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OP 6
Mathematical Modeling

(100 marks, 80 lectures)

(To answer five questions, choosing one out of two questions from each unit)

Unit- I: Introduction, Basic Steps of Mathematical Modeling, its needs, types pf models, limitations, Elementary ideas of dynamical systems, autonomous dynamical systems in the plane- linear theory, Equilibrium point, node, saddle point, focus, centre and limit-cycle idea with simple illustrations and figures, Linearization of non-linear plane autonomous systems.

Unit-II: Population Models: Basic concepts, Exponential growth model, formulation , solution, interpretation and limitations. Compensation and depensation, Logistic growth model, formulation, solution, interpretation and limitations. Lotka- Volterra model of two competing species, formulation, solution, interpretation and limitations.

Unit-II: Epidemic Models: Basic concepts, Simple epidemic model, formulation, solution, interpretation , and limitation, General epidemic model, formulation, solution, interpretation and limitations .

Unit-IV: Economic models: Production and supply functions, price-elasticities, utility of consumption and consumer surplus, pure competition, competitive equilibrium , monopoly versus competition, duopoly, oligopoly, conjectural variation, theory of production, production function , Cobb- Douglas production function and its properties , Costs of production and related models .

Unit-V: Mathematical modeling in Bio-logical Environment: Blood flow and oxygen transfer , Modeling blood flow, viscousity, Poiseuille law, mathematical formulation of the problem, solution and interpretation, oxygen transfer in red cells, mathematical formulation, solution, interpretation and limitations.

BOOKS

Text Books:

1. Mark M. Meerschaert, Mathematical Modeling, Academic Press, New Work, 1993
2. W. Meyer , Concepts of Mathematical Modeling, McGraw Hill, New York, 1994
3. E. Beltrami , Mathematics for Dynamic Modeling, Academic Press, Orlando, Florida, 1987

Reference books:

4. N. Bailey, The Mathematical Theory of Infectious Diseases, Haftier press, New York, 1975
5. Mathematical modeling in the biological environment, MTE- 14, Indira Gandhi National Open University, New Delhi 1998

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6. J.N. Kapur, Insight into mathematical modeling, Indian National Science Academy, New Delhi 1983
7. M. Braun, Differential Equations , ad their Applications, Springer, New York, 1980