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JB-3199

Second Year B. Sc. (Sem. IV) Examination

April/May – 2013

Mathematical Modelling (I.D.S.)

(New Course)

Time : **3** Hours] [Total Marks : **70**

Instructions :

(1)

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

Name of the Examination :

☛ **S. Y. B. Sc. (Sem. - IV)**

Name of the Subject :

☛ **Mathematical Modelling (I.D.S.) (NEW COURSE)**

☛Subject Code No. : **3 1 9 9** ☛Section No. (1, 2,.....) : **Nil**

Seat No. :

Student's Signature

(2) All questions are compulsory.

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

(4) Follow usual notations.

1 Answer the following questions. **10**

(1) If Rs. 1000 is deposited at a compound interest rate 6% per year, find the amount deposited after six years, if the interest compounded monthly ?

(2) State only Fick's law of diffusion.

(3) State only Newton's cooling law.

(4) Write only differential equation of SIS model with constant number of carriers.

(5) In the change in price of commodity model $p_e - p(t) = (p_e - p(0))e^{-kt}$, . Discuss what happens if $t \to \infty$.

2 (a) Derive mathematical model for effect of immigration and imigration on population size and solve it. 8

OR

(a) Derive mathematical model for interest compounded continuously and solve it. 8

(b) In an archeological wooden specimen, only 25% of original radio carbon-12 is present. When was it made ? 7

OR

(b) How much time does it take for a given amount of money to get double at 6% per annum compounded (1) annually (2) monthly (3) continuously ? 7

3 (a) Derive mathematical model for Fick's law of diffusion and solve it. 8

OR

(a) Derive mathematical model for change in price of commodity and solve it. 8

(b) The concentration of potassium in kidney is 0.0025 mg/cm^3. The kidney is placed in a large Vessel in which potassium concentration is 0.0040 mg/cm^3. In 1 hour the concentration in the kidney increases to 0.0027 mg/cm^3. After how much time will the concentration be 0.0035 mg/cm^3 ? 7

OR

(b) A body where temperature T is initially 300°C is placed in block of ice. Find its temperature at the end of 2 and 3 minutes ? 7

4 (a) Derive mathematical model for Newton's cooling law and solve it. 8

OR

(a) Derive mathematical model of susceptible infected - Removal persons. 8

(b) Integrate $\frac{dI}{dt} = \beta I(N+1-I)$, when t=0, 7

I(0)=1 then prove that $I(t) = \frac{(n+1)e^{(n+1)\beta t}}{n+e^{(n+1)\beta t}}$.

OR

(b) Integrate $\frac{dS}{dt} = -\beta S(n+1-S)$; when t = 0, **7**

S(0)=n then prove that $S(t) = \frac{n(n+1)}{n+e^{(n+1)\beta t}}$.

5 (a) Derive mathematical model for epidemic Susceptible - Infected persons. **8**

OR

(a) Derive mathematical model for Susceptible-Infected-Susceptible persons. **8**

(b) Integrate $\frac{dI}{dt} = \left[\beta(n+1)-\gamma\right]I - \beta I^2$, when t = 0, **7**

$I(0) = I_o$ then prove that

$$I(t) = \frac{(n\beta+\beta-\gamma)I_0 e^{(n\beta+\beta-\gamma)t}}{\left[(n\beta+\beta-\gamma)+\beta I_0\left\{e^{(n\beta+\beta-\gamma)t}-t\right\}\right]}.$$

OR

(b) Integrate $\frac{dI}{dt} = \beta I\left[(n+1-\rho)-I\right]$, when t=0, **7**

$I(0) = I_o$ then prove that

$$I(t) = \frac{(n+1-\rho)I_0 e^{(n+1-\rho)\beta t}}{\left[(n+1-\rho)+I_0\left\{e^{(n+1-\rho)\beta t}-1\right\}\right]}$$