Exam Code : M-24

Subject Code—18063

Dual Degree B.Sc. (Hons.)
EXAMINATION

(Batch 2017 Onwards)

(Sixth Semester)

MATHEMATICS

BML-606

Mathematical Modelling

Time : 3 *Hours* *Maximum Marks* : 70

Note : Attempt *Five* questions in all, selecting *one* question from each Section. Q. No. 1 is compulsory. All questions carry equal marks.

1. (a) Give graphic representation of Mathematical modelling technique.

(b) Define any *four* simple problems that requires mathematical modelling.

(c) Define Linear, non-linear, static, dynamic mathematical models.

(d) State any *two* situations in medicine where mathematical model can be applied.

(e) State the example of modelling in dynamics.

(f) What do you mean by imperfections of models and cost of modelling ?

(g) State Prey-Predator and Simple Epidemics models in difference equations.

(h) Define the solution of all the cases of finding complementary function of linear difference equation.

Section I

2. (a) Illustrate any *ten* characteristics of Mathematical models.

(b) Explain any *three* mathematical modelling through geometry.

3. (a) Discuss the mathematical model for the motion of planets and given that for the Earth $T = 365$ days $= 3.15 \times 10^7$ sec. $r = 93$ million miles $= 1.5 \times 10^{11}$ meters and $G = 6.67 \times 10^{-11}\ nt\ \frac{m^2}{kg^2}$. Show that $S \simeq 2.0 \times 10^{30}$ kg. Where T is the periodic time of the planet, r is radii, G is constant of gravitation and S is the mass of Sun.

(b) Discuss limitations of mathematical modelling.

Section II

4. (a) Discuss Population Growth Model. Suppose the population of the world now is 4 billion and its doubling is 35 years, what will be the population of the world after 350 years, 700 years, 1050 years ?

(b) Explain simple compartment model.

5. (a) Discuss simple epidemic model and solve SIS model when β is known function of t.

(b) Draw some trajectories for the competition model :

$$\frac{dx}{dt} = x(1-0.1y), \frac{dy}{dt} = y(1-0.1x).$$

Section III

6. (a) Discuss the solution of Samuelson's modified investment models, when :

$$\frac{dk}{dt} = \mathrm{I}(t), \frac{d\,\mathrm{I}}{dt} = -mk^n(t)$$

$$\frac{dk}{dt} = \mathrm{I}(t), \frac{d\,\mathrm{I}}{dt} = -mk(\mathrm{T}) - n\mathrm{I}^2(t)$$

(b) Show that for the international trade model, the origin represents a position of stable equilibrium.

7. (a) Show that the projectile attains the maximum height $V^2 \sin^2 \alpha/2g$ at time $\frac{V \sin \alpha}{g}$.

(b) Obtain the equation of the path described by a particle moving under a central force per unit mass.

Section IV

8. (a) Discuss the extended Cohweb model for which

$$p_t - p_e = c(1 - \rho)\ (p_{t-1} - p_e) + c\rho(p_{t-2} - p_e),$$

where c is the ratio of slopes of supply and demand curves and ρ (usually $0 \leq \rho \leq 1$) represents the expectation of suppliers about price reversal, in the case when the roots of auxiliary equation are complex.

(b) Write a short note on Mathematical model for improvement of Plants through elimination of recessives.

9. Explain Mathematical model through difference equation for Markov Chains. Also discuss the special case of probability of working and non-working states of the machine.