National Institute of Technology Meghalaya CURRICULUM An Institute of National Importance Programme **Master of Science** Year of Regulation 2018-19 Department **Mathematics** Semester III Marks Distribution Credit Structure Course Course Name Pre-requisite Code P \mathbf{C} **INT** L T **MID END** Total **MA 533 NIL** 3 0 3 **50 50** 100 200 **Mathematical Biology** 0 Analyze basic models in population dynamics such as CO₁ Malthusian model, Logistic model, Lotka-Volterra prev predator model, Rosenzweig-MacArthur model. Apply model based knowledge in fishery CO₂ management to sustainable harvest of species. The objective of this course is to understand and analyze existing Establish stability analysis in delay differential CO₃ models exploring population dynamics. The possible phenomenon equations applied in prey-predator models. Course Course pertaining to the key components of the model are discussed. It Understand structural stability theory and singular Objectives Outcomes also enhances skill to develop new models which could address CO₄ perturbation theory which are useful in aggregation many interdisciplinary real world problems. method for spatial structured models. Develop and analyze stage-structure models of CO₅ predator and prey community. Apply impulsive differential equations to biological **CO6** pest control theory. Mapping with Program Outcomes (POs) Mapping with PSOs COs No. PO10 PO12 PO₁ PO₂ PO₃ PO4 PO₅ PO6 PO7 PO8 PO9 PO11 PSO₁ PSO₂ PSO3 1 CO₁ 2 CO₂ 3 CO₃ 4 CO₄ 5 CO₅ CO₆ 6 **SYLLABUS** Content No. Hours COs **CO1** Mathematical model of population dynamics in continuous time, Malthusian model, Logistic model, Lotka-06 I Volterra prey-predator model, Rosenzweig-MacArthur model, dynamics of food chain and food web models. CO₂ Exploitation in fishery model, Exploitation and oscillation results in prey-predator system, Maximum Sustainable II Yield (MSY) policy, Maximum Economic Yield (MEY) policy, ecological resilience under harvesting, hydra 04 effect in ecological systems. CO₃ Delay differential equations, population dynamics models with time delay, persistence, local and global stability III05 of the models, stability switching. **CO4** Structural stability, singular perturbation theory, modeling with different time scales, model aggregation, multi-IV 05 patch model with population dispersal, Marine Protected Areas (MPAs), Biological conservation. CO₅

Essential Readings

V

- 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.

CO6

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Supplementary Readings

application to biological pest control theory.

- 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.

Stage-structure population models in continuous and discrete time, Impulsive differential equations and

Total Hours