Course No	Course Name	L-T-P-Credits
MA 550	**Mathematical Biology**	**3-0-0: 3**

Prerequisite: nil

Course Objectives: The objective of this course is to understand and analyze existing models exploring population dynamics. The possible phenomenon pertaining to the key components of the model are discussed. It also enhances skill to develop new models which could address many interdisciplinary real world problems.

Course Outcomes: After successful completion of the course, students will be able to:

1. Analyze basic models in population dynamics such as Malthusian model, Logistic model, Lotka-Volterra prey-predator model, Rosenzweig-MacArthur model.
2. Apply model based knowledge in fishery management to sustainable harvest of species.
3. Establish stability analysis in delay differential equations applied in prey-predator models.
4. Understand structural stability theory and singular perturbation theory which are useful in aggregation method for spatial structured models.
5. Develop and analyze stage-structure models of predator and prey community.
6. Apply impulsive differential equations to biological pest control theory.

SYLLABUS

Module	Contents	Hours
I	Mathematical model of population dynamics in continuous time, Malthusian model, Logistic model, Lotka-Volterra prey-predator model, Rosenzweig-MacArthur model, dynamics of food chain and food web models.	6
II	Exploitation in fishery model, Exploitation and oscillation results in prey-predator system, Maximum Sustainable Yield (MSY) policy, Maximum Economic Yield (MEY) policy, ecological resilience under harvesting, hydra effect in ecological systems.	4
III	Delay differential equations, population dynamics models with time delay, persistence, local and global stability of the models, stability switching.	5
IV	Structural stability, singular perturbation theory, modeling with different time scales, model aggregation, multi-patch model with population dispersal, Marine Protected Areas (MPAs), Biological conservation.	5
V	Stage-structure population models in continuous and discrete time, Impulsive differential equations and application to biological pest control theory.	6

Essential Readings:

1. J. D. Murray, "Mathematical Biology: I. An Introduction", Springer, 3rd edition, 2007.
2. K. Gopalsamy, "Stability and Oscillations in Delay Differential Equations of Population Dynamics", Springer, 1992 edition, 1992.

Supplementary Readings:

1. M. Kot, "Elements of Mathematical Ecology", Cambridge University Press, 1st edition, 2001.
2. C. W. Clark, "Mathematical Bioeconomics: The Optimal Management of Renewable Resources", Wiley Blackwell, 2nd edition, 1990.
3. V. Lakshmikantham, D. Bainov, P.S. Simeonov PS, "Theory of Impulsive Differential Equations", World Scientific, 1989.