Second Year B. Sc. (Sem. III) Examination
March/April – 2015
Mathematical Modelling - I (E.G.-IDS-Mathematics) 
(New Course)

Time : 2 Hours] [Total Marks : 50
Instructions :

(1) Fill up strictly the details of signs on your answer book.
Name of the Examination:
Second Year B. Sc. (Sem. III)
Name of the Subject:
Mathematical Modelling - I (E.G.-IDS-Mathematics) (New)
Subject Code No. 3 0 4 4 Section No. (1, 2,.....): Nil

(2) All questions are compulsory.
(3) Figures to the right indicate marks of the corresponding question.
(4) Follow usual notations.

1. Answer the following questions (any two): 5
   (1) In the spread of technological innovations model,
   \[ \frac{N}{R-N} = \frac{N_0}{R-N_0} e^{kt} \]. Discuss what happens if \( t \to \infty \).
   (2) Find orthogonal trajectories of \( r = a \theta \).
   (3) Find orthogonal trajectories of \( y = ae^x \).

2. (a) Derive mathematical model for growth of science and scientist and solve it. 8

   OR

   (a) Derive mathematical model for population growth and solve it. Discuss the case when \( a = 0 \).
   (b) Suppose the population of the world now is 4 billion and its doubling period is 35 years. If the surface area of the earth is 1,860,000 billion square feet, how much space would each person get after 1050 years?

   OR

A-3044] 1 [Contd...
(b) Find the relation between doubling, tripling and quadrupling times for population.

3 (a) Derive mathematical model for spread of technological innovations and solve it.

OR

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

(b) In the spread of technological innovations model if \( k = 0.007, R = 1000, N(0) = 50 \), find \( N(10) \) and find when \( N(t) = 500 \).

OR

(b) Cigarette consumption in a country increased from 50 per capita in 1900 A.D to 3900 per capita in 1960 A.D. 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 (a) Find orthogonal trajectories of family of curve \( x^2 + y^2 = 2ax \).

OR

(a) Find orthogonal trajectories of confocal conics

\[
\frac{x^2}{a^2 + \lambda} + \frac{y^2}{b^2 + \lambda} = 1, \quad \lambda \text{ being parameter.}
\]

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

OR

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