Additional Readings:

i. Murray, J. D. (2002). *An Introduction to Mathematical Biology* (3rd ed.). Springer.
ii. Myint-U, Tyn (1977). *Ordinary Differential Equations*. Elsevier North-Holland, Inc.
iii. Simmons, George F., & Krantz, Steven G. (2015). *Differential Equations*. McGraw-Hill Education. Indian Reprint.
iv. Strogatz, Steven H. (2009). *Nonlinear Dynamics and Chaos* (2nd ed.). Perseus Book Publishing. LLC. Sarat Publication, Kolkata, India.

Teaching Plan (DSE-3 (iii): Biomathematics):

Week 1: Population growth, Administration of drugs, Cell division, Systems of linear ordinary differential equations.
[2] Chapter 1 (Sections 1.1 to 1.3) and Chapter 3 (An overview of the methods in Sections 3.1 to 3.6).

Week 2: Heartbeat, Nerve impulse transmission.
[2] Chapter 4 (Sections 4.2, and 4.3).

Week 3: Chemical reactions, Predator-prey models, Epidemics (mathematical model).
[2] Chapter 4 (Sections 4.4 and 4.5) and Chapter 5 (Section 5.2)

Week 4: The phase plane and Jacobian matrix, Local stability.
[2] Chapter 5 (Sections 5.3 and 5.4).

Week 5: Stability, Limit cycles.
[2] Chapter 5 [Sections 5.5, and 5.6 (up to Page number 137)].

Week 6: Limit cycle criterion and Poincaré–Bendixson Theorem (interpretation only, with Example 5.6.1), Forced oscillations.
[2] Chapter 5 [Section 5.6 (Page number 137 to 138) and Section 5.7).

Week 7: Mathematics of heart physiology: local model, threshold effect, phase plane analysis and heartbeat model.
[2] Chapter 6 (Sections 6.1 to 6.3).

Week 8: A model of the cardiac pacemaker, Excitability and repetitive firing.
[2] Chapter 6 (Section 6.5) and Chapter 7 (Section 7.1).

Week 9: Travelling waves, Bifurcation, Bifurcation of a limit cycle.
[2] Chapter 7 (Section 7.2), and Chapter 13 (Sections 13.1 and 13.2).

Weeks 10 and 11: Discrete bifurcation and period-doubling, Chaos, Stability of limit cycles, Poincaré plane.
[2] Chapter 13 (Sections 13.3 to 13.6).

Week 12: Matrix models of base substitutions for DNA sequences, Jukes–Cantor model, Kimura models, Phylogenetic distances.
[1] Chapter 4 (Sections 4.4 and 4.5).

Week 13: Constructing phylogenetic trees: phylogenetic trees, unweighted pair-group method with arithmetic means (UPGMA), Neighbor joining method.
[1] Chapter 5 (Sections 5.1 to 5.3).

Week 14: Genetics**:** Mendelian genetics, probability distributions in genetics.
[1] Chapter 6 [Sections 6.1 and 6.2 (up to Equation 6.2 only)].

Facilitating the Achievement of Course Learning Outcomes

Unit No.	Course Learning Outcomes	Teaching and Learning Activity	Assessment Tasks
1.	Learn the development, analysis and interpretation of bio mathematical models such as	(i) Each topic to be explained with examples. (ii) Students to be involved in	• Student presentations.

	population growth, cell division, and predator-prey models.	discussions and encouraged to ask questions. (iii) Students to be given homework/assignments. (iv) Students to be encouraged to give short presentations.	• Participation in discussions. • Assignments and class tests. • Mid-term examinations. • End-term examinations.
2.	Learn about the mathematics behind heartbeat model and nerve impulse transmission model.		
3.	Appreciate the theory of bifurcation and chaos.		
4.	Learn to apply the basic concepts of probability to molecular evolution and genetics.		

Keywords: Bifurcation and chaos, Forced oscillations, Jukes–Cantor model, Kimura model, Limit cycles, Phase plane, Phylogenetic distances, Stability, UPGMA.