



RAN-2503000504063001

B.Sc. (Sem. -IV) Examination September - 2025

Mathematics - SEC : Mathematics Modelling (MH-SEC-401)

[Total Marks: 25

સૂચના : / Instructions (1) ઉપરોક્ત દર્શાવેલ વિગતો ઉત્તરવહી પર અવશ્ય લખવી. Fill up strictly the above details on your answer book (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. (6) Total marks 25.	Seat No.: <table border="1" style="width: 100px; height: 30px;"> <tr> <td style="width: 20px; height: 20px;"></td> <td style="width: 20px; height: 20px;"></td> <td style="width: 20px; height: 20px;"></td> <td style="width: 20px; height: 20px;"></td> <td style="width: 20px; height: 20px;"></td> <td style="width: 20px; height: 20px;"></td> </tr> </table> Student's Signature						

Q. 1. Answer any FIVE as directed.

(05)

- (1) State the model for growth of Science and Scientists.
- (2) If $\frac{d^2x}{dt^2} = a - 2bx$, then find the condition at which $\frac{d^2x}{dt^2} < 0$ and $\frac{d^2x}{dt^2} > 0$.
- (3) Let $x(t) = x(0)e^{rt}$. If $x(t) = 1$, then find $x(0)$.
- (4) State the equation of orthogonal trajectories of the family of confocal conics.
- (5) State the equation and Draw the figure of concentric circles.
- (6) Write the differential equation of the family of Orthogonal trajectories of

$$\phi\left(x, y, \frac{dy}{dx}\right) = 0.$$

Q. 2. Attempt any TWO of the following.

[10]

- (1) Derive the model for growth of Technological Innovations and solve it. Find the time t at which the number of scientists will becomes double of its present size.
- (2) Let $\frac{dN}{dt} = kN(R - N)$. If $k = 0.007$, $R = 1000$, $N(0) = 50$, then find $N(10)$.
Also find t when $N(t) = 500$.
- (3) A colony of insects was found to have 250 insects at the beginning. Thereafter, the number of insects doubled every two days. What is the amount of insects after 16, 32 and 48 days?

Q. 3. Attempt any TWO of the following.

[10]

- (1) Obtain the Orthogonal trajectories of the family of curves $r = a \sin \theta$ and $y^2 = 4cx$.
- (2) Find the Orthogonal trajectories of the family of curves $x^2 - 4cx + y^2 = 0$.
- (3) (a) Find curves for which tangent makes a constant angle with the radius vector.
(b) Find curves for which the projection of the normal on the x - axis is of constant length.