DMM-3102

B. Sc. (Sem. IV) Examination

April / May - 2016

Mathematical Modelling (E.G.)

(New Course)

Time : Hours] [Total Marks : **50**

Instructions :

(1)

નીચે દર્શાવેલ ☛ નિશાનીવાળી વિગતો ઉત્તરવહી પર અવશ્ય લખવી.
Fillup strictly the details of ☛ signs on your answer book.

Name of the Examination :
☛ **B. Sc. (SEM. 4)**

Name of the Subject :
☛ **MATHEMATICAL MODELLING (E.G.) (NEW)**

☛ Subject Code No. : **3 1 0 2** ☛ Section No. (1, 2,.....) : **NIL**

Seat No. :

Student's Signature

(2) All questions are compulsory.

(3) Follow usual notations.

(4) Figures to the right indicate marks of the question.

(5) Use of Scientific non-programmable calculator is allowed.

1 Answer any **four** as directed : 8

(1) In a population growth model, if $a > 0$, then find the doubling period of the population.

(2) Prove the equation for the quandropping period of population.

(3) In the spread of technological innovations model, $\frac{N}{R-N} = \frac{N_0}{R-N_0} e^{kRt}$, discuss what happens when $t \to \infty$.

(4) Find orthogonal trajectories of $xy = c$.

(5) Find orthogonal trajectories of $r = a\theta$.

2 Attempt any **two** : 14

(1) Derive the mathematical model for population growth and solve it. Also discuss the case when $a = 0$.

(2) Find the relation between doubling, tripling and quadrupling times for population.

(3) The rate of some types of insects is 40% per month. If initially there are only two insects, then find the population of insects after 2, 6, 10 and 15 months.

(4) In the year 1961, the population of the world was 3.06×10^9. Suppose the population increase at a rate of 2% per year, then find the population of the world of the year 1991. Prove that the population of the world becomes double in about 35 years.

3 Attempt any **two** : 14

(1) Derive the mathematical model for spread of infectious diseases and solve it.

(2) In the spread of technological innovations model, if $k = 0.007$, $R = 1000$, $N_0 = 50$, then find $N(10)$ and find t for $N(t) = 500$.

(3) Cigarette consumption in a country increased from 50 per capita in 1900 AD to 3900 per capita in 1960 AD. Assuming that the growth in consumption follows a logistic law with a limiting consumption of 4000 per capita, estimate the consumption per capita in 1950.

(4) Derive the mathematical model for Logistic law for population growth and solve it.

4 Attempt any **two** : 14

(1) Find orthogonal trajectories of family of curve $y^2 = acx$.

(2) Find the curves for which tangent makes at a point is always perpendicular to the line.

(3) Find orthogonal trajectories of family of curve $y = ae^{-2x}$.

(4) Find orthogonal trajectories of family of curve $x^2 + y^2 = a^2$.