model when βis a known function of t.
8. A population is decaying exponentially. Can this decay be stopped or reversed by an immigration at a large constant rate into the population?
9. Initially, if there are n susaptables and **a** infective, find expressions for s(t) and I(t) and discuss the variation of both with a.
10. Assuming that a particle projected vertically upwards from the surface of the earth moves in vacuum under a force ga^2/x^2 directed towards the centre of earth, where x is the distance of the particle from the centre of the earth, find the initial velocity of projection so that the particle never return to earth.
11. A lake of constant volume V contains at time t an amount Q(t) of pollutant evenly distributed throughout the lake. Suppose water containing concentration k of pollutant enters the lake at a rate re and water leaves the lake at the same rate r and water leaves the lake at the same rate. Suppose pollutants are also added to the lake at a constant rate P. Discuss the mathematical modelling. If initial concentration of the lake is c_0, find c(t).

******