

SANKALCHAND PATEL UNIVERSITY, VISNAGAR

Faculty of Science & Humanities



**Structure, Teaching Scheme and Syllabus of
B. Sc. (Mathematics) Honours with Research
Sem-6 as per NEP-2020**

Program Code: SC104

With effect from: 2023-24

Semester-6

Branch Name:	B.Sc. Mathematics
Program Code:	SC104
Course Name:	Mathematical Analysis-II
Course Code:	16-MAM304-3C
Pre-requisite Course:	

Course Objectives:

- To understand the concept of Limit, Continuity and Differentiation.
- To be able to understand concept of The Riemann – Stieltje’s Integral.
- To understand concept of Sequences and Series of functions.

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
3	-	2	4	50	25	-	25	100

Subject Contents:

Sr. No	Topic	Total Hours	Weightage (%)
1	Limits and Continuity: Limits and Continuity for a functions from a metric space into another metric space, continuity of a composite function, Structural properties of continuous functions from a metric space in to R_k , Continuity and Compactness, Continuity and connectedness, Discontinuities, Monotonic function, Discontinuities of a monotonic function, Infinite limits and limits at infinity. Differentiation: Derivatives of a real function, Continuity and differentiability, Structural properties of the class of differentiable functions, Mean value theorems, Continuity of derivatives, L’Hospital rule, Derivatives of higher order, Taylor’s theorem.	15	34
2	The Riemann – Stieltje’s Integral: Riemann integral and Stieltje’s Integral, properties of Riemann integral and Stieltje’s integral, Integration and Differentiation, Integration of Vector Valued Functions, Rectifiable curves.	15	33
3	Sequences and Series of functions: Sequences of functions, Limit of a Sequence of functions, Uniform convergence, tests for uniform convergence and continuity, Uniform convergence and differentiation.	15	33

Reference Books:

1. A First Course in Mathematical Analysis, D. Somasundaram & B. Choudhary, Narosa Publishing House.
2. Fundamentals of Mathematical Analysis, G. Das & S. Pattnayak Tata Mcgraw Hill Pub.Co
3. Fundamental of Real Analysis, S. L. Gupta & Nisha Rani – Vikas Pub. House Pvt. Ltd. New Delhi.

List of Open Source Software/learning website:

1. https://www.youtube.com/watch?v=2CkNeN8S258&list=PLYisSyPLgRv63erEi49zu0w1x_oAP1K89
2. <https://www.youtube.com/watch?v=xj5zJgLydZ8&list=PLmxCweM-UENxjYBQLuYMCzHa8L5FY0y6V>
3. https://www.youtube.com/watch?v=-LcblAy_e6c&list=PLWqxGONF6iEQtstxUoqSJhgenrNW-qvFA

Practical

1. Application of Limits and Continuity for a functions from a metric space into another metric space.
2. Application of Discontinuity.
3. Application of Mean value theorem
4. Application of Taylor's theorem.
5. Application of Riemann Stieltje's integral.
6. Application of Uniform convergence.

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Explain Limit, Continuity, and Differentiation and solve its applications.	4 Analysing 3 Applying
CLO2	Discuss Riemann integral and Stieltje's integral.	2 Understanding
CLO3	Define Sequences and Series of functions and create various examples of its.	1 Remembering 6 Creating
CLO4	Justify tests for uniform convergence and continuity.	5 Evaluating
CLO5	Describe Limit of a sequence of functions.	1 Remembering
CLO6	Explain Integration and Differentiation.	4 Analysing

Mapping of CLOs with POs & PSOs:

Course Learning Outcomes	Programme Outcomes (POs)																Programme Specific Outcome (PSOs)			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	PSO1	PSO2	PSO3	PSO4
CLO1	1	2			2	1			1			1					2	1		
CLO2		2	1		2	1											2			
CLO3		2	2		2	1			1								2	2		
CLO4	2	2	1		2				1			1					2			
CLO5		1			1	1														
CLO6	1	1	1		1												2	2		

3: High, 2: Medium, 1: Low

Branch Name:	B.Sc. Mathematics
Program Code:	SC104
Course Name:	General Topology- II
Course Code:	16-MAM305-3C
Pre-requisite Course:	

Course Objectives:

- To understand the concept of Matrices of a Linear Transformation.
- To understand the concept of Linear Functional and Duality.
- To be able to know about Eigen Values and Eigen Vectors.

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
3	-	2	4	50	25	-	25	100

Subject Contents:

Sr. No	Topic	Total Hours	Weightage (%)
1	Compact spaces, compact sets in the real line, limit–point compactness, locally compact spaces, one–point compactification.	15	34
2	Countability Axioms: First countable space, second countable space, separable space, Lindeloff space.	15	33
3	Separation axioms- Hausdorff space, regular space, normal space, Urysohn's lemma, completely regular space, Tietze extension theorem.	15	33

Reference Books:

1. "Topology – A first course" – by J. R. Munkres, Prentice Hall of India.
2. "General Topology" – by S. Willard, Addison Wesley.
3. "Topology" – by J. Dugundji, Prentice – Hall of India.
4. "General Topology" – by J. L. Kelley, D. Van Nostrand.

List of Open Source Software/learning website:

1. <https://www.youtube.com/watch?v=9m1hKQ4qSfA&list=PL8D5taFfp6CzMzOFJq1y5lkNJkyNGuUJq>
2. <https://www.youtube.com/watch?v=EKdkI6DopLw>
3. <https://www.youtube.com/watch?v=Ebr1piFxEwI&list=PLYisSyPLgRv7LwFX8MLNCgl7HJ6x1iUCr>

Practical

1. Application of compact spaces.
2. Application of Countability axioms.
3. Application of separation axioms.

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Discuss Compact space and Solve applications of its.	2 Understanding 3 Applying
CLO2	Describe First countable space.	1 Remembering
CLO3	Explain second countable space, separable space and Lindeloff space.	4 Analysing
CLO4	Justify Hausdorff space and regular space.	5 Evaluating
CLO5	Describe normal space and Urysohn's lemma	1 Remembering
CLO6	Create example depend on Compact spaces, Countability Axioms and Separation axioms.	6 Creating

Mapping of CLOs with POs & PSOs:

Course Learning Outcomes	Programme Outcomes (POs)																Programme Specific Outcome (PSOs)			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	PSO1	PSO2	PSO3	PSO4
CLO1	2	2			2	1											2	1		
CLO2		1	1			1			1								1			
CLO3	1	2	2		2												2			
CLO4	1	2			2												1	2		
CLO5			1														1			
CLO6	2	2	2		2	1			1								2	2		

3: High, 2: Medium, 1: Low

Branch Name:	B.Sc. Mathematics
Program Code:	SC104
Course Name:	Operations Research-II
Course Code:	16-MAM306-3C
Pre-requisite Course:	

Course Objectives:

- To understand the concept of C.F and P.I.
- To be able to understand concept of exactness of the linear differential equations.
- To understand concept of Method of variation of Parameters.

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
3	-	2	4	50	25	-	25	100

Subject Contents:

Sr. No	Topic	Total Hours	Weightage (%)
1	Transportation Problem- Introduction, general method of a T.P., unbounded T.P. NWCM, Least cost method, VAM methods to find the initial solution, Dual of a T.P. and MODI method, degeneracy in a T.P., variations in T.P. Maximization T.P. and Prohibited routes.	15	34
2	Assignment Problem- General model of A.P.(A.P. as a special case of a T.P.) Hungarian Method of solving a A.P., variations in a A.P-maximization, prohibited assignments. Sequencing Problem: Methods of sequencing, Johnson's Algorithm for a two machine problem, three machine problem and M-machine problem, Processing Two jobs through M-machines.	15	33
3	Game Theory: Introduction, Two-person zero games, Minimax and Maximin principles, saddle point theorems, mixed strategies, method for solution of 2×2 game, dominance principles, solution of games without saddle points by using dominance and then mixed strategies, graphical method of solving $2 \times m$ and $m \times 2$ game, L.P. solution of games.	15	33

Reference Books:

1. Operations Research, by. J.K.Sharma. Macmillan Publishers India Ltd.
2. Operations Research by Nita Shah, Ravi Gor and Hardik Soni, Prentice Hall of India.
3. Operational Research, Kumar Prakashan, Ahmedabad.
4. Operations Research (Principles and Practice) by Pradeep Prabhakar Pai, Oxford University Press.

List of Open Source Software/learning website:

1. <https://www.youtube.com/watch?v=Ow3XWYnPgSM&list=PLU6SqdYcYsfLdur9EvX7TXe0VeNgAdVtD>
2. <https://www.youtube.com/watch?v=VacEloz6dGs&t=277s>
3. <https://www.youtube.com/watch?v=4Zbefvups6M>

Practical

1. Applications of Transportation Problem.
2. Applications of Assignment Problem.
3. Applications of Game Theory.

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Solve LPP by NWCM, LCM and VAM.	3 Applying
CLO2	Discuss Assignment Problem.	2 Understanding
CLO3	Create various examples depend on Transportation Problem, sequencing problem and game theory.	6 Creating,
CLO4	Justify Johnson's Algorithm for a two machine problem and three machine problem.	5 Applying
CLO5	Describe Game and Find value of game.	1 Remembering, 3 Applying
CLO6	Explain theorem depend on transportation problem, assignment problem and game theory.	4 Analysing

Mapping of CLOs with POs & PSOs:

Course Learning Outcomes	Programme Outcomes (POs)																Programme Specific Outcome (PSOs)			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	PSO1	PSO2	PSO3	PSO4
CLO1	2	1			2	1											2	2	2	
CLO2		2	1		2	1			1								2		1	2
CLO3		2	2		2	2			1								2	2		1
CLO4	2	2	1		2	1			1								2	2	2	2
CLO5		1			1												1			
CLO6	2	2	2		2	2			1								2	2	1	1

3: High, 2: Medium, 1: Low

Branch Name:	B.Sc. Mathematics
Program Code:	SC104
Course Name:	Mathematical Modelling-II
Course Code:	16-MAE303-3C
Pre-requisite Course:	

Course Objectives:

- To understand the Epidemic Models, SIS Model and Epidemic model with removal.
- To know about Diffusion and Glucose in the Blood stream.
- To understand Traffic Models.

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
3	-	2	4	50	25	-	25	100

Subject Contents:

Sr. No	Topic	Total Hours	Weightage (%)
1	Epidemic Models, Simple deterministic model, SIS Model, Epidemic Models with constant number of carriers, Epidemic model with removal.	15	34
2	Diffusion and Glucose in the Blood stream, Model for diabetes Mellitus, Genetics Models: Hardy-Weinberg law model for genetics, Genetics model for Blood groups	15	33
3	Traffic Models: Macroscopic Highway traffic model, continuum hypotheses And the fundamental diagram, linear-car-following models.	15	33

Basic Reference book:

1. J.N. Kapur, *Mathematical Modeling*, Wiley Eastern Ltd., 1988.
2. J.N. Kapur, *Mathematical Models in Biology and Medicine*, East-West press Pvt. Ltd., 1992.
3. Braum, Colemem & Drew, *Differential Equation Models*, Springer-Verlag, 1983
4. Martin Braun, *Differential Equation and their applications*, Springer-Verlag, 1977

List of Open Source Software/learning website:

1. <https://youtu.be/HkudpjElcsc?si=GcGuNvUAtrKgrkfu>
2. <https://youtu.be/9D-G15eTFOY?si=IDvSsRW8Karlzpjg>
3. <https://youtu.be/QeyhPcwQGoM?si=r5dOHS4ffKw8gYGe>

Practical

1. Application of Epidemic Models.
2. Application of Simple deterministic model.
3. Application of SIS Model.
4. Application of Model for diabetes Mellitus.
5. Application of Genetics Models.
6. Application of Traffic Models.

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Describe Epidemic Models, Simple deterministic model and SIS Model,	1 Remembering
CLO2	Discuss Epidemic Models with constant number of carriers and Epidemic model with removal	2 Understanding
CLO3	Illustrate Diffusion and Glucose in the Blood stream and Model for diabetes Mellitus	3 Applying
CLO4	Explain Genetics Models.	4 Analyzing
CLO5	Justify continuum hypotheses And the fundamental diagram.	5 Evaluating
CLO6	Create different types of Traffic Models.	6 creating

Mapping of CLOs with POs & PSOs:

Course Learning Outcomes	Programme Outcomes (POs)																Programme Specific Outcome (PSOs)			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	PSO1	PSO2	PSO3	PSO4
CLO1		1	2		1	2											1		1	1
CLO2		2	1		2	2			1			1					2		2	2
CLO3	2				2	1						1					1	2	2	1
CLO4		1	1		2	2			1								2	2		2
CLO5	1	2			2	2											2		1	
CLO6	2	2	2		2	2			1			1					2	2	2	2

3: High, 2: Medium, 1: Low

Branch Name:	B.Sc. Mathematics
Program Code:	SC104
Course Name:	Bio Mathematics
Course Code:	16-MAE303-30
Pre-requisite Course:	Basics of Statistics

Course Objectives:

- To understand concept of Mathematical models in Biology.
- To understand the basic concept of Calculation of entropy.
- To know about Calculation of energy and entropy and free energy.

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
3	--	2	4	50	25	--	25	100

Subject Contents:

Sr. No	Topic	Total Hours	Weightage (%)
1	Mathematical models in Biology: Simple model for polymerization depolymerization dynamics, Simple model for molecular motor motion, Biased walk, Growth velocity of polymerizing filaments, Master equation, Solving master equation, Wright-Fisher model, Simplest model in population genetics/evolution, Binomial distribution, Evolution.	15	34
2	Definition of temperature, Definition of internal energy, Definition of entropy, Calculation of entropy, entropy of a flexible protein, Definitions, Calculation of partition function, Calculation of Free energy, Thermal Equilibrium, Bending of DNA, Worm-like chain model, Partition function, Gibbs free energy.	15	33
3	Force extension relation of single stranded DNA, Persistence length, Looping of DNA, Proteins binding on DNA, Calculation of energy, entropy and free energy, Thought experiment on DNA melting, Plotting functions using computer, gnu plot demonstration, numerical calculations, Interpolation.	15	33

Reference Books:

1. Mathematics for Biological Scientists, M. Aitken, B. Broadhursts, S. Haldky, Garland Science (2009)
2. Introduction to Mathematics for Life Scientists, E. Batschelet, Springer Verlag, 3rd edition (2003)
3. Calculus for Life Sciences, R. De Sapio, W. H. Freeman and Co. (1976)
4. Physical Biology of the Cell, R. Phillips, J. Kondev, J. Theriot, Garland Science (2009)
5. Random Walks in Biology, H. C. Berg, Princeton university press (1993)

List of Open Source Software/learning website:

1. <https://archive.nptel.ac.in/courses/102/101/102101003/>

Practical

1. Application of Mathematical models in Biology
2. Application of Thermal Equilibrium, Bending of DNA.
3. Application of Force extension relation of single stranded DNA, Persistence length.

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Explain Mathematical models in Biology	4 Analysing
CLO2	Discuss temperature, entropy and internal energy.	2 Understanding
CLO3	Explain Worm-like chain model, Partition function, Gibbs free energy.	4 Analysing
CLO4	Describe Persistence length, Looping of DNA and Proteins binding on DNA.	1 Remembering
CLO5	Solve Simplest model in population genetics/evolution	3 Applying
CLO6	Create Plotting functions using computer.	6 Creating

Mapping of CLOs with POs & PSOs:

Course Learning Outcomes	Programme Outcomes (POs)																Programme Specific Outcome (PSOs)			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	PSO1	PSO2	PSO3	PSO4
CLO1		2	2		2	1											2	1	1	1
CLO2		2	1		2	2			1					1			1			1
CLO3		2	2		1	1			1											
CLO4		1	1		2	1											1			1
CLO5	2	2	2		2									1			2	2	1	
CLO6	2	2	2		2	2			1	2							1	2	1	1

3: High, 2: Medium, 1: Low

Branch Name:	B.Sc. Mathematics
Program Code:	SC104
Course Name:	Advanced English
Course Code:	16-AEC301-3C
Pre-requisite Course:	Basics English Grammar and Composition up to S.Y. B.Sc.

Course Objectives:

- To inculcate human values among the students through poems and prose.
- To create an interest in literature and to develop language skills.
- The students will become familiar with formal vocabulary that is common in academic texts.

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
2	--	--	2	25	25	--	--	50

Subject Contents:

Sr. No	Topic	Total Hours	Weightage (%)
1	VOCABULARY&GRAMMARLINK Review of Confusing Words, Simple- Compound and Complex Sentences.	9	30%
2	SPEAKING Group Discussion Group discussion as a part of selection process, group behavior & leadership Potential, Tips for Effective group discussion. Group Discussion (GD) Topics on Current Affairs The New Education Policy (NEP): Challenges in Implementation, India's Space Missions: From Chandrayaan to Gaganyaan, India's Role in G20 Leadership: Achievements and Challenges	6	20%
3	READING&WRITING Writing Portion Essay Writing: Electric Vehicles: The Future of Transportation, The Role of Artificial Intelligence in Shaping the Future, Impact of Western Culture on Indian Youth, How Technology is Transforming Education Unseen Passages/Comprehension Texts from journals, newspapers, research articles, and essays.	6	20%
4	TEXT Catalyst-Lesson 6 to 10	9	30%

Text Books:

1. Catalyst-Text Book,2020
2. Easy to learn English grammar by Dr.Jayesh Patel,2021

Reference Books:

1. Very Useful Verbs book (Enka Publication)2021
2. Contemporary English Grammar Structure & Composition,2020
3. Murphy R. Intermediate English Grammar(New Delhi: Cambridge University)2019

List of Open Source Software/learning website:

1. englishpage.com
2. epaper.timesofindia.com
3. epaperindianexpress.com
4. <https://www.youtube.com/watch?v=QdAgyD4xhY>

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Describe how public speaking can be used to advocate or create change	1 Remembering
CLO2	Explain the goals and benefits of public speaking	2 Understanding
CLO3	Use parallel structures correctly and effectively.	3 Applying
CLO4	Identify strategies for researching and supporting a speech	4 Analyzing
CLO5	Recognize when to use visual aids	3 Applying
CLO6	Describe how public speaking can be used to advocate or create change	6 Creating

Mapping of CLOs with POs & PSOs:

Course Learning Outcomes	Programme Outcomes (POs)																Programme Specific Outcome (PSOs)			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	PSO1	PSO2	PSO3	PSO4
CLO1				3		1		2			1				1					
CLO2			2	3	2	1	2			2	1	2								
CLO3			1	2				2	1						2					
CLO4							1				1									
CLO5					1		1			2		1			1					
CLO6			1																	

3: High, 2: Medium, 1: Low