IIT Mandi
Proposal for a New Course

Course number	**: Mathematical Modeling**
Course Name	**: MA 610**
Credit Distribution	**:** 3-0-0-3
Intended for	**:** Elective for M.Sc./ MTech/PhD/BTech (All Branches)
Prerequisite	**:** IC 110, IC 111 for BTech, Ordinary Differential Equations for M.Sc./MTech/PhD
Mutual Exclusion	**: NA**

---

1. Preamble:

The objective of this course is to introduce the use of mathematics as an effective tool in solving real- world problems through mathematical modelling and analytical and/or numerical computations. By using examples in physical, engineering, biological and social sciences, we show how to convert real-world problems into mathematical equations through proper assumptions and physical laws. Qualitative analysis and analytical solutions for some models will be provided to interpret and explain qualitative and quantitative phenomena of the real-world problems.

2. Course Modules with quantitative lecture hours:

Module 1: Introduction -Aim and history, A few simple examples, what is a model, The process of mathematical modeling, Model classification

(4 hours)

Module 2: Optimization models - One variable optimization, some additional materials on population, Multi variable optimization, Computational methods for optimization, some materials on simplex method, Discrete Models - World population growth data snooping, Linear models, Logistic models, Theorems on stability

(7 hours)

Module 3: Probability models-Introduction, Discrete probability models, Continuous probability models, Models for population, Introduction of Population models: Malthus model, Population growth: Logistic model, Harvesting, Population of interacting species: Lotka-Volterra systems (some additional materials), Age-dependent population models.

(7 hours)

Module 4: Applications of mathematical modeling-Mainly mathematical models to study and understand phenomena in chemistry, biology , engineering, political sciences, business and in social sciences.

(6)

Laboratory/practical/tutorial Modules:

Individual final project: During the last two weeks of the semester, each student will carry out a project investigating a new mathematical model or carrying out a significant extension of an existing mathematical model discussed in class

(6)

Textbooks:

1. A First Course in Mathematical Modeling (4th edition), 2009, by F. R. Giordano, W. P. Fox, S. B. Horton and M. D. Weir. Publisher: Brooks/Cole Publishing Company (ISBN-10: 049555877X; ISBN-13: 9780495558774).
2. Mathematical Modelling: A Tool for Problem Solving in Engineering, Physical, Biological and Social Sciences, Pergamon 1990.

References:

1. Mathematical modeling: a tool for problem solving in engineering, physical, biological, and social sciences, 1990, by D.N.P. Murthy and N.W. Page and E.Y. Rodin. Publisher: Pergamon Press.
2. Mathematical modeling: a case study approach, 1989, by Dick Clements. Publisher: Cambridge University Press.
3. Modeling with Ordinary Differential Equations, 1993, by T.P. Dreyer. Publisher: CRC Press.
4. Clive L. Dyne: Principles of Mathematical Modelling, Academic Press, 2004.
5. Mathematical Modeling (second edition), 1998, by M. M. Meerschaert. Publisher: Academic Press

3. Similarity with the existing courses:
(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.	Course Code	Similarity Content	Approx. % of Content
1.	ME620	Nil	Nil
2.	BE506	Nil	Nil
3.	MA650	Deterministic models	<5%

6. Justification of new course proposal if cumulative similarity content is >30%: NA