



# DEPARTMENT OF MATHEMATICS

Semester: 9

Integrated M.Sc. Mathematics

Academic Year: 2019-20

Subject: 060090303 Advanced Mathematical Modeling

## Teaching Schedule

**Course Objectives:** To provide a tool to actively explore new ideas and improve the learning process as well as allowing plant operators training facilities and there by increasing their ability to handle unforeseen situations.

**Course outcomes:** Upon completion of the course, students shall be able to

**C01:** be familiar with terms of the basic of mathematical modelling.

**C02:** understand the latest development, merits and demerits of mathematical modelling.

**C03:** design difference equation based mathematical model and resolve the problem of field population, pollution, econometrics, and cooling system etc.

**C04:** apply the difference equation based mathematical model to resolve the problems related to Epidemic model, compartment model, inflection model etc.

**C05:** make the mathematical model of partial differential equation to resolve various problems.

**C06:** establish the connection of applicability of mathematical models to resolve the real problems arise in the fields of science and engineering.

Unit	Sub Unit	No. of Lect.(s)	Topics	Reference Chapter/ Additional Reading	Teaching Methodology to be used	Active Learning Activities	Evaluation Parameter
<b>Basics of Mathematical Modelling [10 hours]</b>							
1	1.1	1	What is Mathematical ?	Ch#1 Mathematical Modeling	PPT, Chalk & Talk	<b>For Slow Learner:</b> Students must write some theory given by teacher after completion	Assignment- 1
	1.2	3	History of Mathematical Modelling				





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	1.3	3	latest development in Mathematical Modelling	J N Kapur Ch#1 Mathematical Modeling S.Banerjee		of unit.  <b>For Advanced Learner:</b> Student will give PPT presentation of theory given by teacher after completion of unit.	Unit Test -1  Internal examination
	1.4	3	Merits and Demerits of Mathematical Modelling				
<b>Mathematical Modelling Through Difference Equations –I [20 hours]</b>							
2	2.1	2	Introduction to difference equations, Non-linear Difference equations	Ch#5 Mathematical Modeling J N Kapur Ch#2 Mathematical Modeling S.Banerjee	PPT, Chalk & Talk	<b>For Slow Learner:</b> Students must solve some examples of Modeling given by teacher after completion of unit. <b>For Advanced Learner:</b> Student will give PPT presentation of some examples of Modeling given by teacher after completion of unit.	Assignment-2  Unit Test -1 Unit Test -2  Internal examination
	2.2	3	Steady state solution and linear stability analysis, Introduction to Discrete Models				
	2.3	10	Linear Model : Growth models, Decay models, Newton's Law of Cooling, Bank Account Problem and mortgage problem, Drug Delivery Problem, Harrod Model of Economic growth, War Model, Lake pollution model, Alcohol in the bloodstream model, Arm Race models, Linear Prey-Predator models,				





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	2.4	5	Non Linear Models: Density dependent growth models with harvesting.				
<b>Mathematical Modelling Through Difference Equations -I [15 hours]</b>							
<b>3</b>	3.1	1	Introduction to Continuous Models	Ch#5 Mathematical Modeling J N Kapur Ch#3 Mathematical Modeling S.Banerjee	Chalk & Talk	<p><b>For Slow Learner:</b> Students must solve some examples of Modeling given by teacher after completion of unit.</p> <p><b>For Advanced Learner:</b> Student will give PPT presentation of some examples of Modeling given by teacher after completion of unit.</p>	<p>Unit Test -2 Assignment-3</p> <p>Internal examination</p>
	3.2	4	Carbon Dating, Drug Distribution in the Body, Growth and decay of current in a L-R Circuit				
	3.3	3	Horizontal Oscillations, Vertical Oscillations, Damped Force Oscillation				
	3.4	4	Dynamics of Rowing, Combat Models, Mathematical Model of Influenza Infection (within host), Epidemic Models (SI, SIR, SIRS, SIC), Spreading of rumour model,				
	3.5	3	Steady State solutions, Linearization and Local Stability Analysis, logistic and gomperzian growth, prey-predator model, Competition models.				





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## Mathematical Modelling Through Partial Differential Equations [15 hours]

4	4.1	4	Fluid flow through a porous medium, heat flow through a small thin rod (one dimensional),	Ch#6 Mathematical Modeling J N Kapur Ch#4 Mathematical Modeling S. Banerjee	Chalk & Talk	<b>For Slow Learner:</b> Students must solve some examples of Modeling given by teacher after completion of unit. <b>For Advanced Learner:</b> Student will give PPT presentation of some examples of Modeling given by teacher after completion of unit.	Internal examination  Assignment-4
	4.2	4	Wave equation, Vibrating string, Traffic flow				
	4.3	3	Theory of Car-following, Crime Model				
	4.4	4	Linear stability Analysis: one and two species models with diffusion, Conditions for diffusive instability with examples.				

### Text book:

1. Kapur J. N., "Mathematical Modelling", New Age International Publishers, 2007.

### Reference book:

1. Banerjee Sandip, "Mathematical Modelling Models, Analysis and Applications", CRC Press, Taylor & Francis Group, 2014.

### Course Objectives and Course Outcomes Mapping:

- To provide a tool to actively explore new ideas: CO1, CO3, CO6
- To improve the learning process as well as allowing plant operators training facilities: CO2, CO4
- To increase students' ability to handle unforeseen situations: CO4, CO5, CO6





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## Course Units and Course Outcomes Map ping:

Unit No.	Unit	Course Outcomes					
		CO1	CO2	CO3	CO4	CO5	CO6
1	Basics of Mathematical Modelling	✓	✓				✓
2	Mathematical Modelling Through Difference Equations -I			✓			✓
3	Mathematical Modelling Through Difference Equations -II				✓		✓
4	Mathematical Modelling Through Partial Differential Equations					✓	✓

## Programme Outcomes (PO)

### PO1: Knowledge

Provides knowledge about the fundamentals of pure, applied and computing mathematics and its applications to students that creates the opportunities in industries and research centers.

### PO2: Core Competence

Creates competency in science and mathematics to formulate, analyses and solve problem and/or also to pursue advanced study or research.

### PO3: Breadth

Trains students having good knowledge in unearth core of academia and industry by the roots of mathematics.

### PO4: Evaluation

Imparts in students to raise trial and error-based curiosity and problem-solving functionality with research based advanced tutorial for higher level decision makings tools.





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Programme Outcomes and Course Outcomes mapping:

Programme Outcome	Course Outcomes					
	C01	C02	C03	C04	C05	C06
PO1	✓	✓			✓	
PO2		✓	✓	✓		
PO3				✓	✓	✓
PO4		✓	✓			✓

