M.Sc., MATHEMATICS

Syllabus

Program Code: PMT

2021-2022 onwards

MANNAR THIRUMALAI NAICKER COLLEGE

(AUTONOMOUS)

Re-accredited with "A" Grade by NAAC

PASUMALAI, MADURAI – 625 004

Eligibility condition for admission

For admission to Post Graduate Programmers (P.G) a candidate should have passed the 3years degree course (under 10 + 2 + 3 pattern) (B.Sc Mathematics and B.Sc Mathematics with CA) recognized by the university as equivalent there to.

Duration

Two years. Each year consists of 2 semesters. The duration of a semester is 90 working days.

Attendance

75% of the classes in each semester shortage of attendance can be condoned as per existing university rules.

Evaluation procedure:

A mark Statement with CGPA = $\frac{\sum(MarksXcredits)}{\sum(Credits)}$

Where the summations are over all paper appeared up to the current semester.

Examinations: 3 hours duration. Total marks 100 for all papers

External Internal ratio 75:25 with 2 Internal tests.

Subjects of Study

The courses offered under the PG programs belong to the following categories:

1. Core Subjects
2. Electives
3. Non Major Electives (NME)

Pattern of the question paper for the Continuous Internal Assessment

Note: Duration – 1 hour 30 minutes

The components for continuous internal assessment are:

Part –A

Four multiple choice questions (answer all) 4 x01= 04 Marks

Part –B

Three short answers questions (answer all) 3 x02= 06 Marks

Part –C

Two questions (‘either …. or ‘type) 2 x 05=10 Marks

Part –D

Two questions out of three 2 x 10 =20 Marks

Total 40 Marks

The scheme of Examinations:

The components for continuous internal assessment are:

(40 Marks of two continuous internal assessments will be converted to 15 marks)

Two tests and their average	--15 marks
Seminar /Group discussion	--5 marks
Assignment	--5 marks

Total	25 Marks

Pattern of the question paper for the Summative Examinations:

Note: Duration- 3 hours

Part –A

Ten multiple choice questions	10 x01	= 10 Marks

No Unit shall be omitted: not more than two questions from each unit.)

Part –B

Short answer questions (one question from each unit)	5 x02	= 10 Marks

Part –C

Five Paragraph questions (‘either …. or ‘type)	5 x 05	= 25 Marks

(One question from each Unit)

Part –D

Three Essay questions out of five	3 x 10	=30 Marks

(One question from each Unit)

Total	75 Marks

Minimum Marks for a Pass

50% of the aggregate (Internal +Summative Examinations).

No separate pass minimum for the Internal Examinations.

34 marks out of 75 is the pass minimum for the Summative Examinations.

VISION

To empower the students so as to face the competitive world and make them fit for the MNCs according to their necessity and requirement

MISSION

- To maintain the standard of teaching in various areas of Pure and Applied Mathematics
- To provide an excellent learning environment with theoretical and practical knowledge where students can explore mathematical concepts.
- To mold the students to become a competent users of Mathematics and its applications.
- To instill the spirit of research through innovative teaching and research facilities.
- To qualify the students to meet the industry expectations.

The 12 Graduate Attributes*:

1. (KB) A knowledge base for engineering: Demonstrated competence in university level mathematics, natural sciences, engineering fundamentals, and specialized engineering knowledge appropriate to the program.
2. (PA) Problem analysis: An ability to use appropriate knowledge and skills to identify, formulate, analyze, and solve complex engineering problems in order to reach substantiated conclusions
3. (Inv.) Investigation: An ability to conduct investigations of complex problems by methods that include appropriate experiments, analysis and interpretation of data and synthesis of information in order to reach valid conclusions.
4. (Des.) Design: An ability to design solutions for complex, open-ended engineering problems and to design systems, components or processes that meet specified needs with appropriate attention to health and safety risks, applicable standards, and economic, environmental, cultural and societal considerations.
5. (Tools) Use of engineering tools: An ability to create, select, apply, adapt, and extend appropriate techniques, resources, and modern engineering tools to a range of engineering activities, from simple to complex, with an understanding of the associated limitations.
6. (Team) Individual and teamwork: An ability to work effectively as a member and leader in teams, preferably in a multi-disciplinary setting.
7. (Comm.) Communication skills: An ability to communicate complex engineering concepts within the profession and with society at large. Such ability includes reading, writing, speaking and listening, and the ability to comprehend and write effective reports and design documentation, and to give and effectively respond to clear instructions.

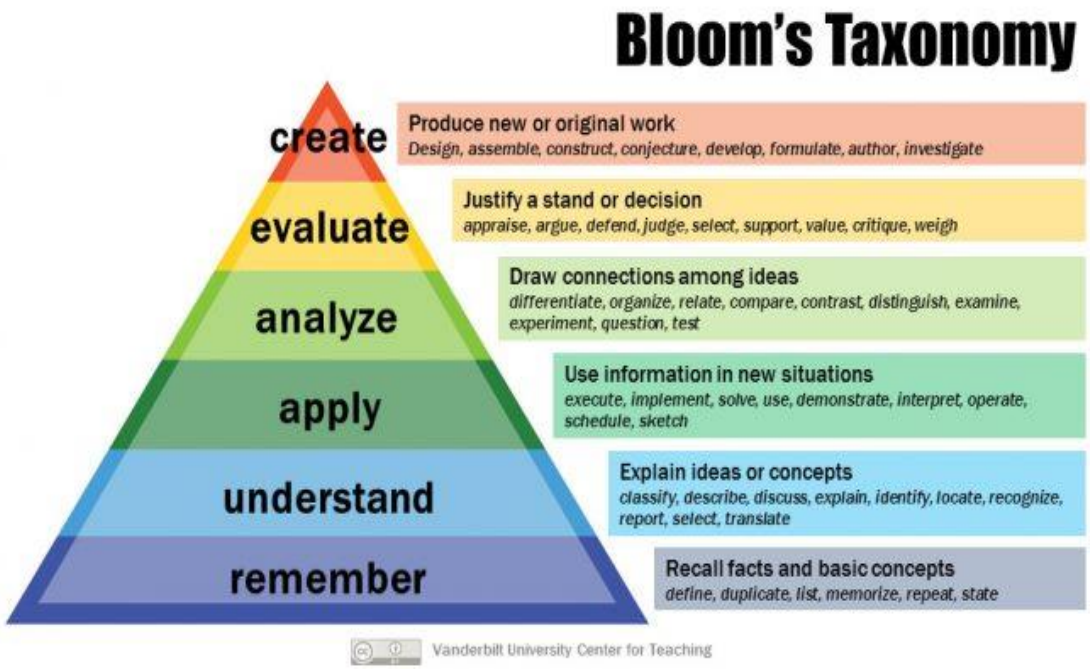
8. (Prof.) Professionalism: An understanding of the roles and responsibilities of the professional engineer in society, especially the primary role of protection of the public and the public interest.
9. (Impacts) Impact of engineering on society and the environment: An ability to analyze social and environmental aspects of engineering activities. Such ability includes an understanding of the interactions that engineering has with the economic, social, health, safety, legal, and cultural aspects of society, the uncertainties in the prediction of such interactions; and the concepts of sustainable design and development and environmental stewardship.
10. (Ethics) Ethics and equity: An ability to apply professional ethics, accountability, and equity.
11. (Econ.) Economics and project management: An ability to appropriately incorporate economics and business practices including project, risk, and change management into the practice of engineering and to understand their limitations.
12. (LL) Life-long learning: An ability to identify and to address their own educational needs in a changing world in ways sufficient to maintain their competence and to allow them to contribute to the advancement of knowledge

WA	Graduate Attributes	Caption as
1	Demonstrated competence in university level mathematics, natural sciences, engineering fundamentals, and specialized engineering knowledge appropriate to the program.	**A knowledge base for engineering**
2	An ability to use appropriate knowledge and skills to identify, formulate, analyze, and solve complex engineering problems in order to reach substantiated conclusions	**Problem analysis**
3	An ability to conduct investigations of complex problems by methods that include appropriate experiments, analysis and interpretation of data and synthesis of information in order to reach valid conclusions.	**Investigation**
7	An ability to communicate complex engineering concepts within the profession and with society at large. Such ability includes reading, writing, speaking and listening, and the ability to comprehend and write effective reports and design documentation, and to give and effectively respond to clear instructions.	**Communication skills**
6	An ability to work effectively as a member and leader in teams, preferably in a multi-disciplinary setting.	**Individual and teamwork**
10	An ability to apply professional ethics, accountability, and equity.	**Ethics and equity**
12	An ability to identify and to address their own educational needs in a changing world in ways sufficient to maintain their competence and to allow them to contribute to the advancement of knowledge	**Life-long learning**

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)	
PEO1:	Enhance the entrepreneurial abilities, life skills and research initiates through experiential learning practices and building self confidence
PEO2:	Collaborate with industry and alumnae to explore the new avenues in respective domains and raise the employability ratio
PEO3:	Equip with soft skills and critical thinking to produce an erudite and trustworthy generation to fit into versatile situations
PEO4:	Adhere to the ethical and environmental sustainability to create morally upright and empowered citizens to face industry/ Institution
PEO5:	Up-skill / Re-skill their primary knowledge and potentials to compete in the dynamic global environment.
PEO6:	To build confidence to appear for Competitive / Civil Service examinations and to conquer commanding positions in organizational level.

PO NO	PROGRAMME OUTCOMES (POs)	
At the end of the programme, the students will be able to		
PO – 1	Demonstrate the knowledge and understanding of Science concepts and its relevant fields.	**Disciplinary Knowledge**
PO – 2	Identify, formulate, analyse complex problems and reach valid conclusions using the methodologies of Science.	**Problem Solving**
PO – 3	Employ critical and analytical thinking in understanding the concepts and apply them in various problems appearing in different branches of Science.	**Analytical Reasoning & Critical Thinking**
PO - 4	Communicate the known concepts effectively within the profession and with any forum	**Communication Skills**
PO - 5	Function successfully as a member/leader in any team and to apply ethics, accountability and equity in their life.	**Team Work and Moral/Ethical Awareness**
PO - 6	Use ICT tools in various learning situations, related information sources, suitable software to analyze data and furthermore participating in learning activities throughout life to meet the demands of work place through knowledge /up-skilling / re-skilling	**Digital Literacy & Life-long Learning**

PROGRAM SPECIFIC OUTCOME (PSOs)	
PSO1:	Demonstrate the understanding of mathematical concepts in the field of Science and Technology.
PSO2:	Express their mathematical knowledge with others effectively in both oral and written form in an organized manner.
PSO3:	Proficient in using digital learning platforms and update their knowledge, skills to fulfill the requirements at the workplace in their life span.
PSO4:	Employ critical and analytical thinking in understanding the concepts of Mathematical Science and in appearing Competitive examinations SET/ NET/ TET.
PSO5:	Choose appropriate mathematical and computational methods in order to solve different types of problems and work efficiently as a team member / leader..
PSO6:	Work independently and do detailed study of various concepts of Science. Plan, execute, report the results of an experiment/investigation with the highest standard of ethics in research



MANNAR THIRUMALAI NAICKER COLLEGE (Autonomous), Pasumalai

M.Sc., MATHEMATICS, Curriculum

(For the student admitted during the academic year 2021-2022 onwards)

Course Code	Title of the Course	Hours	Credits	Maximum Marks		
				Int	Ext	Total
FIRST SEMESTER						
	Core Courses					
21PMTC11	Algebra	6	4	25	75	100
21PMTC12	Analysis	6	4	25	75	100
21PMTC13	Ordinary Differential Equations	6	4	25	75	100
21PMTC14	Graph Theory and its Algorithms	6	4	25	75	100
21PMTC15	Classical Mechanics	6	4	25	75	100
	Total	**30**	**20**	**125**	**375**	**500**
SECOND SEMESTER						
21PMTC21	Advanced Algebra	6	4	25	75	100
21PMTC22	Partial Differential Equations	6	4	25	75	100
21PMTC23	Numerical Analysis	6	4	25	75	100
21PMTC24	Fuzzy Algebra and its Applications	6	4	25	75	100
21PMTN21	Mathematics for Competitive Examinations	6	6	25	75	100
	Total	**30**	**22**	**125**	**375**	**500**
THIRD SEMESTER						
21PMTC31	Field Theory and Lattices	6	4	25	75	100
21PMTC32	Complex Analysis	6	4	25	75	100
21PMTC33	Topology	6	4	25	75	100
21PMTE31	Operations Research	6	6	25	75	100
21PMTE32	Integral Equations	6	6	25	75	100
	Total	**30**	**24**	**125**	**375**	**500**
FOURTH SEMESTER						
21PMTC41	Measure Theory and Integration	6	4	25	75	100
21PMTC42	Functional Analysis	6	4	25	75	100
21PMTPR1	Project	6	4	40	60	100
21PMTE41	Number Theory	6	6	25	75	100
21PMTE42	Stochastic Process	6	6	25	75	100
	Total	**30**	**24**	**140**	**360**	**500**
	Grand Total	**120**	**90**	**515**	**1485**	**2000**

FIRST SEMESTER

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MATHEMATICS
(For those who joined in 2021-2022 and after)

Course Name	**ALGEBRA**			
Course Code	**21PMTC11**	**L**	**P**	**C**
Category	**Core**	6	-	4

Nature of course:	**EMPLOYABILITY**	✓	SKILL ORIENTED	ENTREPRENEURSHIP

Course Objectives:

- To introduce the advanced ideas in Group theory.
- To familiarize Abelian groups and Ring theory.
- To know about unique factorization domain.
- To equip the students in fields and ideals.
- To know about Euclidean rings, Polynomial rings.

Unit: I		18

Groups (Definitions only) – Subgroups - A Counting Principle - Normal subgroups and Quotient groups - Permutation groups**.**

Unit: II	.	18

Another Counting Principle -Sylow's Theorems - Direct Products – Finite Abelian Groups

Unit: III		18

Ideals and Quotient Rings - More Ideals and Quotient Rings, The Field of Quotients of an Integral Domain

Unit: IV		18

Euclidean Rings - A particular Euclidean Rings.

Unit: V		18

Polynomial rings - Polynomials over the rational field - Polynomial rings over Commutative rings.

	Total Lecture Hours	90

Books for Study: I. N. Herstein, **Topics in Algebra**, Second Edition, John Wiley and Sons, New Delhi, Reprint 2010.

Unit I - Chapter 2: Sections 2.1, 2.4, 2.5, 2.6, 2.10
Unit II - Chapter 2: Sections 2.11, 2.12, 2.13, 2.14
Unit III- Chapter 3: Sections 3.4, 3.5, 3.6,
Unit IV - Chapter 3: Sections 3.7, 3.8
Unit V - Chapter 3: Sections 3.9,3.10,3.11.

Books for References:

1. Joseph A Gallian,***Contemporary Abstract Algebra***, 8th Edition, *Cengage Learning India Private Limited, New Delhi*, 2013.
2. Thomas W.Hungerford, **Algebra**, Springer International Edition, Newyork, 2009.
3. Lang Serge ,**Algebra** , Addison – Welsey,2002

Web Resources

https://www.youtube.com/watch?v=PN-cro0J_v8&list=PLEAYkSg4uSQ1Yhxu2U-BxtRjZElrfVVcO

https://nptel.ac.in/courses/111/106/111106113/ http://www.freebookcentre.net/maths-books-download/Notes-on-Abstract-Algebra-by-John-Perry.html		
COURSE OUTCOMES		**K Level**
On the successful completion of the course , the students will be able to		
CO1:	Demonstrate the understanding of group, normal groups, quotient group and permutation groups.	**K2**
CO2:	Use Sylow's theorem in algebraic structures	**K4**
CO3:	Examine ideals, quotient rings and integral domain	**K3**
CO4:	Analyse Euclidean ring	**K5**
CO5:	Classify the irreducibility of polynomials, rings over field	**K4**

CO & PO Mappings:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	2	1	1	3	2
CO 2	3	2	1	-	2	2
CO 3	2	3	-	1	2	1
CO 4	2	3	1	1	3	2
CO 5	2	2	1	1	2	1

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

UNIT	COURSE NAME	Hours	Pedagogy
I	Groups (Definitions only) – Subgroups - A Counting Principle - Normal subgroups and Quotient groups - Permutation groups	**18**	**Chalk & Talk**
II	Another Counting Principle -Sylow's Theorems - Direct Products – Finite Abelian Groups.	**18**	**Chalk & Talk**
III	Ideals and Quotient Rings - More Ideals and Quotient Rings, The Field of Quotients of an Integral Domain.	**18**	**Chalk & Talk**
IV	Euclidean Rings - A particular Euclidean Rings.	**18**	**Chalk & Talk**
V	Polynomial rings - Polynomials over the rational field - Polynomial rings over Commutative rings.	**18**	**Chalk & Talk**

Course Designed by: **Dr.A.Hamari Choudhi** and **Dr.V.Ramachandran**

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)								
Internal	Cos	K Level	Section A		Section B		Section C Either or Choice	Section D Open Choice
			MCQs		Short Answers			
			No. of. Questions	K - Level	No. of. Questions	K - Level		
CI AI	CO1	Upto K2	2	K1&K2	1	K1	2	1
	CO2	Upto K3	2	K1&K2	2	K2	2	1
CI AII	CO3	Upto K4	2	K1&K2	1	K2	2	1
	CO4	Upto K4	2	K1&K2	2	K2	2	1
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	2
		No. of Questions to be answered	4		3		2	1
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	10

Distribution of Marks with K Level CIA I & CIA II								
	K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2	2			4	8	20
	K2	2	4			6	12	
	K3			10	10	20	40	40
	K4			10	10	20	40	40
	Marks	4	6	20	20	50	100	100
CIA II	K1	2	2			4	8	20
	K2	2	4			6	12	
	K3			10	10	20	40	40
	K4			10	10	20	40	40
	Marks	4	6	20	20	50	100	100

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S.No	COs	K - Level	MOQs		Short Answers		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	**Upto K2**	**2**	**K1&K2**	**1**	**K1**	**2(K1&K1)**	**1(K2)**
2	CO2	**Upto K3**	**2**	**K1&K2**	**1**	**K1**	**2(K3&K3)**	**1(K3)**
3	CO3	**Upto K4**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K4)**
4	CO4	**Upto K4**	**2**	**K1&K2**	**1**	**K2**	**2(K4&K4)**	**1(K3)**
5	CO5	**Upto K3**	**2**	**K1&K2**	**1**	**K2**	**2(K2&K2)**	**1(K3)**
No. of Questions to be Asked			**10**		**5**		**10**	**5**
No. of Questions to be answered			**10**		**5**		**5**	**3**
Marks for each question			**1**		**2**		**5**	**10**
Total Marks for each section			**10**		**10**		**25**	**30**
(Figures in parenthesis denotes, questions should be asked with the given K level)								

Distribution of Marks with K Level							
K Level	**Section A (Multiple Choice Questions)**	**Section B (Short Answer Questions)**	**Section C (Either/ or Choice)**	**Section D (Open Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidated %**
K1	5	4			9	7.5	**17**
K2	5	6			11	9.17	
K3			25	20	45	37.5	**37**
K4			25	30	55	45.83	**46**
Marks	10	10	50	50	120	100	**100**
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.							

Summative Examinations - Question Paper – Format

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q.No	**CO**	**K Level**	**Questions**
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K4	
17) b	CO2	K4	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K5	
19) b	CO4	K5	
20) a	CO5	K4	
20) b	CO5	K4	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q.No	**CO**	**K Level**	**Questions**
21	CO1	K2	
22	CO2	K4	
23	CO3	K3	
24	CO4	K5	
25	CO5	K4	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MATHEMATICS
(For those who joined in 2021-2022 and after)

Course Name	**ANALYSIS**			
Course Code	**21PMTC12**	**L**	**P**	**C**
Category	**Core**	6	-	4

Nature of course:	**EMPLOYABILITY**	✓	**SKILL ORIENTED**	✓	**ENTREPRENEURSHIP**	✓

Course objectives:

- To acquire knowledge about continuous functions and its properties.
- To relate the derivative of real valued functions with continuous functions.
- To impart the fundamental theorem of Calculus.
- To introduce the concept of Riemann integral.
- To get an idea about the Sequences and Series of functions.

Unit: I		**18**

Limits of Functions - Continuous Functions - Continuity and Compactness - Continuity and Connectedness – Discontinuities - Monotonic Functions - Infinite Limits and Limits at Infinity.

Unit: II		**18**

The Derivative of a Real Function - Mean Value Theorems – The Continuity of Derivatives – L'Hospital's Rule – Derivatives of Higher Order - Taylor's Theorem - Differentiation of Vector valued Functions

Unit: III		**18**

The Riemann-Stieltjes Integral- Definition and Existence of the Integral - Properties of the Integral - Integration and Differentiation - Integration of Vector valued functions -Rectifiable Curves.

Unit: IV		**18**

Sequence and Series of functions – Uniform convergence - Uniform convergence and Continuity - Uniform convergence and Integration

Unit: V		**18**

Uniform Convergence and Differentiation – Equi-continuous Families of Functions - The Stone - Weierstrass Theorem

	Total Lecture Hours	90

Books for Study:

Walter Rudin, **Principles of Mathematical Analysis** - McGraw Hill International Editions, Mathematics series, Third Edition (1976).

Unit I : Chapter 4 Section 4.1 – 4.34
Unit II: Chapter 5 Section 5.1 – 5.19
Unit III: Chapter 6 Section 6.1 – 6.27
Unit IV :Chapter 7 Section 7.1 – 7.15
Unit V: Chapter 7 Section 7.16 – 7.26

Books for References:

1. Patrick M. Fitzpatrick, **Advanced Calculus**, AMS, Pine and Applied Undergraduate Texts, Indian Edition, 2006.
2. Apostol, **Mathematical Analysis**, Narosa Publishing House, Indian edition, 1974.
3. H.L. Royden, **Real Analysis**, Third Edition, OHI Learning Pvt Ltd., 3rd Edition, New Delhi, 2009.

Web Resources

https://nptel.ac.in/courses/111/106/111106053/ https://ocw.mit.edu/courses/mathematics/18-100c-real-analysis-fall-2012/ https://cosmolearning.org/courses/real-analysis-with-prof-sh-kulkarni/		
COURSE OUTCOMES		**K Level**
On the successful completion of the course , the students will be able to		
CO1:	Knowledge about limit, continuity, connectedness and its properties.	K2
CO2:	Identify the derivative of real valued functions with continuous concept and consequences	K3
CO3:	Illustrate the derivatives of higher order, differentiation and integration	K3
CO4:	Apply the fundamental theorem of sequence and series	K4
CO5:	Importance of uniform convergence and Stone – Weierstrass theorem	K5

CO & PO Mappings:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	**3**	**2**	**3**	**2**	**1**	**1**
CO 2	**3**	**2**	**2**	**1**	**2**	**-**
CO 3	**3**	**2**	**2**	**2**	**2**	**1**
CO 4	**3**	**2**	**3**	**2**	**1**	**-**
CO 5	**3**	**2**	**3**	**1**	**2**	**1**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

UNIT	COURSE NAME	Hours	Pedagogy
I	Limits of Functions - Continuous Functions - Continuity and Compactness - Continuity and Connectedness – Discontinuities - Monotonic Functions - Infinite Limits and Limits at Infinity.	**18**	**Chalk & Talk**
II	The Derivative of a Real Function - Mean Value Theorems – The Continuity of Derivatives – L'Hospital's Rule – Derivatives of Higher Order - Taylor's Theorem - Differentiation of Vector valued Functions	**18**	**Chalk & Talk**
III	The Riemann-Stieltjes Integral- Definition and Existence of the Integral - Properties of the Integral - Integration and Differentiation - Integration of Vector valued functions -Rectifiable Curves.	**18**	**Chalk & Talk**
IV	Sequence and Series of functions – Uniform convergence - Uniform convergence and Continuity - Uniform convergence and Integration	**18**	**Chalk & Talk**
V	Uniform Convergence and Differentiation - Equicontinuous Families of Functions - The Stone - Weierstrass Theorem	**18**	**Chalk & Talk**

Course Designed by: **Mrs.S.Andal** and Mrs. **S.Ragavi**

Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)								
Internal	Cos	K Level	Section A		Section B		Section C Either or Choice	Section D Open Choice
			MCQs		Short Answers			
			No. of. Questions	K - Level	No. of. Questions	K - Level		
CIA I	CO1	Upto K2	2	K1&K2	1	K1	2	1
	CO2	Upto K3	2	K1&K2	2	K2	2	1
CIA II	CO3	Upto K4	2	K1&K2	1	K2	2	1
	CO4	Upto K4	2	K1&K2	2	K2	2	1
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	2
		No. of Questions to be answered	4		3		2	1
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	10

Distribution of Marks with K Level CIA I & CIA II								
	K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2	2			4	8	20
	K2	2	4			6	12	
	K3			10	10	20	40	40
	K4			10	10	20	40	40
	Marks	4	6	20	20	50	100	100
CIA II	K1	2	2			4	8	20
	K2	2	4			6	12	
	K3			10	10	20	40	40
	K4			10	10	20	40	40
	Marks	4	6	20	20	50	100	100

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S.No	COs	K - Level	MOQs		Short Answers		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	Upto K2	2	K1&K2	1	K1	2(K1&K1)	1(K2)
2	CO2	Upto K3	2	K1&K2	1	K1	2(K3&K3)	1(K3)
3	CO3	Upto K4	2	K1&K2	1	K2	2(K3&K3)	1(K4)
4	CO4	Upto K4	2	K1&K2	1	K2	2(K4&K4)	1(K3)
5	CO5	Upto K3	2	K1&K2	1	K2	2(K2&K2)	1(K3)
No. of Questions to be Asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30
(Figures in parenthesis denotes, questions should be asked with the given K level)								

Distribution of Marks with K Level							
K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either/ or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5	4			9	7.5	17
K2	5	6			11	9.17	
K3			25	20	45	37.5	37
K4			25	30	55	45.83	46
Marks	10	10	50	50	120	100	100
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.							

Summative Examinations - Question Paper – Format

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q.No	**CO**	**K Level**	**Questions**
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K4	
19) b	CO4	K4	
20) a	CO5	K5	
20) b	CO5	K5	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q.No	**CO**	**K Level**	**Questions**
21	CO1	K2	
22	CO2	K3	
23	CO3	K3	
24	CO4	K4	
25	CO5	K5	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MATHEMATICS
(For those who joined in 2021-2022 and after)

Course Name	**ORDINARY DIFFERENTIAL EQUATIONS**			
Course Code	21PMTC13	**L**	**P**	**C**
Category	Core	6	-	4

Nature of course:	**EMPLOYABILITY**	✓	SKILL ORIENTED	ENTREPRENEURSHIP

COURSE OBJECTIVES:

- To produce knowledge on ODEs.
- To familiarize with power series solution, special functions.
- To learn about existence and uniqueness of solutions.
- To solve homogenous and non-homogenous equations.
- To solve standard type of OD equations.

Unit: I		**18**

Second order homogeneous equation, Initial Value Problem, Linear Dependence and Independence, A formula for Wronskian, Non-homogeneous equation of order two.

Unit: II		**18**

Homogeneous equation of order n, Initial value problems, Annihilator method to solve non-homogeneous equation, algebra of constant coefficient operators.

Unit: III		**18**

Initial value problem for the homogeneous equation, Solution of the Homogeneous equation, the Wronskian and linear independence, Reduction of the order of a homogeneous equation, The non-homogeneous equation, Homogeneous equation with analytic coefficients, The Legendre equation.

Unit: IV		**18**

The Euler equation, Second order equation with Regular Singular points – an example, Second order equation with Regular Singular points – the general case, A convergence proof, The exceptional cases, The Bessel equation, The Bessel equation (continued) .

Unit: V		**18**

Equation with Variable Separated, Exact equation, The method of Successive Approximations, The Lipschitz Condition, Convergence of the Successive Approximation, Non local existence of solution, Approximation to and uniqueness of solutions.

	Total Lecture Hours	90

Books for Study:

E.A.Coddington, **An Introduction to Ordinary Differential Equation**, PHI Learning Private Limited, New Delhi, 2010.

Unit I - Chapter 2 : Section 1 to 6
Unit II - Chapter 2 : Section 7 to 12
Unit III - Chapter 3: Section 1 to 8
Unit IV - Chapter 4: Section 1 to 8
Unit V - Chapter 5: Section 1 to 8

Books for References:

1. M.Rama Mohan Rao, **Ordinary Differential Equations Theory and Applications**,

East West Press Publications, New Delhi, 1980.
2. Purna Chandra Biswal, **Ordinary Differential Equations,** PHI Learning Publications, New Delhi, 2012.
3. SG Deo**, Ordinary Differential Equations**, Tata Mc Graw Hill Publications, New Delhi, 2010.

Web Resources

https://nptel.ac.in/courses/111/107/111107111/
https://ocw.mit.edu/courses/mathematics/18-03-differential-equations-spring-2010/video-lectures/
https://www.youtube.com/watch?v=CogfMjKUGc0

COURSE OUTCOMES		**K Level**
On the successful completion of the course , the students will be able to		
CO1:	Analyze the existence and uniqueness of solutions of ordinary differential equations	**K4**
CO2:	Solve homogenous equation and non-homogenous equation with constant co-efficient	**K3**
CO3:	Develop the concepts of ordinary differential equation for homogeneous and non-homogenous equations.	**K3**
CO4:	Demonstrate the understanding of power series and special functions	**K2**
CO5:	Compute the solution by iterative procedure for exact equation.	**K3**

CO & PO Mapping:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	2	1	-	3	1
CO 2	2	-	2	2	2	2
CO 3	2	2	2	-	3	1
CO 4	2	-	-	-	1	2
CO 5	3	-	2	1	2	2

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

UNIT	COURSE NAME	Hours	Pedagogy
I	Second order homogeneous equation, Initial Value Problem, Linear Dependence and Independence, A formula for Wronskian, Non-homogeneous equation of order two.	18	Chalk & Talk
II	Homogeneous equation of order n, Initial value problems, Annihilator method to solve non- homogeneous equation, algebra of constant coefficient operators.	18	Chalk & Talk
III	Initial value problem for the homogeneous equation, Solution of the Homogeneous equation, the Wronskian and linear independence, Reduction of the order of a homogeneous equation, The non-homogeneous equation, Homogeneous equation with analytic coefficients, The Legendre equation.	18	Chalk & Talk
IV	The Euler equation, Second order equation with Regular Singular points – an example, Second order equation with Regular Singular points – the general case, A convergence proof, The exceptional cases, The Bessel equation, The Bessel equation (continued) .	18	Chalk & Talk
V	Equation with Variable Separated, Exact equation, The method of Successive Approximations, The Lipschitz Condition, Convergence of the Successive Approximation, Non local existence of solution, Approximation to and uniqueness of solutions.	18	Chalk & Talk

Course Designed by: **Dr.M.Saravanan** and **Mrs. R.Sumathi**

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)								
Internal	Cos	K Level	Section A MCQs		Section B Short Answers		Section C Either or Choice	Section D Open Choice
			No. of. Questions	K - Level	No. of. Questions	K - Level		
CI AI	CO1	Upto K2	2	K1&K2	1	K1	2	1
	CO2	Upto K3	2	K1&K2	2	K2	2	1
CI AII	CO3	Upto K4	2	K1&K2	1	K2	2	1
	CO4	Upto K4	2	K1&K2	2	K2	2	1
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	2
		No. of Questions to be answered	4		3		2	1
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	10

Distribution of Marks with K Level CIA I & CIA II								
	K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2	2			4	8	20
	K2	2	4			6	12	
	K3			10	10	20	40	40
	K4			10	10	20	40	40
	Marks	4	6	20	20	50	100	100
CIA II	K1	2	2			4	8	20
	K2	2	4			6	12	
	K3			10	10	20	40	40
	K4			10	10	20	40	40
	Marks	4	6	20	20	50	100	100

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S.No	COs	K - Level	MOQs		Short Answers		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	**Upto K2**	**2**	**K1&K2**	**1**	**K1**	**2(K1&K1)**	**1(K2)**
2	CO2	**Upto K3**	**2**	**K1&K2**	**1**	**K1**	**2(K3&K3)**	**1(K3)**
3	CO3	**Upto K4**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K4)**
4	CO4	**Upto K4**	**2**	**K1&K2**	**1**	**K2**	**2(K4& K4)**	**1(K3)**
5	CO5	**Upto K3**	**2**	**K1&K2**	**1**	**K2**	**2(K2&K2)**	**1(K3)**
No. of Questions to be Asked			**10**		**5**		**10**	**5**
No. of Questions to be answered			**10**		**5**		**5**	**3**
Marks for each question			**1**		**2**		**5**	**10**
Total Marks for each section			**10**		**10**		**25**	**30**
(Figures in parenthesis denotes, questions should be asked with the given K level)								

Distribution of Marks with K Level							
K Level	**Section A (Multiple Choice Questions)**	**Section B (Short Answer Questions)**	**Section C (Either/ or Choice)**	**Section D (Open Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidated %**
K1	5	4			9	7.5	17
K2	5	6			11	9.17	
K3			25	20	45	37.5	37
K4			25	30	55	45.83	46
Marks	10	10	50	50	120	100	100
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.							

Summative Examinations - Question Paper – Format

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q.No	**CO**	**K Level**	**Questions**
16) a	CO1	K4	
16) b	CO1	K4	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K2	
19) b	CO4	K2	
20) a	CO5	K3	
20) b	CO5	K3	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q.No	**CO**	**K Level**	**Questions**
21	CO1	K4	
22	CO2	K3	
23	CO3	K3	
24	CO4	K2	
25	CO5	K3	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MATHEMATICS
(For those who joined in 2021-2022 and after)

Course Name	**GRAPH THEORY AND ITS ALGORITHMS**			
Course Code	**21PMTC14**	**L**	**P**	**C**
Category	**Core**	6	-	4

Nature of course:	**EMPLOYABILITY**	✓	SKILL ORIENTED	ENTREPRENEURSHIP

Course objectives:

- To understand the fundamental concepts in graph theory.
- To apply graph theory in different fields
- To improve the different types of proof writing skills.
- To learn to model problems using graphs
- To solve the problems algorithmically.

Unit: I		18

The Incidence and Adjacency Matrices, Sub graphs, Vertex degrees, Paths and Connection, Cycles, Sperner's lemma, Trees, Cut edges and Bonds, Cut vertices

Unit: II		18

Euler tours, Hamiltonian cycles, The travelling salesman problem, Matchings, Matchings and Coverings in Bipartite graphs

Unit: III		18

Edge Chromatic Number, Vizing's Theorem, Chromatic number, Brook's theorem.

Unit: IV		18

Plane and Planar graphs, Dual Graphs ,Euler's formula ,Bridges ,Kuratowski's Theorem, Directed Graphs, Directed Paths, Directed Cycles, Flows, Cuts, The Max-Flow Min –Cut theorem.

Unit: V		18

Algorithms : connectedness and components – spanning tree – cut vertices and separability – directed circuits – shortest path algorithm – planarity testing – isomorphism

	Total Lecture Hours	90

Books for Study:

1. J.A.Bondy and U.S.R.Murty, Graph Theory with Applications. North Holland Publications, New york, 1976.

Unit I - Chapter 1 : Section 1.3 to 1.7 and 1.9
Chapter 2: Section 2.1 to 2.3
Unit II – Chapter 4: Section 4.1, 4.2 and 4.4
Chapter 5: Section 5.1 to 5.2
Unit III - Chapter 6 : Section 6.1, 6.2
Chapter 8 : Section 8.1, 8.2
Unit IV - Chapter 9 : Section 9.1 to 9.5
Chapter 10 : Section 10.1 to 10.3

2. Narsingh Deo: Graph Theory with Applications to Engineering and Computer Science, Prentice Hall, 1979.

Unit V - Chapter 11 : Section 11.4 to 11.7

Books for References:

1. John Clark and Derek Allan Holton, **A first look at Graph Theory**, World ScientificPublications, Singapore, 1991.

2. Harary, **Graph Theory**, Narosa Publishing House, New Delhi, 1988.
3. S.K.Yadav, **Elements of Graph Theory**, Ane Books Pvt. Ltd,New Delhi, 2010

Web Resources

https://nptel.ac.in/courses/111/106/111106102/
https://nptel.ac.in/courses/111/106/111106050/
https://www.math.kit.edu/iag6/lehre/graphtheo2015w/media/lecture_notes.pdf

Course Outcomes		**K Level**
On the successful completion of the course , the students will be able to		
CO1:	Understand the definition of different types of graphs and Sperner's lemma.	**K2**
CO2:	Make use of graph theory concepts in travelling salesman problem, Matching and covering.	**K3**
CO3:	Categorize chromatic number, edge chromatic number with theorems.	**K4**
CO4:	Develop the different types of proof writing skills for planar graphs and directed graphs	**K5**
CO5:	Apply various types of algorithms in graph.	**K3**

CO & PO Mappings:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	**3**	**2**	**1**	**-**	**-**	**2**
CO 2	**2**	**2**	**2**	**1**	**2**	**1**
CO 3	**2**	**1**	**1**	**1**	**2**	**-**
CO 4	**3**	**2**	**1**	**1**	**1**	**1**
CO 5	**3**	**2**	**3**	**2**	**2**	**1**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

UNIT	COURSE NAME	Hours	Pedagogy
I	The Incidence and Adjacency Matrices, Sub graphs, Vertex degrees, Paths and Connection, Cycles, Sperner's lemma, Trees, Cut edges and Bonds, Cut vertices	18	**PPT, Chalk & Talk, quiz**
II	Euler tours, Hamiltonian cycles, The travelling salesman problem, Matchings, Matchings and Coverings in Bipartite graphs	18	**Chalk & Talk, PPT**
III	Edge Chromatic Number, Vizing's Theorem, Chromatic number, Brook's theorem	18	**Chalk & Talk**
IV	Plane and Planar graphs, Dual Graphs ,Euler's formula ,Bridges , Kuratowski's Theorem, Directed Graphs, Directed Paths, Directed Cycles, Flows, Cuts, The Max-Flow Min –Cut theorem.	18	**Chalk & Talk, Assignment**
V	Algorithms : connectedness and components – spanning tree – cut vertices and separability – directed circuits – shortest path algorithm – planarity testing – isomorphism	18	**Chalk & Talk, PPT**

Course Designed by: **Dr.V.Ramachandran** and **Dr.A.Hamari Choudhi**

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)								
Internal	Cos	K Level	Section A MCQs		Section B Short Answers		Section C Either or Choice	Section D Open Choice
			No. of. Questions	K - Level	No. of. Questions	K - Level		
CI AI	CO1	Upto K2	2	K1&K2	1	K1	2	1
	CO2	Upto K3	2	K1&K2	2	K2	2	1
CI AII	CO3	Upto K4	2	K1&K2	1	K2	2	1
	CO4	Upto K4	2	K1&K2	2	K2	2	1
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	2
		No. of Questions to be answered	4		3		2	1
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	10

Distribution of Marks with K Level CIA I & CIA II								
	K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2	2			4	8	20
	K2	2	4			6	12	
	K3			10	10	20	40	40
	K4			10	10	20	40	40
	Marks	4	6	20	20	50	100	100
CIA II	K1	2	2			4	8	20
	K2	2	4			6	12	
	K3			10	10	20	40	40
	K4			10	10	20	40	40
	Marks	4	6	20	20	50	100	100

K1- Remembering and recalling facts with specific answers
K2- Basic understanding of facts and stating main ideas with general answers
K3- Application oriented- Solving Problems
K4- Examining, analyzing, presentation and make inferences with evidences
CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S.No	COs	K - Level	MOQs		Short Answers		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	**Upto K2**	**2**	**K1&K2**	**1**	**K1**	**2(K1&K1)**	**1(K2)**
2	CO2	**Upto K3**	**2**	**K1&K2**	**1**	**K1**	**2(K3&K3)**	**1(K3)**
3	CO3	**Upto K4**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K4)**
4	CO4	**Upto K4**	**2**	**K1&K2**	**1**	**K2**	**2(K4&K4)**	**1(K3)**
5	CO5	**Upto K3**	**2**	**K1&K2**	**1**	**K2**	**2(K2&K2)**	**1(K3)**
No. of Questions to be Asked			**10**		**5**		**10**	**5**
No. of Questions to be answered			**10**		**5**		**5**	**3**
Marks for each question			**1**		**2**		**5**	**10**
Total Marks for each section			**10**		**10**		**25**	**30**
(Figures in parenthesis denotes, questions should be asked with the given K level)								

Distribution of Marks with K Level							
K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either/ or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5	4			9	7.5	**17**
K2	5	6			11	9.17	
K3			25	20	45	37.5	**37**
K4			25	30	55	45.83	**46**
Marks	**10**	**10**	**50**	**50**	**120**	**100**	**100**
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.							

Summative Examinations - Question Paper – Format

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q.No	**CO**	**K Level**	**Questions**
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K4	
18) b	CO3	K4	
19) a	CO4	K4	
19) b	CO4	K4	
20) a	CO5	K3	
20) b	CO5	K3	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q.No	**CO**	**K Level**	**Questions**
21	CO1	K2	
22	CO2	K3	
23	CO3	K4	
24	CO4	K5	
25	CO5	K3	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MATHEMATICS
(For those who joined in 2021-2022 and after)

Course Name	**CLASSICAL MECHANICS**			
Course Code	**21PMTC15**	**L**	**P**	**C**
Category	**Core**	6	-	4

Nature of course:	**EMPLOYABILITY**	✓	SKILL ORIENTED	ENTREPRENEURSHIP

Course objectives:

- To recall the basic concepts of motion of a particle.
- To understand D' Alembert's Principle and Lagrangian's Formulation.
- To derive the Lagrange's Equations from Hamilton's Principle.
- To apply the concept of the Equations of Motion and the Equivalent one-dimensional Problems.
- To understand the Kepler's law and Inverse-Square Law of Force.

Unit: I		18

Mechanics of a Particle, Mechanics of a System of Particles, Constraints.

Unit: II		18

D'Alembert 's principle and Lagrange's equations, Velocity – dependent potentials and the dissipation function, Hamilton's principle, Some techniques of the calculus of variations.

Unit: III		18

Derivation of Lagrange's equations from Hamilton's principle, Extension of Hamilton's principle to non-holonomic systems, Advantages of a variational principle formulation, Conservation theorems and Symmetry properties.

Unit: IV		18

Reduction to the equivalent one – body problem. The equations of motion and first integrals, The equivalent one –dimensional problem and Classification of orbits, The virial theorem

Unit: V		18

The Differential equation for the orbit and integrable power – law potentials, Conditions for closed orbits (Bertrand's theorem), The Kepler problem : Inverse square law of force, The motion in time in the Kepler problem, The Laplace – Runge- Lenz vector.

	Total Lecture Hours	90

Books for Study:

H.Goldstein, **Classical Mechanics**, Second Edition, Addison Wesley, Newyork, 1980.

Unit I - Chapter 1 : Section 1.1 to 1.3
Unit II - Chapter 1 : Section 1.4, 1.5 & Chapter 2 : Section 2.1, 2.2
Unit III - Chapter 2 : Section 2.3 to 2.6
Unit IV - Chapter 3 : Section 3.1 to 3.4
Unit V - Chapter 3 : Section 3.5 to 3.9

Books for References:

1. Madhumangal, A Course on Classical Mechanics, Narosa Publishing Private Ltd, New Delhi, 2009.
2. B.D.Gupta, Satya Prakash, Classical Mechanics, 6th Edition, Kedar Nath Ram Nath Publications, Mearut, 1987-1988
3. R.Douglas Gregory, Classical Mechanics,Cambridge University Press.

Web Resources

http://staff.um.edu.mt/jmus1/diffeq1.pdf https://ocw.mit.edu/courses/physics/8-09-classical-mechanics-iii-fall-2014/lecture-notes/ http://math.huji.ac.il/~razk/Teaching/LectureNotes/LectureNotesMechanics.pdf		
COURSE OUTCOMES		**K Level**
On the successful completion of the course , the students will be able to		
CO1:	Demonstrate the understanding of the fundamental concepts in dynamics of system of particle.	**K2**
CO2:	Derive D'Alembert 's principle, Lagrange's equations and Hamilton's principle.	**K4**
CO3:	Represent the complicated mechanical systems using the Lagrangian and Hamiltonian principle.	**K2**
CO4:	Explain the concepts of one –dimensional problem and Classification of orbits.	**K3**
CO5:	Derive Bertrand's theorem, The Kepler problem, the Laplace – Runge- Lenz vector.	**K4**

CO & PO Mapping:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	**3**	**3**	**2**	**1**	**1**	**-**
CO 2	**3**	**3**	**3**	**1**	**2**	**2**
CO 3	**3**	**2**	**3**	**1**	**1**	**1**
CO 4	**3**	**2**	**2**	**1**	**2**	**1**
CO 5	**3**	**3**	**3**	**2**	**2**	**2**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

UNIT	COURSE NAME	Hours	Pedagogy
I	Mechanics of a Particle, Mechanics of a System of Particles, Constraints.	18	**Chalk & Talk**
II	D'Alembert 's principle and Lagrange's equations, Velocity – dependent potentials and the dissipation function, Hamilton's principle, Some techniques of the calculus of variations	18	**Chalk & Talk**
III	Derivation of Lagrange's equations from Hamilton's principle, Extension of Hamilton's principle to non-holonomic systems, Advantages of a variational principle formulation, Conservation theorems and Symmetry properties.	18	**Chalk & Talk**
IV	Reduction to the equivalent one – body problem. The equations of motion and first integrals, The equivalent one –dimensional problem and classification of orbits, The virial theorem	18	**Chalk & Talk**
V	The differential equation for the orbit and integrable power – law potentials, Conditions for closed orbits (Bertrand's theorem), The Kepler problem : Inverse square law of force, The motion in time in the Kepler problem, The Laplace – Runge- Lenz vector.	18	**Chalk & Talk**

Course Designed by: **Dr.S.Andal** and **Dr.R.Bhavani**

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)								
Internal	Cos	K Level	Section A		Section B		Section C Either or Choice	Section D Open Choice
			MCQs		Short Answers			
			No. of. Questions	K - Level	No. of. Questions	K - Level		
CI AI	CO1	Upto K2	2	K1& K2	1	K1	2	1
	CO2	Upto K3	2	K1& K2	2	K2	2	1
CI AII	CO3	Upto K4	2	K1& K2	1	K2	2	1
	CO4	Upto K4	2	K1& K2	2	K2	2	1
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	2
		No. of Questions to be answered	4		3		2	1
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	10

Distribution of Marks with K Level CIA I & CIA II								
	K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2	2			4	8	20
	K2	2	4			6	12	
	K3			10	10	20	40	40
	K4			10	10	20	40	40
	Marks	4	6	20	20	50	100	100
CIA II	K1	2	2			4	8	20
	K2	2	4			6	12	
	K3			10	10	20	40	40
	K4			10	10	20	40	40
	Marks	4	6	20	20	50	100	100

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S.No	COs	K - Level	MOQs		Short Answers		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	**Upto K2**	**2**	**K1&K2**	**1**	**K1**	**2(K1&K1)**	**1(K2)**
2	CO2	**Upto K3**	**2**	**K1&K2**	**1**	**K1**	**2(K3&K3)**	**1(K3)**
3	CO3	**Upto K4**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K4)**
4	CO4	**Upto K4**	**2**	**K1&K2**	**1**	**K2**	**2(K4&K4)**	**1(K3)**
5	CO5	**Upto K3**	**2**	**K1&K2**	**1**	**K2**	**2(K2&K2)**	**1(K3)**
No. of Questions to be Asked			**10**		**5**		**10**	**5**
No. of Questions to be answered			**10**		**5**		**5**	**3**
Marks for each question			**1**		**2**		**5**	**10**
Total Marks for each section			**10**		**10**		**25**	**30**
(Figures in parenthesis denotes, questions should be asked with the given K level)								

Distribution of Marks with K Level							
K Level	**Section A (Multiple Choice Questions)**	**Section B (Short Answer Questions)**	**Section C (Either/ or Choice)**	**Section D (Open Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidated %**
K1	5	4			9	7.5	17
K2	5	6			11	9.17	
K3			25	20	45	37.5	37
K4			25	30	55	45.83	46
Marks	10	10	50	50	120	100	100
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.							

Summative Examinations - Question Paper – Format

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q.No	**CO**	**K Level**	**Questions**
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K4	
17) b	CO2	K4	
18) a	CO3	K2	
18) b	CO3	K2	
19) a	CO4	K3	
19) b	CO4	K3	
20) a	CO5	K4	
20) b	CO5	K4	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q.No	**CO**	**K Level**	**Questions**
21	CO1	K2	
22	CO2	K4	
23	CO3	K2	
24	CO4	K3	
25	CO5	K4	

SECOND SEMESTER

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MATHEMATICS
(For those who joined in 2021-2022 and after)

Course Name	**ADVANCED ALGEBRA**			
Course Code	**21PMTC21**	**L**	**P**	**C**
Category	**Core**	6	-	4

Nature of course:	**EMPLOYABILITY**	✓	SKILL ORIENTED	ENTREPRENEURSHIP

Course objectives:

- To familiarize various methods on solving algebraic equations.
- To introduce Schwarz's inequality.
- To explain about various transformations.
- To study about determinants.
- To explain canonical and triangular forms.

Unit: I		18
Elementary Basic Concepts - Dual Spaces – Inner Product Spaces.		
Unit: II		18
The Algebra of linear transformations, Characteristic roots		
Unit: III		18
Canonical forms, Triangular form, Nilpotent transformations		
Unit: IV		18
Trace and Transpose, Determinants.		
Unit: V		18
Hermitian, Unitary and Normal transformations		
	Total Lecture Hours	90

Books for Study:

I. N.Herstein,**Topics in Algebra**, Second Edition, John Wiley and Sons, New Delhi, Reprint 2010.

Unit I - Chapter 4: Section 4.1, 4.3 ,4.4.

Unit II - Chapter 6: Section 6.1 and 6.2

Unit III - Chapter 6: Sections 6.4 and 6.5

Unit IV - Chapter 6 : Section 6.8 and 6.9

Unit V - Chapter 6: Section 6.10

Books for References:

1. Thomas W.Hungerford, **Algebra**, Spinger International Edition, Newyork, 2009.
2. M.L. Khanna, **Linear Algebra**, Jai PrakashNath Publications, Meerut, 1984.
3. Martin Isaacs ,**Algebra**, Library of Congress Cataloging-in-Publication Data, Edition, New Delhi, 2009.

Web Resources

https://nptel.ac.in/courses/111/106/111106131/
https://www.youtube.com/watch?v=yKRbG9Y5pYY&list=PLEAYkSg4uSQ3AaON5oCbS6ecwKsoopBN3
https://www.youtube.com/watch?v=cDCFS68W7ZA

Course outcomes:		K Level
On the successful completion of the course , the students will be able to		
CO1:	Explain the properties of Inner Product Spaces.	K2
CO2:	Use linear transformation for characteristic roots and vectors	K3
CO3:	Represent Canonical forms, Triangular form, Nilpotent transformations	K2
CO4:	Determine the Trace and transpose, determinants	K3
CO5:	Evaluate the normal transformation	K5

CO & PO Mapping:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	2	1	2	1	1
CO 2	3	2	2	1	1	2
CO 3	3	2	1	2	1	1
CO 4	3	3	2	1	2	2
CO 5	3	2	2	1	1	1

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

UNIT	COURSE NAME	Hours	Pedagogy
I	Elementary Basic Concepts - Dual Spaces – Inner Product Spaces.	18	Chalk &Talk
II	The Algebra of linear transformations, Characteristic roots	18	Chalk &Talk
III	Trace and Transpose, Determinants.	18	Chalk &Talk
IV	Trace and Transpose, Determinants.	18	Chalk &Talk
V	Hermitian, Unitary and Normal transformations.	18	Chalk &Talk

Course Designed by: **Dr.A.Hamari Choudhi** and **Dr.V.Ramachandran**

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)								
Internal	Cos	K Level	Section A		Section B		Section C Either or Choice	Section D Open Choice
			MCQs		Short Answers			
			No. of. Questions	K - Level	No. of. Questions	K - Level		
CI AI	CO1	Upto K2	2	K1&K2	1	K1	2	1
	CO2	Upto K3	2	K1&K2	2	K2	2	1
CI AII	CO3	Upto K4	2	K1& K2	1	K2	2	1
	CO4	Upto K4	2	K1&K2	2	K2	2	1
Question Pattern CIA I & II	No. of Questions to be asked		4		3		4	2
	No. of Questions to be answered		4		3		2	1
	Marks for each question		1		2		5	10
	Total Marks for each section		4		6		10	10

Distribution of Marks with K Level CIA I & CIA II								
	K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2	2			4	8	20
	K2	2	4			6	12	
	K3			10	10	20	40	40
	K4			10	10	20	40	40
	Marks	4	6	20	20	50	100	100
CIA II	K1	2	2			4	8	20
	K2	2	4			6	12	
	K3			10	10	20	40	40
	K4			10	10	20	40	40
	Marks	4	6	20	20	50	100	100

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S.No	COs	K - Level	MCQs		Short Answers		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	**Upto K2**	**2**	**K1&K2**	**1**	**K1**	**2(K1&K1)**	**1(K2)**
2	CO2	**Upto K3**	**2**	**K1&K2**	**1**	**K1**	**2(K3&K3)**	**1(K3)**
3	CO3	**Upto K4**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K4)**
4	CO4	**Upto K4**	**2**	**K1&K2**	**1**	**K2**	**2(K4&K4)**	**1(K3)**
5	CO5	**Upto K3**	**2**	**K1&K2**	**1**	**K2**	**2(K2&K2)**	**1(K3)**
No. of Questions to be Asked			**10**		**5**		**10**	**5**
No. of Questions to be answered			**10**		**5**		**5**	**3**
Marks for each question			**1**		**2**		**5**	**10**
Total Marks for each section			**10**		**10**		**25**	**30**
(Figures in parenthesis denotes, questions should be asked with the given K level)								

Distribution of Marks with K Level							
K Level	**Section A (Multiple Choice Questions)**	**Section B (Short Answer Questions)**	**Section C (Either/ or Choice)**	**Section D (Open Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidated %**
K1	5	4			9	7.5	**17**
K2	5	6			11	9.17	
K3			25	20	45	37.5	**37**
K4			25	30	55	45.83	**46**
Marks	10	10	50	50	120	100	**100**
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.							

Summative Examinations - Question Paper – Format

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q.No	**CO**	**K Level**	**Questions**
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K2	
18) b	CO3	K2	
19) a	CO4	K3	
19) b	CO4	K3	
20) a	CO5	K4	
20) b	CO5	K4	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q.No	**CO**	**K Level**	**Questions**
21	CO1	K2	
22	CO2	K3	
23	CO3	K2	
24	CO4	K3	
25	CO5	K5	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MATHEMATICS
(For those who joined in 2021-2022 and after)

Course Name	**PARTIAL DIFFERENTIAL EQUATIONS**			
Course Code	21**PMTC22**	**L**	**P**	**C**
Category	Core	6	-	4

Nature of course:	**EMPLOYABILITY**	✓	SKILL ORIENTED	ENTREPRENEURSHIP

Course objectives:

- To study about linear classifications of partial differential equations.
- To solve different types of PDEs using various methods.
- To classify second order PDEs.
- To derive one dimensional wave and heat conduction equations.
- To solve Dirichlet's and Neumann's Problem in various domain.

Unit: I		18

P.D.E –Curves and Surfaces – Genesis of First Order P.D.E – Classification of Integrals – Linear Equation of the first Order – Partial Differential Equation –Compatible Systems – Charpit's Method – Jacobi's Method.

Unit: II		18

Integral Surfaces Through a Given Curve –Quasi-Linear Equation –Non- Linear First Order P.D.E.

Unit: III		18

Second Order P.D.E.: Genesis of Second Order P.D.E – Classification of Second Order P.D.E - One- Dimensional Wave Equation – Vibration of an Infinite String –Vibration of a Semi – infinite String – Vibration of a String of Finite Length (Method of Separation of Variables).

Unit: IV		18

Laplace's Equation Boundary Value Problems- Maximum and Minimum Principle- The Cauchy Problem – The Dirichlet Problem for the Upper Half Plane – The Neumann Problem for the Upper Half Plane – The Dirichlet Interior Problem for a Circle – The Dirichlet Exterior Problem for a Circle – The Neumann Problem for Circle – The Dirichlet Problem for a Rectangle – Harnack's Theorem.

Unit: V		18

Green's function, Heat Conduction Problem – Heat Conduction –Infinite Rod Case- Heat Conduction Finite Rod Case – Duhamel's Principle – Wave Equation –Heat Conduction Equation

	Total Lecture Hours	90

Books for Study:

T.Amarnath, **An Elementary Course in Partial Differential Equation**, Narosa Publishing Company, Chennai, 1997.

Unit I - Chapter 1 : Section 1.1 to 1.8 Unit II - Chapter 1 : Section 1.9 to 1.11
Unit III - Chapter 2 : Section 2.1 to 2.3 (2.3.1 to 2.3.3and 2.3.5)
Unit IV - Chapter 2 : Section 2.4.1 to 2.4.10
Unit V - Chapter 2 : Section 2.4 (2.4.11 to 2.4.13)
Section 2.5 (2.5.1and 2.5.2)
Section 2.6 (2.6.1and 2.6.2)

Books for References:

1. E.T. Copson, **Partial differential equations**, S. Chand and Company Ltd., New Delhi, 1984.
2. Jeffrey Raich, **Partial differential equations**, Springer Publisher, Newyork, 1991.
3. Ian Sneddon, **Elements of Partial Differential Equations**, Mc Graw-Hill Book Company,

New Delhi, 1985.		
Web Resources		
https://www.iist.ac.in/sites/default/files/people/IN08026/Canonical_form.pdf. **https://nptel.ac.in/courses/111/107/111107111/** **https://nptel.ac.in/courses/122/107/122107037/**		
COURSE OUTCOMES		**K Level**
On the successful completion of the course , the students will be able to		
CO1:	Solve the Linear first order partial differential equations using various methods.	**K3**
CO2:	Analyze the Semi-linear, Quasi-linear & Non-linear first order partial differential equations.	**K4**
CO3:	Classify the second order partial differential equations	**K4**
CO4:	Apply the concepts of partial differential equations in solving boundary value problems.	**K3**
CO5:	Determine the solutions for homogeneous and non-homogeneous partial differential equations.	**K3**

CO & PO Mapping:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	**3**	**2**	**1**	**1**	**3**	**1**
CO 2	**3**	**2**	**1**	**1**	**2**	**-**
CO 3	**3**	**2**	**1**	**-**	**2**	**1**
CO 4	**3**	**2**	**1**	**-**	**2**	**-**
CO 5	**3**	**2**	**1**	**1**	**2**	**-**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

UNIT	COURSE NAME	Hours	Pedagogy
I	P.D.E –Curves and Surfaces – Genesis of First Order P.D.E – Classification of Integrals – Linear Equation of the first Order – Partial Differential Equation –Compatible Systems – Charpit's Method – Jacobi's Method.	18	**Chalk & Talk**
II	Integral Surfaces Through a Given Curve –Quasi-Linear Equation –Non- Linear First Order P.D.E.	18	**Chalk & Talk**
III	Second Order P.D.E.: Genesis of Second Order P.D.E – Classification of Second Order P.D.E - One- Dimensional Wave Equation – Vibration of an Infinite String –Vibration of a Semi – infinite String – Vibration of a String of Finite Length (Method of Separation of Variables).	18	**Chalk & Talk**
IV	Laplace's Equation Boundary Value Problems- Maximum and Minimum Principle- The Cauchy Problem – The Dirichlet Problem for the Upper Half Plane – The Neumann Problem for the Upper Half Plane – The Dirichlet Interior Problem for a Circle – The Dirichlet Exterior Problem for a Circle – The Neumann Problem for Circle – The Dirichlet Problem for a Rectangle – Harnack's Theorem.	18	**Chalk & Talk**
V	Green's function, Heat Conduction Problem – Heat Conduction – Infinite Rod Case- Heat Conduction Finite Rod Case – Duhamel's Principle – Wave Equation –Heat Conduction Equation	18	**Chalk & Talk**

Course Designed by: **Mrs.R.Sumathi** and **Dr.M.Saravanan**

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)								
Internal	**Cos**	**K Level**	**Section A**		**Section B**		**Section C Either or Choice**	**Section D Open Choice**
			MCQs		**Short Answers**			
			No. of. Questions	**K - Level**	**No. of. Questions**	**K - Level**		
CI AI	**CO1**	**Upto K2**	**2**	**K1&K2**	**1**	**K1**	**2**	**1**
	CO2	**Upto K3**	**2**	**K1&K2**	**2**	**K2**	**2**	**1**
CI AII	**CO3**	**Upto K4**	**2**	**K1&K2**	**1**	**K2**	**2**	**1**
	CO4	**Upto K4**	**2**	**K1&K2**	**2**	**K2**	**2**	**1**
Question Pattern CIA I & II	No. of Questions to be asked		**4**		**3**		**4**	**2**
	No. of Questions to be answered		**4**		**3**		**2**	**1**
	Marks for each question		**1**		**2**		**5**	**10**
	Total Marks for each section		**4**		**6**		**10**	**20**

Distribution of Marks with K Level CIA I & CIA II								
	K Level	**Section A (Multiple Choice Questions)**	**Section B (Short Answer Questions)**	**Section C (Either / Or Choice)**	**Section D (Open Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidate of %**
CIA I	**K1**	2	2			4	**8**	**20**
	K2	2	4			6	**12**	
	K3			10	10	20	**40**	**40**
	K4			10	10	20	**40**	**40**
	Marks	4	6	20	20	50	**100**	**100**
CIA II	**K1**	2	2			4	**8**	**20**
	K2	2	4			6	**12**	
	K3			10	10	20	**40**	**40**
	K4			10	10	20	**40**	**40**
	Marks	4	6	20	20	50	**100**	**100**

K1- Remembering and recalling facts with specific answers
K2- Basic understanding of facts and stating main ideas with general answers
K3- Application oriented- Solving Problems
K4- Examining, analyzing, presentation and make inferences with evidences
CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S.No	COs	K - Level	MCQs		Short Answers		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	**Upto K2**	**2**	**K1&K2**	**1**	**K1**	**2(K1&K1)**	**1(K2)**
2	CO2	**Upto K3**	**2**	**K1&K2**	**1**	**K1**	**2(K3&K3)**	**1(K3)**
3	CO3	**Upto K4**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K4)**
4	CO4	**Upto K4**	**2**	**K1&K2**	**1**	**K2**	**2(K4&K4)**	**1(K3)**
5	CO5	**Upto K3**	**2**	**K1&K2**	**1**	**K2**	**2(K2&K2)**	**1(K3)**
No. of Questions to be Asked			**10**		**5**		**10**	**5**
No. of Questions to be answered			**10**		**5**		**5**	**3**
Marks for each question			**1**		**2**		**5**	**10**
Total Marks for each section			**10**		**10**		**25**	**30**
(Figures in parenthesis denotes, questions should be asked with the given K level)								

Distribution of Marks with K Level							
K Level	**Section A (Multiple Choice Questions)**	**Section B (Short Answer Questions)**	**Section C (Either/ or Choice)**	**Section D (Open Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidated %**
K1	5	4			9	7.5	**17**
K2	5	6			11	9.17	
K3			25	20	45	37.5	**37**
K4			25	30	55	45.83	**46**
Marks	10	10	50	50	120	100	**100**
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.							

Summative Examinations - Question Paper – Format

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q.No	**CO**	**K Level**	**Questions**
16) a	CO1	K3	
16) b	CO1	K3	
17) a	CO2	K4	
17) b	CO2	K4	
18) a	CO3	K4	
18) b	CO3	K4	
19) a	CO4	K3	
19) b	CO4	K3	
20) a	CO5	K3	
20) b	CO5	K3	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q.No	**CO**	**K Level**	**Questions**
21	CO1	K3	
22	CO2	K4	
23	CO3	K4	
24	CO4	K3	
25	CO5	K3	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MATHEMATICS
(For those who joined in 2021-2022 and after)

Course Name	**NUMERICAL ANALYSIS**			
Course Code	21**PMTC23**	**L**	**P**	**C**
Category	**Core**	6	-	4

Nature of course:	**EMPLOYABILITY**	✓	SKILL ORIENTED	ENTREPRENEURSHIP

Course Objectives:

- To develop Numerical computational skills.
- To practice Numerical computational applications.
- To introduce difference equations and recurrence equations.
- To demonstrate understanding and implementation of numerical solution of algorithms based for employability
- To find the errors in the approximation

Unit: I		18

Bisection method – Iteration method (approximation method) based on first degree equation, second degree equation, General Iteration Methods .

Unit: II		18

Direct methods: forward substitution method, back substitution method, Cramer rule, Gauss elimination method, Gauss Jordan method – triangulation method – LU decomposition– Cholesky method – Partition method.

Unit: III		18

Iterative methods - Jacobi iteration methods, Gauss-Seidel iteration methods, Similarity transformation – Eigen values – Eigen vectors –Jacobi method for symmetric matrices.

Unit: IV		18

Lagrange's and Newton Interpolation, Finite Difference Operators, Interpolating Polynomials using Finite Differences, Hermite Interpolation.

Unit: V		18

Numerical Differentiation, Partial Differentiation, Numerical Integration, Methods based on Interpolation, Composite Integration methods.

	Total Lecture Hours	90

Books for Study:

M.K.Jain, S.R.K.Iyengar, R.K.Jain, **Numerical Methods for scientific and Engineering computation** – 4th edition, New age international Pvt limited, New Delhi, 2009.

Unit I - Chapter 2 : Section 2.1-2.4 and 2.6
Unit II - Chapter 3 : Section 3.1, 3.2
Unit III - Chapter 3 : Section 3.4, 3.5 and 3.7
Unit IV - Chapter 4 : Section 4.1 – 4.5
Unit V - Chapter 5 : Section 5.1, 5.2, 5.5 - 5.7, 5.9.

Books for References:

1. G.Shankar Rao, **Numerical Analysis,** New Age International publishers, New Delhi,1997.
2. Rainer Kress, **Numerical Analysis**, Springer international Edition, New Delhi, 2010.
3. S.R.K.Iyengar ,R.K.Jain **,Numerical Methods,** , New age international Pvt limited, New Delhi, 2008

Web Resources

http://www.ece.mcmaster.ca/~xwu/part6.pdf **http://www.cis.upenn.edu/~cis515/cis515-12-sl2.pdf** **https://wiki.math.ntnu.no/_media/tma4215/2012h/note.pdf**		
COURSE OUTCOMES		**K Level**
On the successful completion of the course , the students will be able to		
CO1:	Demonstrate the understanding of direct methods and iterative methods for equations	**K2**
CO2:	Apply proper methods for solving transcendental, algebraic and system of equations	**K3**
CO3:	Evaluate interpolation and extrapolation using tabular values	**K5**
CO4:	Associate tabular values with integration and differentiation	**K2**
CO5:	Use iterative methods for PDE	**K3**

CO & PO Mapping:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	**3**	**2**	**3**	**2**	**3**	**2**
CO 2	**3**	**2**	**3**	**2**	**2**	**2**
CO 3	**2**	**2**	**2**	**2**	**3**	**2**
CO 4	**2**	**3**	**2**	**-**	**2**	**2**
CO 5	**2**	**2**	**-**	**-**	**2**	**-**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

UNIT	COURSE NAME	Hours	Pedagogy
I	Bisection method – Iteration method (approximation method) based on first degree equation, second degree equation, General Iteration Methods .	18	**Chalk & Talk**
II	Direct methods: forward substitution method, back substitution method, Cramer rule, Gauss elimination method, Gauss Jordan method – triangulation method – LU decomposition– Cholesky method – Partition method.	18	**Chalk & Talk**
III	Iterative methods - Jacobi iteration methods, Gauss-Seidel iteration methods, Similarity transformation – Eigen values – Eigen vectors – Jacobi method for symmetric matrices.	18	**Chalk & Talk**
IV	Lagrange's and Newton Interpolation, Finite Difference Operators, Interpolating Polynomials using Finite Differences, Hermite Interpolation.	18	**Chalk & Talk**
V	Numerical Differentiation, Partial Differentiation, Numerical Integration, Methods based on Interpolation, Composite Integration methods.	18	**Chalk & Talk**

Course Designed by: **Dr.M.Saravanan** and **Dr.A.Arivuchelvam**

Learning Outcome Based Education & Assessment (LOBE)

Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)								
Internal	Cos	K Level	Section A		Section B		Section C Either or Choice	Section D Open Choice
			MCQs		Short Answers			
			No. of. Questions	K - Level	No. of. Questions	K - Level		
CI AI	CO1	Upto K2	2	K1&K2	1	K1	2	1
	CO2	Upto K3	2	K1&K2	2	K2	2	1
CI AII	CO3	Upto K4	2	K1&K2	1	K2	2	1
	CO4	Upto K4	2	K1&K2	2	K2	2	1
Question Pattern CIA I & II	No. of Questions to be asked		4		3		4	2
	No. of Questions to be answered		4		3		2	1
	Marks for each question		1		2		5	10
	Total Marks for each section		4		6		10	10

Distribution of Marks with K Level CIA I & CIA II								
	K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2	2			4	8	20
	K2	2	4			6	12	
	K3			10	10	20	40	40
	K4			10	10	20	40	40
	Marks	4	6	20	20	50	100	100
CIA II	K1	2	2			4	8	20
	K2	2	4			6	12	
	K3			10	10	20	40	40
	K4			10	10	20	40	40
	Marks	4	6	20	20	50	100	100

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S.No	COs	K - Level	MCQs		Short Answers		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	**Upto K2**	**2**	**K1&K2**	**1**	**K1**	**2(K1&K1)**	**1(K2)**
2	CO2	**Upto K3**	**2**	**K1&K2**	**1**	**K1**	**2(K3&K3)**	**1(K3)**
3	CO3	**Upto K4**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K4)**
4	CO4	**Upto K4**	**2**	**K1&K2**	**1**	**K2**	**2(K4&K4)**	**1(K3)**
5	CO5	**Upto K3**	**2**	**K1&K2**	**1**	**K2**	**2(K2&K2)**	**1(K3)**
No. of Questions to be Asked			**10**		**5**		**10**	**5**
No. of Questions to be answered			**10**		**5**		**5**	**3**
Marks for each question			**1**		**2**		**5**	**10**
Total Marks for each section			**10**		**10**		**25**	**30**
(Figures in parenthesis denotes, questions should be asked with the given K level)								

Distribution of Marks with K Level							
K Level	**Section A (Multiple Choice Questions)**	**Section B (Short Answer Questions)**	**Section C (Either/ or Choice)**	**Section D (Open Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidated %**
K1	5	4			9	7.5	17
K2	5	6			11	9.17	
K3			25	20	45	37.5	37
K4			25	30	55	45.83	46
Marks	10	10	50	50	120	100	100
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.							

Summative Examinations - Question Paper – Format

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q.No	**CO**	**K Level**	**Questions**
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K4	
18) b	CO3	K4	
19) a	CO4	K2	
19) b	CO4	K2	
20) a	CO5	K3	
20) b	CO5	K3	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q.No	**CO**	**K Level**	**Questions**
21	CO1	K2	
22	CO2	K3	
23	CO3	K5	
24	CO4	K2	
25	CO5	K3	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MATHEMATICS
(For those who joined in 2021-2022 and after)

Course Name	**FUZZY ALGEBRA AND ITS APPLICATIONS**			
Course Code	21PMTC24	**L**	**P**	**C**
Category	Core	6	-	4

Nature of course:	**EMPLOYABILITY**	✓	SKILL ORIENTED	ENTREPRENEURSHIP

Course Objectives:

- To familiarize the concept of crisp set and its properties
- To learn the basics of fuzzy sets and its operations
- To differentiate crisp logic, multi-valued logic and fuzzy logic
- To use inference theory in fuzzy logic
- To learn the application in real life

Unit: I		18

Fuzzy sets: Basic types– Basic concepts – Additional properties of α – cuts – Representation of fuzzy sets – Extension principle for fuzzy sets – Types of operations – Fuzzy complements

Unit: II		18

Fuzzy numbers – Linguistic variables – Arithmetic operation on intervals – Arithmetic operation on fuzzy numbers

Unit: III		18

Fuzzy relation : Crisp versus Fuzzy relation – projection and cyclinderic extensions- Binary fuzzy relation on a single set – fuzzy equivalence relations – Fuzzy compatibility relation

Unit: IV		18

Fuzzy logic: Classical logic – An over view – multi valued logic – Fuzzy propositions –Fuzzy quantifiers – Linguistic hedges – Inference from conditional fuzzy propositions – Inference from conditional and quantified propositions – Inference from quantified propositions

Unit: V		18

Applications : Applications to Civil Engineering –Computer Engineering – Reliability theory – Robotics – Medicine – Economics.

	Total Lecture Hours	90

Books for Study:

George J Klir and B.Yuan, **Fuzzy sets and Fuzzy logic – Theory and application**, Second edition, Prentice Hall, New Delhi,1995.

Unit I - Chapter 1 : Sections 1.2 to 1.4
Chapter 2 : Sections 2.1 to 2.3
Chapter 3 : Sections 3.1,3.2
Unit II - Chapter 4 : Section 4.1 to 4.4
Unit III - Chapter 5 : Sections 5.1 to 5.6
Unit IV - Chapter 8 : Sections 8.2 to 8.8
Unit V - Chapter 16 : Sections 16.1 , 16.2, 16.5 to 16.7,
Chapter 17 : Sections 17.1 to 17.3.

Books for References:

1. H.J.Zimmermann, **Fuzzy Set Theory and its Applications**, Fourth Edition, Springer Publishers, New Delhi, 2006.

2. Timothy J. Ross, "**Fuzzy Logic with Engineering Applications**", 3rd Edition, Willey, 2010.
3. Michal Baczynski and Balasubramaniam Jayaram, **Fuzzy Implications**, Springer Verlag, Heidelberg, 2008

Web Resources

https://www.thesisscientist.com/docs/Study%20Notes/66860129-5a91-459d-810f-54e0fc41175d
https://ocw.mit.edu/courses/health-sciences-and-technology/hst-951j-medical-decision-support-spring-2003/lecture-notes/lecture4.pdf
https://www.iitk.ac.in/eeold/archive/courses/2013/intel-info/d1pdf3.pdf
https://nptel.ac.in/courses/106105173/2
https://www.cse.iitb.ac.in/~cs621-2011/lectures_2009/cs621-lect38-fuzzy-logic-2009-11-11.ppt

COURSE OUTCOMES		K Level
On the successful completion of the course , the students will be able to		
CO1:	Interpret fuzzy set theory, representation, operation and extension principle	K2
CO2:	Identify fuzzy numbers and its linguistic variables	K2
CO3:	Validate fuzzy relation, projections and its equivalence.	K5
CO4:	Analyse multi valued logic and fuzzy logic with inference theory	K3
CO5:	Apply fuzziness in real valued problems	K3

CO & PO Mappings:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	2	-	1	2	-
CO 2	2	2	-	-	2	-
CO 3	2	1	1	2	2	1
CO 4	2	1	1	2	2	1
CO 5	2	1	1	1	-	2

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

UNIT	COURSE NAME	Hours	Pedagogy
I	Fuzzy sets: Basic types– Basic concepts – Additional properties of α – cuts – Representation of fuzzy sets – Extension principle for fuzzy sets – Types of operations – Fuzzy complements	18	Chalk & Talk
II	Fuzzy numbers – Linguistic variables – Arithmetic operation on intervals – Arithmetic operation on fuzzy numbers	18	Chalk & Talk
III	Fuzzy relation : Crisp versus Fuzzy relation – projection and cyclinderic extensions- Binary fuzzy relation on a single set – fuzzy equivalence relations – Fuzzy compatibility relation	18	Chalk & Talk
IV	Fuzzy logic: Classical logic – An over view – multi valued logic – Fuzzy propositions –Fuzzy quantifiers – Linguistic hedges – Inference from conditional fuzzy propositions – Inference from conditional and quantified propositions – Inference from quantified propositions	18	Chalk & Talk
V	Applications : Applications to Civil Engineering –Computer Engineering – Reliability theory – Robotics – Medicine – Economics.	18	Chalk & Talk

Course Designed by: **Dr.M.Saravanan** and **Dr.P.Chitra Devi**

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)								
Internal	Cos	K Level	Section A MCQs		Section B Short Answers		Section C Either or Choice	Section D Open Choice
			No. of. Questions	K - Level	No. of. Questions	K - Level		
CI AI	CO1	Upto K2	2	K1&K2	1	K1	2	1
	CO2	Upto K3	2	K1&K2	2	K2	2	1
CI AII	CO3	Upto K4	2	K1&K2	1	K2	2	1
	CO4	Upto K4	2	K1&K2	2	K2	2	1
Question Pattern CIA I & II	No. of Questions to be asked		4		3		4	2
	No. of Questions to be answered		4		3		2	1
	Marks for each question		1		2		5	10
	Total Marks for each section		4		6		10	10

Distribution of Marks with K Level CIA I & CIA II								
	K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2	2			4	8	20
	K2	2	4			6	12	
	K3			10	10	20	40	40
	K4			10	10	20	40	40
	Marks	4	6	20	20	50	100	100
CIA II	K1	2	2			4	8	20
	K2	2	4			6	12	
	K3			10	10	20	40	40
	K4			10	10	20	40	40
	Marks	4	6	20	20	50	100	100

K1- Remembering and recalling facts with specific answers
K2- Basic understanding of facts and stating main ideas with general answers
K3- Application oriented- Solving Problems
K4- Examining, analyzing, presentation and make inferences with evidences
CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S.No	COs	K - Level	MCQs		Short Answers		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	Upto K2	2	K1&K2	1	K1	2(K1&K1)	1(K2)
2	CO2	Upto K3	2	K1&K2	1	K1	2(K3&K3)	1(K3)
3	CO3	Upto K4	2	K1&K2	1	K2	2(K3&K3)	1(K4)
4	CO4	Upto K4	2	K1&K2	1	K2	2(K4&K4)	1(K3)
5	CO5	Upto K3	2	K1&K2	1	K2	2(K2&K2)	1(K3)
No. of Questions to be Asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30
(Figures in parenthesis denotes, questions should be asked with the given K level)								

Distribution of Marks with K Level							
K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either/ or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5	4			9	7.5	17
K2	5	6			11	9.17	
K3			25	20	45	37.5	37
K4			25	30	55	45.83	46
Marks	10	10	50	50	120	100	100
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.							

Summative Examinations - Question Paper – Format

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q.No	**CO**	**K Level**	**Questions**
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K2	
17) b	CO2	K2	
18) a	CO3	K4	
18) b	CO3	K4	
19) a	CO4	K3	
19) b	CO4	K3	
20) a	CO5	K3	
20) b	CO5	K3	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q.No	**CO**	**K Level**	**Questions**
21	CO1	K2	
22	CO2	K2	
23	CO3	K5	
24	CO4	K3	
25	CO5	K3	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MATHEMATICS
(For those who joined in 2021-2022 and after)

Course Name	**MATHEMATICS FOR COMPETITIVE EXAMINATIONS**			
Course Code	**21PMTN21**	**L**	**P**	**C**
Category	**Non Major Elective Course**	6	-	6

Nature of course:	**EMPLOYABILITY**	✓	**SKILL ORIENTED**	✓	ENTREPRENEURSHIP

Course objectives:

- To develop knowledge on numbers, data interpretation.
- To familiarize the application through various statistical methods.
- To convert real data into a statistical data interpretation.
- To use these concepts in competitive examinations.
- To develop the computational skills.

Unit: I		18
H.C.F. and L.C.M. of numbers – Simplifications.		
Unit: II		18
Percentage – Profit and loss – Ratio and proportion.		
Unit: III		18
Time and work – Time and distance – Problems on Trains.		
Unit: IV		18
Simple interest – Compound interest – Permutation and Combination.		
Unit: V		18
Data interpretation: Tabulation – Bar Graphs – Pie charts.		
	Total Lecture Hours	90

Books for Study:

Aggarwal. R.S, **Quantitative Aptitude**, S.Chand and Company Ltd, 2009, New Delhi.

Unit I – Chapters 2 & 4 (Except exercises)
Unit II – Chapters 10, 11 & 12 (Except exercises)
Unit III – Chapters 15, 17 & 18 (Except exercises)
Unit IV – Chapters 21, 22 & 30 (Except exercises)
Unit V – Chapters 36, 37 & 38 (Except exercises)

Books for References:

1. Abhigit Guha, **Quantitative Aptitude**, 4th Edition, Tata McGraw Hill Publications, 2011, New Delhi.
2. Mohan Rao.U, **Quantitative Aptitude**, Scitech Publications, Reprint 2013, Chennai.
3. Aggarwal. R.S, **Verbal & Non Verbal Reasoning**, S.Chand & Co, 2009, New Delhi.

Web Resources

https://thecompanyboy.com/rs-aggarwal-quantitative-aptitude-pdf-free-download
https://www.toprankers.com/exams/quantitative-aptitude-questions-pdf/
https://www.sawaal.com/aptitude-reasoning/quantitative-aptitude-arithmetic-ability-questions-and-answers.html

COURSE OUTCOMES	**K Level**
On the successful completion of the course , the students will be able to	

CO1:	Understand the concepts of Mathematics along with analytical ability	**K2**
CO2:	Develop the mathematical problem solving skill	**K3**
CO3:	Evaluate the problems on data interpretation	**K5**
CO4:	Identify the time related problems and solving	**K4**
CO5:	Illustrate appropriate methods for solving Permutation and Combination	**K2**

CO & PO Mapping:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	**3**	**2**	**3**	**3**	**3**	**2**
CO 2	**3**	**2**	**3**	**3**	**3**	**3**
CO 3	**3**	**2**	**3**	**3**	**3**	**2**
CO 4	**3**	**3**	**2**	**3**	**3**	**2**
CO 5	**2**	**3**	**2**	**3**	**3**	**2**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

UNIT	COURSE NAME	Hours	Pedagogy
I	H.C.F. and L.C.M. of numbers – Simplifications.	18	**Chalk & Talk**
II	Percentage – Profit and loss – Ratio and proportion.	18	**Chalk & Talk**
III	Time and work – Time and distance – Problems on Trains.	18	**Chalk & Talk**
IV	Simple interest – Compound interest – Permutation and ombination.	18	**Chalk & Talk**
V	Data interpretation: Tabulation – Bar Graphs – Pie charts.	18	**Chalk & Talk**

Course Designed by: **Mrs.S.Ragavi** and **Mrs.S.Andal**

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)								
Internal	Cos	K Level	Section A		Section B		Section C Either or Choice	Section D Open Choice
			MCQs		Short Answers			
			No. of. Questions	K - Level	No. of. Questions	K - Level		
CIA I	CO1	Upto K2	2	K1&K2	1	K1	2	1
	CO2	Upto K3	2	K1&K2	2	K2	2	1
CIA II	CO3	Upto K4	2	K1&K2	1	K2	2	1
	CO4	Upto K4	2	K1&K2	2	K2	2	1
Question Pattern CIA I & II	No. of Questions to be asked		4		3		4	2
	No. of Questions to be answered		4		3		2	1
	Marks for each question		1		2		5	10
	Total Marks for each section		4		6		10	10

Distribution of Marks with K Level CIA I & CIA II								
	K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2	2			4	8	20
	K2	2	4			6	12	
	K3			10	10	20	40	40
	K4			10	10	20	40	40
	Marks	4	6	20	20	50	100	100
CIA II	K1	2	2			4	8	20
	K2	2	4			6	12	
	K3			10	10	20	40	40
	K4			10	10	20	40	40
	Marks	4	6	20	20	50	100	100

K1- Remembering and recalling facts with specific answers
K2- Basic understanding of facts and stating main ideas with general answers
K3- Application oriented- Solving Problems
K4- Examining, analyzing, presentation and make inferences with evidences
CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S.No	COs	K - Level	MCQs		Short Answers		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	**Upto K2**	**2**	**K1&K2**	**1**	**K1**	**2(K1&K1)**	**1(K2)**
2	CO2	**Upto K3**	**2**	**K1&K2**	**1**	**K1**	**2(K3&K3)**	**1(K3)**
3	CO3	**Upto K4**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K4)**
4	CO4	**Upto K4**	**2**	**K1&K2**	**1**	**K2**	**2(K4&K4)**	**1(K3)**
5	CO5	**Upto K3**	**2**	**K1&K2**	**1**	**K2**	**2(K2&K2)**	**1(K3)**
No. of Questions to be Asked			**10**		**5**		**10**	**5**
No. of Questions to be answered			**10**		**5**		**5**	**3**
Marks for each question			**1**		**2**		**5**	**10**
Total Marks for each section			**10**		**10**		**25**	**30**
(Figures in parenthesis denotes, questions should be asked with the given K level)								

Distribution of Marks with K Level							
K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either/ or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5	4			9	7.5	**17**
K2	5	6			11	9.17	
K3			25	20	45	37.5	**37**
K4			25	30	55	45.83	**46**
Marks	**10**	**10**	**50**	**50**	**120**	**100**	**100**
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.							

Summative Examinations - Question Paper – Format

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q.No	**CO**	**K Level**	**Questions**
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K4	
18) b	CO3	K4	
19) a	CO4	K4	
19) b	CO4	K4	
20) a	CO5	K2	
20) b	CO5	K2	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q.No	**CO**	**K Level**	**Questions**
21	CO1	K2	
22	CO2	K3	
23	CO3	K5	
24	CO4	K4	
25	CO5	K2	

THIRD SEMESTER

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MATHEMATICS
(For those who joined in 2021-2022 and after)

Course Name	**FIELD THEORY AND LATTICES**			
Course Code	**21PMTC31**	**L**	**P**	**C**
Category	**Core**	6	-	4

Nature of course:	**EMPLOYABILITY**	✓	SKILL ORIENTED	ENTREPRENEURSHIP

Course Objectives:

- To make the students familiar with the concepts of Galois theory
- To introduce application of Galois theory in solvability by radicals
- To study about lattices and its special types
- To make the students understand the aspects of field theory
- To familiarize finite field theory

Unit: I		18
Fields, Extension fields, Roots of polynomials		
Unit: II		18
More about roots, The elements of Galois theory.		
Unit: III		18
Solvability by Radicals, Galois groups over the rationals		
Unit: IV		18
Finite fields, Wedderburn's Theorem on finite division rings		
Unit: V		18
Lattices: Lattices and posets, lattices as posets. Sub lattices; direct products, distributive lattices, modular and geometric lattices, Boolean lattices.		
	Total Lecture Hours	**00 Hrs**

Books for Study:

1) Herstein.I.N, **Topics in Algebra**, Second Edition, John Wiley and Sons, 1999, New Delhi.
2) GarrotBirkoff and Thomas Bartee**, Modern Applied Algebra**, CBC Publishers and Distributors, 1999, NewDelhi.

Unit I- Text Book 1 : Chapter 5 : Sections 5.1,5.3
Unit II -Text Book 1 : Chapter 5 : Sections 5.5,5.6
Unit III - Text Book 1 : Chapter 5 : Sections 5.7,5.8
Unit IV - Text Book 1 : Chapter 7 : Sections 7.1,7.2
Unit V- Text Book 2 : Chapter 9 : Sections 9.1 to 9.7

Books for References:

1. Vijay K.Khanna, **"Lattices and Boolean Algebras",** Second Edition, Vikas Publishing House Pvt. Ltd,2008.
2. John B.Fraleigh**, "A First Course in Abstract Algebra",** Third Edition, Narosa Publishers, 2003, New Delhi.
3. Patrick Morandi ,**"Field and Galois Theory"** ,Springer International Edition, 1996, New Delhi.

Web Resources:

1.https://jmilne.org/math/CourseNotes/FT.pdf
2.https://www.youtube.com/watch?v=Uk_YQkonLBU&list=PL1iySp9JVsLltlFByt1e5Aq5uF

1tV5_hB 3.https://www.youtube.com/watch?v=UjaD2eVYnQc&list=PL1iySp9JVsLltlFByt1e5Aq5uF1tV5_hB&index=2		
Course Outcomes		**K Level**
On the successful completion of the course , the students will be able to		
CO1:	Explain the notion of field theory.	**K4**
CO2:	Analyze the relationship between the ring, field and Galois theory.	**K4**
CO3:	Develop the proof of solvable group for radicals.	**K3**
CO4:	Explain the finite division rings	**K4**
CO5:	Classify the different types of lattices	**K4**

CO & PO Mappings:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	**3**	**2**	**2**	**1**	**1**	**1**
CO 2	**3**	**2**	**3**	**1**	**1**	**1**
CO 3	**3**	**3**	**3**	**1**	**2**	**1**
CO 4	**3**	**3**	**3**	**2**	**2**	**1**
CO 5	**3**	**3**	**3**	**2**	**2**	**1**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

UNIT	SUBJECT NAME	Hours	Pedagogy
I	Fields, Extension fields, Roots of polynomials	18	**Chalk & Talk**
II	More about roots, The elements of Galois theory.	18	**Chalk & Talk, PPT**
III	Solvability by Radicals, Galois groups over the rationals	18	**Chalk & Talk**
IV	Finite fields, Wedderburn's Theorem on finite division rings	18	**Chalk & Talk, PPT**
V	Lattices: Lattices and posets, lattices as posets. Sub lattices; direct products, distributive lattices, modular and geometric lattices, Boolean lattices.	18	**Chalk & Talk, PPT**

Course Designed by: Dr. A. Hamari Choudhi, Head & Associate Professor **&**
Dr. V. Ramachandran, Assistant Professor

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)								
Internal	**Cos**	**K Level**	**Section A**		**Section B**		**Section C Either or Choice**	**Section D Open Choice**
			MCQs		**Short Answers**			
			No. of. Questions	**K - Level**	**No. of. Questions**	**K - Level**		
CI AI	**CO1**	**Upto K4**	**2**	**K1&K2**	**1**	**K1**	**2**	**1**
	CO2	**Upto K4**	**2**	**K1&K2**	**2**	**K2**	**2**	**1**
CI AII	**CO3**	**Upto K4**	**2**	**K1&K2**	**1**	**K2**	**2**	**1**
	CO4	**Upto K4**	**2**	**K1&K2**	**2**	**K2**	**2**	**1**
Question Pattern CIA I & II	No. of Questions to be asked		**4**		**3**		**4**	**2**
	No. of Questions to be answered		**4**		**3**		**2**	**1**
	Marks for each question		**1**		**2**		**5**	**10**
	Total Marks for each section		**4**		**6**		**10**	**10**

Distribution of Marks with K Level CIA I & CIA II								
	K Level	**Section A (Multiple Choice Questions)**	**Section B (Short Answer Questions)**	**Section C (Either / Or Choice)**	**Section D (Open Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidate of %**
CIA I	**K1**	2	2			4	**8**	**20**
	K2	2	4			6	**12**	
	K3			10	10	20	**40**	**40**
	K4			10	10	20	**40**	**40**
	Marks	**4**	**6**	**20**	**20**	**50**	**100**	**100**
CIA II	**K1**	2	2			4	**8**	**20**
	K2	2	4			6	**12**	
	K3			10	10	20	**40**	**40**
	K4			10	10	20	**40**	**40**
	Marks	**4**	**6**	**20**	**20**	**50**	**100**	**100**

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S.No	COs	K - Level	MCQs		Short Answers		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	Upto K4	2	K1&K2	1	K1	2(K2&K2)	1(K4)
2	CO2	Upto K4	2	K1&K2	1	K1	2(K3&K3)	1(K4)
3	CO3	Upto K3	2	K1&K2	1	K2	2(K3&K3)	1(K3)
4	CO4	Upto K4	2	K1&K2	1	K2	2(K3&K3)	1(K4)
5	CO5	Upto K4	2	K1&K2	1	K2	2(K2&K2)	1(K4)
No. of Questions to be Asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30
(Figures in parenthesis denotes, questions should be asked with the given K level)								

Distribution of Marks with K Level							
K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either/ or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5	4			9	7.5	34
K2	5	6	20		31	25.9	
K3			30	10	40	33.3	33
K4				40	40	33.3	33
Marks	10	10	50	50	120	100	100
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.							

Summative Examinations - Question Paper – Format

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q.No	**CO**	**K Level**	**Questions**
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K3	
19) b	CO4	K3	
20) a	CO5	K2	
20) b	CO5	K2	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q.No	**CO**	**K Level**	**Questions**
21	CO1	K4	
22	CO2	K4	
23	CO3	K3	
24	CO4	K4	
25	CO5	K4	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MATHEMATICS
(For those who joined in 2021-2022 and after)

Course Name	**COMPLEX ANALYSIS**				
Course Code	**21PMTC32**		**L**	**P**	**C**
Category	**Core**		6	-	4
Nature of course:	**EMPLOYABILITY**	SKILL ORIENTED	ENTREPRENURSHIP		

COURSE OBJECTIVES:

- To understand the concept of analyticity, line integrals, residues.
- To familiarize Cauchy integral formula.
- To introduce Taylor and Laurent Series.
- To introduce analytic function, complex integration and Riemann Zeta Function.
- To estimate integrals of special forms in certain regions.

Unit: I		18
Introduction to the concept of Analytic Function –Elementary theory of Power Series.		
Unit: II		18
The Exponential and Trigonometric Function – Conformality – Linear Transformation		
Unit: III		18
Fundamental Theorems – Cauchy's Integral Formula – Local properties of Analytical Function.		
Unit: IV		18
The General form of Cauchy's Theorem – The Calculus of Residues- Harmonic Functions.		
Unit: V		18
Power Series Expansions – Partial Fractions and Factorization - Entire Functions – The Riemann Zeta Function.		
	Total Lecture Hours	90

Books for Study:

Ahlfors, L.V., "**Complex Analysis**", Third Edition, McGraw Hill International Company, 1979, New Delhi.
Unit I : Chapter 2 : Section 1 and 2 (2.4 & 2.5)
Unit II : Chapter 2 : Section 3
Chapter 3 : Section 2 and 3 (3.1 to 3.3)
Unit III: Chapter 4 : Section 1,2,3
Unit IV: Chapter 4 : Section 4 (4.1 to 4.5) , Section 5 & Section 6
Unit V:Chapter 5: Section 1,2(2.1 & 2.2) and Section 3 & 4.

Books for References:

1. Churchill, R.V, J.W. Brown and R.F. Verhey, **Complex Variables and Applications**, McGraw – Hill International Company, 1974, NewDelhi.
2. Conway, J.B, **Functions of one Complex Variable**, Narosa Publishing House, 2006,Chennai.
3. Karunakaran.V, **Complex Analysis**, Narosa Publishing House, 2005,Chennai.

Web Resources

1. https://www.math.lsu.edu/~neubrand/notes.pdf
2. https://nptel.ac.in/courses/111/106/111106141/
3. https://www.youtube.com/watch?v=b5VUnapu-qs
4. https://www.youtube.com/watch?v=gFjlBKW8aZU&list=PLbMVogVj5nJS_i8vfVWJ

	G16mPcoEKMuWT&index=2	
COURSE OUTCOMES		**K Level**
On the successful completion of the course , the students will be able to		
CO1:	Explain the concept of complex function and power series	**K4**
CO2:	Analyze the properties of Analytical Function	**K4**
CO3:	Analyze the Cauchy's theorem for different closed curves	**K4**
CO4:	Construct arguments effectively in proof of theorems in complex analysis	**K3**
CO5:	Develop the series of complex function using Jensen's and Poisson formula	**K3**

CO & PO Mappings:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	**3**	**3**	**3**	**2**	**2**	**1**
CO 2	**3**	**3**	**3**	**2**	**1**	**1**
CO 3	**3**	**2**	**3**	**2**	**2**	**1**
CO 4	**3**	**2**	**2**	**2**	**1**	**1**
CO 5	**3**	**2**	**2**	**2**	**1**	**1**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

UNIT	SUBJECT NAME	Hours	Pedagogy
I	Introduction to the concept of Analytic Function – Residues – Harmonic Elementary theory of Power Series.	18	**Chalk & Talk, PPT**
II	The Exponential and Trigonometric Function – Conformality – Linear Transformation	18	**Chalk & Talk, PPT**
III	Fundamental Theorems – Cauchy Integral Formula – Local properties of Analytical Function.	18	**Chalk & Talk**
IV	The General form of Cauchy's Theorem – The Calculus of Functions.	18	**Chalk & Talk, PPT**
V	Power Series Expansions – Partial Fractions and Factorization - Entire Functions – The Riemann Zeta Function .	18	**Chalk & Talk, PPT**

Course Designed by:

Dr. R. Bhavani, Assistant Professor **& Mrs. S. Ragavi,** Assistant Professor

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)								
Internal	Cos	K Level	Section A		Section B		Section C Either or Choice	Section D Open Choice
			MCQs		Short Answers			
			No. of. Questions	K - Level	No. of. Questions	K - Level		
CI AI	CO1	Upto K4	2	K1&K2	1	K1	2	1
	CO2	Upto K4	2	K1&K2	2	K2	2	1
CI AII	CO3	Upto K4	2	K1&K2	1	K2	2	1
	CO4	Upto K3	2	K1&K2	2	K2	2	1
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	2
		No. of Questions to be answered	4		3		2	1
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	10

Distribution of Marks with K Level CIA I & CIA II								
	K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2	2			4	8	20
	K2	2	4			6	12	
	K3			10	10	20	40	40
	K4			10	10	20	40	40
	Marks	4	6	20	20	50	100	100
CIA II	K1	2	2			4	8	20
	K2	2	4			6	12	
	K3			10	10	20	40	40
	K4			10	10	20	40	40
	Marks	4	6	20	20	50	100	100

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S.No	COs	K - Level	MCQs		Short Answers		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	**Upto K4**	**2**	**K1&K2**	**1**	**K1**	**2(K2&K2)**	**1(K4)**
2	CO2	**Upto K4**	**2**	**K1&K2**	**1**	**K1**	**2(K3&K3)**	**1(K4)**
3	CO3	**Upto K4**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K4)**
4	CO4	**Upto K3**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K3)**
5	CO5	**Upto K3**	**2**	**K1&K2**	**1**	**K2**	**2(K2&K2)**	**1(K3)**
No. of Questions to be Asked			**10**		**5**		**10**	**5**
No. of Questions to be answered			**10**		**5**		**5**	**3**
Marks for each question			**1**		**2**		**5**	**10**
Total Marks for each section			**10**		**10**		**25**	**30**
(Figures in parenthesis denotes, questions should be asked with the given K level)								

Distribution of Marks with K Level							
K Level	**Section A (Multiple Choice Questions)**	**Section B (Short Answer Questions)**	**Section C (Either/ or Choice)**	**Section D (Open Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidated %**
K1	5	4			9	7.5	33
K2	5	6	20		31	25.8	
K3			30	20	50	41.7	42
K4				30	30	25	25
Marks	10	10	50	50	120	100	100
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.							

Summative Examinations - Question Paper – Format

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q.No	**CO**	**K Level**	**Questions**
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K3	
19) b	CO4	K3	
20) a	CO5	K2	
20) b	CO5	K2	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q.No	**CO**	**K Level**	**Questions**
21	CO1	K4	
22	CO2	K4	
23	CO3	K4	
24	CO4	K3	
25	CO5	K3	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
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(For those who joined in 2021-2022 and after)

Course Name	**TOPOLOGY**			
Course Code	**21PMTC33**	**L**	**P**	**C**
Category	**Core**	6	-	4
Nature of course:	**EMPLOYABILITY**	SKILL ORIENTED	ENTREPRENURSHIP	

COURSE OBJECTIVES:

- To familiarize the basic concepts of Topology.
- To learn the various aspects of Topological spaces.
- To study the properties of topological spaces
- To enrich knowledge in metric topology, connected, compact and normal spaces.
- To understand the concept of axioms.

Unit: I		18
Topological Spaces – Basis for a Topology - The Order Topology –The Product Topology on XxY – The Subspace Topology – Closed sets and limit points – Continuous functions – The Product Topology.		
Unit: II		18
The Metric Topology – Connected Spaces – Connected Subspaces of the Real Line.		
Unit: III		18
Compact Spaces – Compact Subspaces of the real line – Limit Point Compactness – Local Compactness.		
Unit: IV		18
Countability Axioms - The Separation Axioms – Normal Spaces.		
Unit: V		18
The Urysohn Lemma – The Urysohnmetrization Theorem – Tietze Extension Theorem		
	Total Lecture Hours	90

Books for Study:

James R.Mukres, "**Topology**" (Second Edition), Prentice –Hall of India Private Ltd, January 1987, New Delhi.

Unit I- Chapter 2 : Sections 12 to 19
Unit II - Chapter 2 : Sections 20 and 21&
Chapter 3 : Sections23 and 24
Unit III - Chapter 3 : Sections 26 to 29
Unit IV - Chapter 4 : Sections 30 to 32
Unit V - Chapter 4 : Sections 33 to35

Books for References:

1. Gupta. K.P, **Topology**, First Edition, Pragati Prakashan Educational, 1974,Meerut-250001
2. James Dugundji, **Topology,** Universal book stall, Reprint 1990, New Delhi
3. Chandrasekhara Rao, "**Topology**", Narosa Publishing House, 2009, NewDelhi.

Web Resources

1. http://www.uio.no/studier/emner/matnat/math/MAT4500/h13/topology.pdf
2. http://nptel.ac.in/courses/111106054/Topology%20complete%20course.pdf

3. http://home.iitk.ac.in/~chavan/topology_mth304.pdf 4. https://www.youtube.com/watch?v=XHKcrs8YaSo&list=PLbMVogVj5nJRR7zYZifYopb52zjoScx1d	
COURSE OUTCOMES	**K Level**
On the successful completion of the course , the students will be able to	
CO1: Compare basis and sub basis in topological spaces	**K4**
CO2: Apply metric space in a topological space	**K3**
CO3: Analyze metrization and compactness of spaces	**K4**
CO4: Explain the countability axioms and separation axioms and separability	**K4**
CO5: Develop the logical arguments related to continuous functions on topological spaces.	**K3**

CO & PO Mappings:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	2	2	1	2	1
CO 2	3	2	3	2	1	1
CO 3	3	2	2	1	1	1
CO 4	3	2	2	1	1	1
CO 5	3	2	2	1	1	1

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

UNIT	SUBJECT NAME	Hours	Pedagogy
I	Topological Spaces – Basis for a Topology - The Order Topology –The Product Topology on XxY – The Subspace Topology – Closed sets and limit points – Continuous functions – The Product Topology.	**18**	**Chalk & Talk, PPT**
II	The Metric Topology – Connected Spaces – Connected Subspaces of the Real Line.	**18**	**Chalk & Talk, PPT**
III	Compact Spaces – Compact Subspaces of the real line – Limit Point Compactness – Local Compactness.	**18**	**Chalk & Talk, PPT**
IV	Countability Axioms - The Separation Axioms – Normal Spaces.	**18**	**Chalk & Talk, PPT**
V	The Urysohn Lemma – The Urysohn Metrization Theorem – Tietze Extension Theorem	**18**	**Chalk & Talk, PPT**

Course Designed by:

Dr. A. Arivu Chelvam, Assistant Professor **& Dr. P. Chitra Devi,** Assistant Professor

Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)								
Internal	Cos	K Level	Section A		Section B		Section C Either or Choice	Section D Open Choice
			MCQs		Short Answers			
			No. of. Questions	K - Level	No. of. Questions	K - Level		
CI AI	CO1	Upto K4	2	K1&K2	1	K1	2	1
	CO2	Upto K3	2	K1&K2	2	K2	2	1
CI AII	CO3	Upto K4	2	K1&K2	1	K2	2	1
	CO4	Upto K4	2	K1&K2	2	K2	2	1
Question Pattern CIA I & II	No. of Questions to be asked		4		3		4	2
	No. of Questions to be answered		4		3		2	1
	Marks for each question		1		2		5	10
	Total Marks for each section		4		6		10	10

Distribution of Marks with K Level CIA I & CIA II								
	K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2	2			4	8	20
	K2	2	4			6	12	
	K3			10	10	20	40	40
	K4			10	10	20	40	40
	Marks	4	6	20	20	50	100	100
CIA II	K1	2	2			4	8	20
	K2	2	4			6	12	
	K3			10	10	20	40	40
	K4			10	10	20	40	40
	Marks	4	6	20	20	50	100	100

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S.No	COs	K - Level	MCQs		Short Answers		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	**Upto K4**	**2**	**K1&K2**	**1**	**K1**	**2(K2&K2)**	**1(K4)**
2	CO2	**Upto K3**	**2**	**K1&K2**	**1**	**K1**	**2(K2&K2)**	**1(K3)**
3	CO3	**Upto K4**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K4)**
4	CO4	**Upto K4**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K4)**
5	CO5	**Upto K3**	**2**	**K1&K2**	**1**	**K2**	**2(K2&K2)**	**1(K3)**
No. of Questions to be Asked			**10**		**5**		**10**	**5**
No. of Questions to be answered			**10**		**5**		**5**	**3**
Marks for each question			**1**		**2**		**5**	**10**
Total Marks for each section			**10**		**10**		**25**	**30**
(Figures in parenthesis denotes, questions should be asked with the given K level)								

Distribution of Marks with K Level							
K Level	**Section A (Multiple Choice Questions)**	**Section B (Short Answer Questions)**	**Section C (Either/ or Choice)**	**Section D (Open Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidated %**
K1	5	4			9	7.5	**42**
K2	5	6	30		41	34.2	
K3			20	20	40	33.3	**33**
K4				30	30	25	**25**
Marks	10	10	50	50	120	100	**100**
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.							

Summative Examinations - Question Paper – Format

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q.No	**CO**	**K Level**	**Questions**
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K2	
17) b	CO2	K2	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K3	
19) b	CO4	K3	
20) a	CO5	K2	
20) b	CO5	K2	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q.No	**CO**	**K Level**	**Questions**
21	CO1	K4	
22	CO2	K3	
23	CO3	K4	
24	CO4	K4	
25	CO5	K3	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MATHEMATICS
(For those who joined in 2021-2022 and after)

Course Name	**OPERATIONS RESEARCH**				
Course Code	**21PMTE31**		**L**	**P**	**C**
Category	**Elective**		6	-	6
Nature of course:	**EMPLOYBILITY**	**SKILL ORIENTED**	ENTREPRENURSHIP		

COURSE OBJECTIVES:

- To familiarize various decision– making tools.
- To solve optimization problems.
- To introduce the application on inventory control system and etc.
- To identify the resources required for a project and generate a plan and work schedule.
- To learn about queuing models

Unit: I		18

Network definitions- Minimal Spanning Tree Algorithm-Shortest route problem-Maximal Flow Model - CPM and PERT.

Unit: II		18

Recursive nature of computations in DP - Forward and Backward recursion - Selected DP applications. General inventory models – Static Economic Order Quantity(EOQ) models

Unit: III		18

Decision making under certainty-Analytic Hierarchy Process(AHP)-Decision making under risk- Decision under uncertainty-Game theory.

Unit: IV		18

Queuing systems – Elements of Queuing model – Role of Exponential Distribution – Pure Birth and Death Models – Generalized Poisson Queuing Models – Specialized Poisson Queues.

Unit: V		18

Unconstrained Problems – Necessary and Sufficient Conditions- Newton – Raphson Method - Constrained Problems – Equality Constraints- Inequality Constraints- Karush-Kuhn-Tucker Conditions

	Total Lecture Hours	**90**

Books for Study:

Hamdy A. Taha**, Operations Research** – An introduction, 8th Edition, PHI, New Delhi.

Unit I- Chapter 6: sections 6.1 to6.5

Unit II - Chapter 10: sections 10.1 to10.3
Chapter 11:sections 11.1 to 11.3

Unit III - Chapter 13:sections 13.1 to 13.4

Unit IV - Chapter 15:sections 15.1 to 15.6

Unit V - Chapter 18: sections 18.1 to18.2

Books for References:

1. KantiSwarup , P.K. Gupta and Man Mohan, "**Operations Research"** , Sultan Chand & sons Publications, Reprint 2006, NewDelhi.

2. Harvey M. Wagner, "**Principles of Operations Research", Second** Edition, Prentice Hall of Pvt Ltd, 1998, NewDelhi.

3. Prem Kumar Gupta and D.S.Hira, "**Operations Research**", S.Chand Publications, 2009, New Delhi.

Web Resources

1. **https://nptel.ac.in/courses/111/105/111105100/**
2. **https://nptel.ac.in/courses/111/104/111104071/**
3. **http://apmonitor.com/me575/**

COURSE OUTCOMES		**K Level**
On the successful completion of the course , the students will be able to		
CO1:	Identify various decision– making tools.	K3
CO2:	Analyze various models in inventory system.	K4
CO3:	Apply suitable method in game theory.	K3
CO4:	Explain Poisson Queuing Models	K4
CO5:	Classify the constrained and unconstrained Problems	K4

CO & PO Mappings:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	**3**	**3**	**3**	**1**	**1**	**1**
CO 2	**3**	**3**	**2**	**2**	**1**	**-**
CO 3	**3**	**3**	**3**	**1**	**1**	**1**
CO 4	**3**	**3**	**2**	**2**	**1**	**-**
CO 5	**3**	**3**	**2**	**2**	**2**	**1**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

UNIT	SUBJECT NAME	Hours	Pedagogy
I	Network definitions- minimal spanning tree algorithm-Shortest route problem-maximal flow model - CPM and PERT.	18	**Chalk & Talk**
II	Recursive nature of computations in DP - Forward and Backward recursion - Selected DP applications. General inventory models – Static Economic Order Quantity(EOQ) models	18	**Chalk & Talk**
III	Decision making under certainty-Analytic Hierarchy Process(AHP)-Decision making under risk- decision under uncertainty-Game theory.	18	**Chalk & Talk**
IV	Queuing systems – Elements of Queuing model – Role of Exponential Distribution – Pure Birth and Death Models – Generalized Poisson Queuing Models – Specialized Poisson Queues.	18	**Chalk & Talk,PPT**
V	Unconstrained Problems – Necessary and Sufficient Conditions-Newton – Raphson Method - Constrained Problems – Equality Constraints- Inequality Constraints- Karush-Kuhn-Tucker Conditions	18	**Chalk & Talk**

Course Designed by:

Dr. P. Chitra Devi, Assistant Professor **& Mrs. R. Sumathi** Assistant Professor

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)								
Internal	Cos	K Level	Section A MCQs		Section B Short Answers		Section C Either or Choice	Section D Open Choice
			No. of. Questions	K - Level	No. of. Questions	K - Level		
CI AI	CO1	Upto K3	2	K1&K2	1	K1	2	1
	CO2	Upto K4	2	K1&K2	2	K2	2	1
CI AII	CO3	Upto K3	2	K1&K2	1	K2	2	1
	CO4	Upto K4	2	K1&K2	2	K2	2	1
Question Pattern CIA I & II	No. of Questions to be asked		4		3		4	2
	No. of Questions to be answered		4		3		2	1
	Marks for each question		1		2		5	10
	Total Marks for each section		4		6		10	10

Distribution of Marks with K Level CIA I & CIA II								
	K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2	2			4	8	20
	K2	2	4			6	12	
	K3			10	10	20	40	40
	K4			10	10	20	40	40
	Marks	4	6	20	20	50	100	100
CIA II	K1	2	2			4	8	20
	K2	2	4			6	12	
	K3			10	10	20	40	40
	K4			10	10	20	40	40
	Marks	4	6	20	20	50	100	100

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S.No	COs	K - Level	MCQs		Short Answers		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	**Upto K3**	**2**	**K1&K2**	**1**	**K1**	**2(K2&K2)**	**1(K3)**
2	CO2	**Upto K4**	**2**	**K1&K2**	**1**	**K1**	**2(K3&K3)**	**1(K4)**
3	CO3	**Upto K3**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K3)**
4	CO4	**Upto K4**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K4)**
5	CO5	**Upto K4**	**2**	**K1&K2**	**1**	**K2**	**2(K2&K2)**	**1(K4)**
No. of Questions to be Asked			**10**		**5**		**10**	**5**
No. of Questions to be answered			**10**		**5**		**5**	**3**
Marks for each question			**1**		**2**		**5**	**10**
Total Marks for each section			**10**		**10**		**25**	**30**
(Figures in parenthesis denotes, questions should be asked with the given K level)								

Distribution of Marks with K Level							
K Level	**Section A (Multiple Choice Questions)**	**Section B (Short Answer Questions)**	**Section C (Either/ or Choice)**	**Section D (Open Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidated %**
K1	5	4			9	7.5	**33**
K2	5	6	20		31	25.7	
K3			30	20	50	41.8	**42**
K4				30	30	25	**25**
Marks	10	10	50	50	120	100	**100**
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.							

Summative Examinations - Question Paper – Format

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q.No	**CO**	**K Level**	**Questions**
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K3	
19) b	CO4	K3	
20) a	CO5	K2	
20) b	CO5	K2	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q.No	**CO**	**K Level**	**Questions**
21	CO1	K3	
22	CO2	K4	
23	CO3	K3	
24	CO4	K4	
25	CO5	K4	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MATHEMATICS
(For those who joined in 2021-2022 and after)

Course Name	**NONLINEAR DIFFERENTIAL EQUATIONS**			
Course Code	**21PMTE32**	**L**	**P**	**C**
Category	**Elective**	6	-	6
Nature of course:	**EMPLOYBILITY**	**SKILL ORIENTED**	ENTREPRENURSHIP	

COURSE OBJECTIVES:

- To form First order Systems in Two Variables and Linearization
- To learn Averaging Methods
- To understand Perturbation Methods
- To solve Linear Systems
- To find the Stability of systems.

Unit: I		18

The general phase plane – Some population models – Linear approximation at equilibrium points – Linear systems in matrix form.

Unit: II		18

An energy balance method for limit cycles – Amplitude and frequency estimates – Slowly varying amplitudes; Nearly periodic solutions - Periodic solutions: Harmonic balance – Equivalent linear equation by harmonic balance – Accuracy of a period estimate.

Unit: III		18

Outline of the direct method – Forced oscillations far from resonance Forced oscillations near resonance with weak excitation – Amplitude equation for undamped pendulum – Amplitude perturbation for the pendulum equation – Lindstedt's method- Forced oscillation of a self – excited equation – The Perturbation method and Fourier series.

Unit: IV		18

Structure of solutions of the general linear system – Constant coefficient system – Periodic coefficients – Floquet theory – Wronskian.

Unit: V		18

Poincare stability – Solutions, paths and norms – Liapunov stability- Stability of linear systems – Comparison theorem for the zero solutions of nearly-linear systems

	Total Lecture Hours	90

Books for Study:

"**Nonlinear Ordinary Differential Equations**" by D.W. Jordan and P. Smith, Clarendon Press, Oxford, 1977.
Unit-I: Chapter 2;
Unit-II :Chapter 4;
Unit-III: Chapter 5: Sections: 5.1 - 5.4, 5.7 -5.10.
Unit-IV: Chapter 8: Sections: 8.1 - 8.4;
Unit-V: Chapter 9: Sections: 9.1 - 9.4, 9.6.

Books for References:

1 "**Differential Equations**" by G.F. Simmons, Tata McGraw-Hill, New Delhi, 1979.
2 "**Ordinary Differential Equations and Stability Theory"** by D.A. Sanchez, Dover, New York, 1968.
3 "**Notes on Nonlinear Systems**" by J.K. Aggarwal, Van Nostrand, 1972.

Web Resources

1. https://www.edx.org/course/differential-equations-2x2-systems

2. https://www.studocu.com/en-gb/document/teesside-university/methods-for-non-linear-mathematics/lecture-notes-course-math1133-nonlinear-differential-equations/135452 3. https://ocw.mit.edu/courses/mathematics/18-03-differential-equations-spring-2010/video-lectures/lecture-31-non-linear-autonomous-systems/	
COURSE OUTCOMES	**K Level**
On the successful completion of the course , the students will be able to	
CO1: Understand the dynamics of basic population models	**K2**
CO2: Find approximate solutions of nonlinear equations using averaging and perturbation methods	**K3**
CO3: Master the concepts of stability in different perspectives	**K4**
CO4: Have an idea on qualitative properties of solutions of linear and nonlinear systems	**K2**
CO5: Improve their problem solving capabilities	**K3**

CO & PO Mappings:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	**3**	**3**	**3**	**1**	**1**	**1**
CO 2	**3**	**3**	**2**	**2**	**1**	**1**
CO 3	**3**	**3**	**3**	**1**	**1**	**-**
CO 4	**3**	**3**	**2**	**2**	**1**	**-**
CO 5	**3**	**3**	**2**	**2**	**2**	**1**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

UNIT	SUBJECT NAME	Hours	Pedagogy
I	The general phase plane – Some population models – Linear approximation at equilibrium points – Linear systems in matrix form.	18	**Chalk & Talk**
II	An energy balance method for limit cycles – Amplitude and frequency estimates – Slowly varying amplitudes; Nearly periodic solutions - Periodic solutions: Harmonic balance – Equivalent linear equation by harmonic balance – Accuracy of a period estimate.	18	**Chalk & Talk**
III	Outline of the direct method – Forced oscillations far from resonance Forced oscillations near resonance with weak excitation – Amplitude equation for undamped pendulum – Amplitude perturbation for the pendulum equation – Lindstedt's method- Forced oscillation of a self – excited equation – The Perturbation method and Fourier series.	18	**Chalk & Talk**
IV	Structure of solutions of the general linear system – Constant coefficient system – Periodic coefficients – Floquet theory – Wronskian.	18	**Chalk & Talk**
V	Poincare stability – Solutions, paths and norms – Liapunov stability-Stability of linear systems – Comparison theorem for the zero solutions of nearly-linear systems	18	**Chalk & Talk**

Course Designed by:

Dr. M. Saravanan, Assistant Professor **& Mrs. S. Ragavi,** Assistant Professor

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)								
Internal	Cos	K Level	Section A		Section B		Section C Either or Choice	Section D Open Choice
			MCQs		Short Answers			
			No. of. Questions	K - Level	No. of. Questions	K - Level		
CI AI	CO1	Upto K2	2	K1&K2	1	K1	2	1
	CO2	Upto K3	2	K1&K2	2	K2	2	1
CI AII	CO3	Upto K4	2	K1&K2	1	K2	2	1
	CO4	Upto K4	2	K1&K2	2	K2	2	1
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	2
		No. of Questions to be answered	4		3		2	1
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	10

Distribution of Marks with K Level CIA I & CIA II								
	K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2	2			4	8	20
	K2	2	4			6	12	
	K3			10	10	20	40	40
	K4			10	10	20	40	40
	Marks	4	6	20	20	50	100	100
CIA II	K1	2	2			4	8	20
	K2	2	4			6	12	
	K3			10	10	20	40	40
	K4			10	10	20	40	40
	Marks	4	6	20	20	50	100	100

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S.No	COs	K - Level	MCQs		Short Answers		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	Upto K2	2	K1&K2	1	K1	2(K2&K2)	1(K2)
2	CO2	Upto K3	2	K1&K2	1	K1	2(K3&K3)	1(K3)
3	CO3	Upto K4	2	K1&K2	1	K2	2(K3&K3)	1(K4)
4	CO4	Upto K4	2	K1&K2	1	K2	2(K4&K4)	1(K3)
5	CO5	Upto K3	2	K1&K2	1	K2	2(K2&K2)	1(K3)
No. of Questions to be Asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30
(Figures in parenthesis denotes, questions should be asked with the given K level)								

Distribution of Marks with K Level							
K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either/ or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5	4			9	7.5	17
K2	5	6			11	9.17	
K3			25	20	45	37.5	37
K4			25	30	55	45.83	46
Marks	10	10	50	50	120	100	100
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.							

Summative Examinations - Question Paper – Format

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q.No	**CO**	**K Level**	**Questions**
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K4	
19) b	CO4	K4	
20) a	CO5	K2	
20) b	CO5	K2	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q.No	**CO**	**K Level**	**Questions**
21	CO1	K2	
22	CO2	K3	
23	CO3	K4	
24	CO4	K2	
25	CO5	K3	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MATHEMATICS
(For those who joined in 2021-2022 and after)

Course Name	**STATISTICS**			
Course Code	**21PMTE33**	**L**	**P**	**C**
Category	**Elective**	6	-	6
Nature of course:	**EMPLOYBILITY**	**SKILL ORIENTED**	ENTREPRENURSHIP	

COURSE OBJECTIVES:

- To develop knowledge on random variables.
- To develop knowledge on various standard distributions.
- To introduce Sampling Theory.
- To familiarize the application through various statistical methods.
- To create statistical models for real life problems.

Unit: I		18

Set theory, Probability set function, Conditional probability and Independence , Random variables of the discrete type , Random Variables of the continuous type , Properties of the distribution function, Expectation of a Random variable, Some special expectations , Chebyshev's inequality.

Unit: II		18

Distributions of random variables, Conditional distributions and expectations , The correlation coefficient , Independent random variables, Extension to several random variables.

Unit: III		18

The Binomial and Related distributions, The Poisson distribution, The Gamma and Chi-square distribution, The Normal distribution, The Bivariate normal distribution.

Unit: IV		18

Sampling theory , Transformations of variables of the discrete type, Transformations of variables of the continuous type, The Beta , t, F distributions, Extensions of the change of variable technique, The moment generating function technique, Some Specific distributions - The distributions of $\bar{X}$ and $\frac{ns^2}{\sigma^2}$, Expectation of functions of Random Variables.

Unit: V		18

Convergence of distribution, Convergence of probability, Limiting moment generating functions , the Central limit theorem , Some theorems of limiting distributions.

	Total Lecture Hours	90

Books for Study

R.V. Hogg andA.T.Craig, **Introduction to Mathematical Statistics**, Fifth Edition , Pearson Education, New Delhi, 2005.

Unit I - Chapter 1 : Sections 1.1 to 1.10
Unit II - Chapter 2 : Sections 2.1 to 2.5

Unit III - Chapter 3 : Sections 3.1 to 3.5
Unit IV - Chapter 4 : Sections 4.1 to 4.9
Unit V - Chapter 5 : Sections 5.1 to 5.5

Books for References:

1. Irwin Miller, **Mathematical Statistics**, Pearson Publisher, 2004.
2. David Freeman, **Statistics**, Viva Book Publisher, 2010.
3. R.S.N.Pillai & Bagavathy ,**Statistics Theory and Practice**, S.Chand Publications, 7th Revised Edition ,2008.

Web Resources

1. **http://users.encs.concordia.ca/~doedel/courses/comp-233/slides.pdf**
2. **https://www.mrecacademics.com/DepartmentStudyMaterials/20210624-80B09-%20PROBABILITY%20AND%20STATISTICS.pdf**
3. **https://www.brainkart.com/subject/Probability-and-Statistics_395/**

COURSE OUTCOMES		**K Level**
On the successful completion of the course , the students will be able to		
CO1:	Select the concepts of Probability theory and Mathematical Statistics.	**K3**
CO2:	Apply properties of Random variables Moments, Characteristic function, Binomial distribution, Poisson distribution, Normal distribution, and Stochastic Convergence.	**K3**
CO3:	Solve today's complex world problems by applying the concepts obtained in the course	**K3**
CO4:	Analyse mean, variance, moments for various distributions using Characteristic function, Probability Generating function, One point distribution and Two point distribution	**K4**
CO5:	Derive various distributions and prove the theorems on Stochastic Convergence	**K4**

CO & PO Mappings:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	3	3	1	1	1
CO 2	3	3	2	2	1	-
CO 3	3	3	3	1	1	1
CO 4	3	3	2	2	1	-
CO 5	3	3	2	2	2	1

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

UNIT	SUBJECT NAME	Hours	Pedagogy
I	Set theory, Probability set function, Conditional probability and Independence , Random variables of the discrete type , Random Variables of the continuous type , Properties of the distribution function, Expectation of a Random variable, Some special expectations , Chebyshev's inequality.	18	**Chalk & Talk, PPT**
II	Distributions of random variables, Conditional distributions and expectations , The correlation coefficient , Independent random variables, Extension to several random variables.	18	**Chalk & Talk**
III	The Binomial and Related distributions, The Poisson distribution, The Gamma and Chi-square distribution, The Normal distribution, The Bivariate normal distribution.	18	**Chalk & Talk**
IV	Sampling theory , Transformations of variables of the discrete type, Transformations of variables of the continuous type, The Beta , t, F distributions, Extensions of the change of variable technique, The moment generating function technique, Some Specific distributions - The distributions of $\bar{X}$ and $\frac{ns^2}{\sigma^2}$, Expectation of functions of Random Variables.	18	**Chalk & Talk, PPT**
V	Convergence of distribution, Convergence of probability, Limiting moment generating functions , the Central limit theorem , Some theorems of limiting distributions.	18	**Chalk & Talk**

Course Designed by:

Dr. R. Bhavani, Assistant Professor **& Mrs. R. Sumathi,** Assistant Professor

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)								
Internal	Cos	K Level	Section A		Section B		Section C Either or Choice	Section D Open Choice
			MCQs		Short Answers			
			No. of. Questions	K - Level	No. of. Questions	K - Level		
CI AI	CO1	Upto K3	2	K1&K2	1	K1	2	1
	CO2	Upto K3	2	K1&K2	2	K2	2	1
CI AII	CO3	Upto K3	2	K1&K2	1	K2	2	1
	CO4	Upto K4	2	K1&K2	2	K2	2	1
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	2
		No. of Questions to be answered	4		3		2	1
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	10

Distribution of Marks with K Level CIA I & CIA II								
	K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2	2			4	8	20
	K2	2	4			6	12	
	K3			10	10	20	40	40
	K4			10	10	20	40	40
	Marks	4	6	20	20	50	100	100
CIA II	K1	2	2			4	8	20
	K2	2	4			6	12	
	K3			10	10	20	40	40
	K4			10	10	20	40	40
	Marks	4	6	20	20	50	100	100

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S.No	COs	K - Level	MCQs		Short Answers		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	**Upto K3**	**2**	**K1&K2**	**1**	**K1**	**2(K2&K2)**	**1(K3)**
2	CO2	**Upto K3**	**2**	**K1&K2**	**1**	**K1**	**2(K2&K2)**	**1(K3)**
3	CO3	**Upto K3**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K3)**
4	CO4	**Upto K4**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K4)**
5	CO5	**Upto K4**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K4)**
No. of Questions to be Asked			**10**		**5**		**10**	**5**
No. of Questions to be answered			**10**		**5**		**5**	**3**
Marks for each question			**1**		**2**		**5**	**10**
Total Marks for each section			**10**		**10**		**25**	**30**
(Figures in parenthesis denotes, questions should be asked with the given K level)								

Distribution of Marks with K Level							
K Level	**Section A (Multiple Choice Questions)**	**Section B (Short Answer Questions)**	**Section C (Either/ or Choice)**	**Section D (Open Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidated %**
K1	5	4			9	7.5	33
K2	5	6	20		31	25.8	
K3			30	30	60	50	50
K4				20	20	16.7	17
Marks	10	10	50	50	120	100	100
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.							

Summative Examinations - Question Paper – Format

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q.No	**CO**	**K Level**	**Questions**
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K2	
17) b	CO2	K2	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K3	
19) b	CO4	K3	
20) a	CO5	K3	
20) b	CO5	K3	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q.No	**CO**	**K Level**	**Questions**
21	CO1	K3	
22	CO2	K3	
23	CO3	K3	
24	CO4	K4	
25	CO5	K4	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MATHEMATICS
(For those who joined in 2021-2022 and after)

Course Name	**INTEGRAL EQUATIONS**			
Course Code	**21PMTE34**	**L**	**P**	**C**
Category	**Elective**	6	-	6
Nature of course:	**EMPLOYABILITY**	SKILL ORIENTED	ENTREPRENURSHIP	

COURSE OBJECTIVES:

- To familiarize the key concept of popular and useful transformations
- To solve ordinary differential equations with different forms of initial and boundary conditions.
- To understand the relationship between integral and differential equations.
- To familiarize Fredholm theory
- To apply integral equation in various transformations

Unit: I		18

Regularity conditions – Special kinds of Kernels – Eigen values and Eigen functions – Convolution Integral – The Inner or Scalar Product of Two Functions – Reduction to a System of Algebraic Equations – Fredholm Alternatives – An Approximate Method

Unit: II		18

Method of Successive Approximations – Iterative Scheme – Examples – Volterra Integral Equation – Examples – Some Results about the Resolvent Kernel.

Unit: III		18

Classical Fredholm Theory – The Method of Solution of Fredholm – Fredholm's first theorem – examples – Fredholm's second theorem – Fredholm's third theorem.

Unit: IV		18

Applications of ordinary differential equations – initial value problems – boundary value problems – examples – Dirac delta function – Green's function approach – examples.

Unit: V		18

Integral transformation methods – introduction – Fourier transform – Laplace transform – application to Volterra integral equations with Convolution type kernels – examples.

	Total Lecture Hours	90

Books for Study:

Linear Integral Equations: Theory & Technique (Second Ed.) by Ram P. Kanwal, Springer Science& Business Media, 2013.

Unit 1: Chapter 1 full, chapter 2.1 to 2.5
Unit 2: Chapter 3 full
Unit 3: Chapter 4 full
Unit 4: Chapter 5.1 to 5.6
Unit 5: Chapter 9.1 to 9.5.

Books for References:

1) Raishinghania M.D. **Integral equation & Boundary value problem**, S. Chand publishing, 2007.
2) Jerri, A. **Introduction to integral equations with applications**, John Wiley & Sons, 1999.
3) Hildebrand, F.B. **Method of applied Mathematics**, Courier corporation, 2012

Web Resources

1.https://nptel.ac.in/courses/111/107/111107103/
2. https://www.youtube.com/watch?v=WPlBrzjI1KI&list=PLq-Gm0yRYwTiPq4ypE6cP-1-UqSHO5pia&index=3

3. http://www.mcs.st-and.ac.uk/~rac/MT5802/Integral%20equations.pdf		
COURSE OUTCOMES		**K Level**
On the successful completion of the course , the students will be able to		
CO1:	Explain various types of kernels	**K4**
CO2:	Solve linear Volterra and Fredholm integral equations using appropriate methods	**K3**
CO3:	Formulate complex problems of ordinary and partial differential equations with techniques of Integral transform	**K4**
CO4:	Apply integrals equation in transforms	**K3**
CO5:	Determine a wide range of differential and integral equations by Fourier transforms	**K4**

CO & PO Mapping:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	**3**	**3**	**3**	**1**	**1**	**1**
CO 2	**3**	**3**	**2**	**2**	**1**	**-**
CO 3	**3**	**3**	**3**	**1**	**1**	**1**
CO 4	**3**	**3**	**2**	**2**	**1**	**-**
CO 5	**3**	**3**	**2**	**2**	**2**	**1**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

UNIT	SUBJECT NAME	Hours	Pedagogy
I	Regularity conditions – Special kinds of Kernels – Eigen values and Eigen functions – convolution integral – the inner or scalar product of two functions – Reduction to a system of algebraic equations – Fredholm alternatives – An approximate method	18	**Chalk & Talk**
II	Method of Successive approximations – iterative scheme – examples – Volterra integral equation – examples – Some results about the resolvent Kernel.	18	**Chalk & Talk**
III	Classical Fredholm theory – the method of solution of Fredholm – Fredholm's first theorem – examples – Fredholm's second theorem – Fredholm's third theorem.	18	**Chalk & Talk**
IV	Applications of ordinary differential equations – initial value problems – boundary value problems – examples – Dirac delta function – Green's function approach – examples.	18	**Chalk & Talk**
V	Integral transformation methods – introduction – Fourier transform – Laplace transform – application to Volterra integral equations with Convolution type kernels – examples.	18	**Chalk & Talk**

Course Designed by:

Dr. M. Saravanan, Assistant Professor **& Dr. S. Andal,** Assistant Professor

Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)								
Internal	Cos	K Level	Section A		Section B		Section C Either or Choice	Section D Open Choice
			MCQs		Short Answers			
			No. of. Questions	K - Level	No. of. Questions	K - Level		
CI AI	CO1	Upto K4	2	K1&K2	1	K1	2	1
	CO2	Upto K3	2	K1&K2	2	K2	2	1
CI AII	CO3	Upto K4	2	K1&K2	1	K2	2	1
	CO4	Upto K3	2	K1&K2	2	K2	2	1
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	2
		No. of Questions to be answered	4		3		2	1
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	10

Distribution of Marks with K Level CIA I & CIA II								
	K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2	2			4	8	20
	K2	2	4			6	12	
	K3			10	10	20	40	40
	K4			10	10	20	40	40
	Marks	4	6	20	20	50	100	100
CIA II	K1	2	2			4	8	20
	K2	2	4			6	12	
	K3			10	10	20	40	40
	K4			10	10	20	40	40
	Marks	4	6	20	20	50	100	100

K1- Remembering and recalling facts with specific answers
K2- Basic understanding of facts and stating main ideas with general answers
K3- Application oriented- Solving Problems
K4- Examining, analyzing, presentation and make inferences with evidences
CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S.No	COs	K - Level	MCQs		Short Answers		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	**Upto K4**	**2**	**K1&K2**	**1**	**K1**	**2(K2&K2)**	**1(K4)**
2	CO2	**Upto K3**	**2**	**K1&K2**	**1**	**K1**	**2(K3&K3)**	**1(K3)**
3	CO3	**Upto K4**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K4)**
4	CO4	**Upto K3**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K3)**
5	CO5	**Upto K4**	**2**	**K1&K2**	**1**	**K2**	**2(K2&K2)**	**1(K4)**
No. of Questions to be Asked			**10**		**5**		**10**	**5**
No. of Questions to be answered			**10**		**5**		**5**	**3**
Marks for each question			**1**		**2**		**5**	**10**
Total Marks for each section			**10**		**10**		**25**	**30**
(Figures in parenthesis denotes, questions should be asked with the given K level)								

Distribution of Marks with K Level							
K Level	**Section A (Multiple Choice Questions)**	**Section B (Short Answer Questions)**	**Section C (Either/ or Choice)**	**Section D (Open Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidated %**
K1	5	4			9	7.5	33
K2	5	6	20		31	25.8	
K3			30	20	50	41.7	42
K4				30	30	25	25
Marks	10	10	50	50	120	100	100
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.							

Summative Examinations - Question Paper – Format

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q.No	**CO**	**K Level**	**Questions**
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K3	
19) b	CO4	K3	
20) a	CO5	K2	
20) b	CO5	K2	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q.No	**CO**	**K Level**	**Questions**
21	CO1	K4	
22	CO2	K3	
23	CO3	K4	
24	CO4	K3	
25	CO5	K4	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MATHEMATICS
(For those who joined in 2021-2022 and after)

Course Name	**CRYPTOGRAPHY**				
Course Code	**21PMTE35**		**L**	**P**	**C**
Category	**Elective**		6	-	6
Nature of course:	**EMPLOYABILITY**	**SKILL ORIENTED**	ENTREPRENEURSHIP		

COURSE OBJECTIVES:

To learn about Mathematics of Crypotogrphy
To get the Key ciphers
To understand the need for the modern stream ciphers
To know about Data Encryption Standard
To know about Advanced Encryption Standards

Unit: I		18

Security goals–Cryptographic attacks –Mathematics of Cryptography: Integer arithmetic–Modular arithmetic–Matrices–Linear congruence.

Unit: II		18

Traditional symmetric–Key ciphers: Introduction–Substitution ciphers-Transposition ciphers– Stream and block ciphers

Unit: III		18

Mathematics of symmetric – Key cryptography: Algebraic structures –GF(2*n*)Fields .Introduction to modern symmetric – Key ciphers: Modern block ciphers – Modern stream ciphers

Unit: IV		18

Data Encryption Standard (DES): Introduction – DES structure – DES analysis –Security of DES – Multiple DES (Conventional Encryption Algorithms) – Examples of block ciphers influenced by DES

Unit: V		18

Advanced Encryption Standard (AES) Transformations–Key expansion– The AES Ciphers– Examples– Analysis of AES.

	Total Lecture Hours	90

Books for Study:

Behrouz Forouzan A and Debdeep Mukhopadhyay, ***"Cryptography and Network Security***" 2013 , 2nd Edition, McGraw Hill Education (India) Private Limited, New Delhi.
UnitI: Chapter1-Section-1.1-1.4, Chapter2.,Section-2.1-2.4
UnitII: Chapter-3-Section-3.1-3.4
UnitIII: Chapter4-Section-4.1-4.2,Chapter5,Section-5.1-5.2
UnitIV: Chapter6-Section-6.1-6.6
UnitV: Chapter7-Section-7.1-7.6

Books for References:

1.Atul Kahate,2014, **Cryptography and Network Security,** Third Edition, McGraw Hill Education(India) Private Limited, New Delhi.
2.Bruce Schneier,2012, **Applied Cryptography: Protocols, Algorithms and Source code in C**, 2nd Edition,Wiley India , New Delhi.
3.Stallings,2013,**Cryptography and Network Security,: Principles and Practice,** Sixth Edition, Pearson Education,
New Delhi, India.

Web Resources

https://cseweb.ucsd.edu/~mihir/papers/gb.pdf
https://www.researchgate.net/publication/2859322_Notes_on_Cryptography

http://www.cse.iitd.ac.in/~shweta/notes/Lec1.pdf		
COURSE OUTCOMES		**K Level**
On the successful completion of the course , the students will be able to		
CO1	Demonstrate the understanding the fundamentals of cryptography	**K2**
CO2	Demonstrate standard cryptographic Algorithms used to analyze confidentiality, integrity and authenticity.	**K2**
CO3	List the security issues in the network, key distribution and management schemes	**K4**
CO4	Explain in detail about Data encryption standard(DES)Structure	**K4**
CO5	Analyze the Advanced Encryption standard(AES)	**K4**

CO & PO Mappings:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	**3**	**3**	**3**	**1**	**1**	**1**
CO 2	**3**	**3**	**2**	**2**	**1**	**-**
CO 3	**3**	**3**	**3**	**1**	**1**	**1**
CO 4	**3**	**3**	**2**	**2**	**1**	**-**
CO 5	**3**	**3**	**2**	**2**	**2**	**1**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

UNIT	SUBJECT NAME	Hours	Pedagogy
I	Security goals–Cryptographic attacks–Services and mechanism Techniques. Mathematics of Cryptography: Integer arithmetic–Modular arithmetic–Matrices–Linear congruence.	18	**Chalk & Talk**
II	Traditional symmetric–Key ciphers: Introduction Substitution ciphers-Transposition ciphers– Stream and block ciphers	18	**Chalk & Talk**
III	Mathematics of symmetric – Key cryptography: Algebraic structures – GF(2*n*)Fields Introduction to modern symmetric – Key ciphers: Modern block ciphers – Modern stream ciphers	18	**Chalk & Talk**
IV	Data Encryption Standard (DES): DES structure – DES analysis –Security of DES – Multiple DES (Conventional Encryption Algorithms) – Examples of block ciphers influenced by DES	18	**Chalk & Talk**
V	Advanced Encryption Standard(AES) Transformations– Key expansion– The AES Ciphers– Examples– Analysis of AES.	18	**Chalk & Talk**

Course Designed by:

Dr. A. Arivu Chelvam, Assistant Professor **& Dr. V. Ramachandran** Assistant Professor

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)								
Internal	**Cos**	**K Level**	**Section A**		**Section B**		**Section C Either or Choice**	**Section D Open Choice**
			MCQs		**Short Answers**			
			No. of. Questions	**K - Level**	**No. of. Questions**	**K - Level**		
CI AI	**CO1**	**Upto K2**	**2**	**K1&K2**	**1**	**K1**	**2**	**1**
	CO2	**Upto K2**	**2**	**K1&K2**	**2**	**K2**	**2**	**1**
CI AII	**CO3**	**Upto K4**	**2**	**K1&K2**	**1**	**K2**	**2**	**1**
	CO4	**Upto K4**	**2**	**K1&K2**	**2**	**K2**	**2**	**1**
Question Pattern CIA I & II		No. of Questions to be asked	**4**		**3**		**4**	**2**
		No. of Questions to be answered	**4**		**3**		**2**	**1**
		Marks for each question	**1**		**2**		**5**	**10**
		Total Marks for each section	**4**		**6**		**10**	**10**

Distribution of Marks with K Level CIA I & CIA II								
	K Level	**Section A (Multiple Choice Questions)**	**Section B (Short Answer Questions)**	**Section C (Either / Or Choice)**	**Section D (Open Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidate of %**
CIA I	**K1**	2	2			4	**8**	**20**
	K2	2	4			6	**12**	
	K3			10	10	20	**40**	**40**
	K4			10	10	20	**40**	**40**
	Marks	**4**	**6**	**20**	**20**	**50**	**100**	**100**
CIA II	**K1**	2	2			4	**8**	**20**
	K2	2	4			6	**12**	
	K3			10	10	20	**40**	**40**
	K4			10	10	20	**40**	**40**
	Marks	**4**	**6**	**20**	**20**	**50**	**100**	**100**

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S.No	COs	K - Level	MCQs		Short Answers		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	Upto K2	2	K1&K2	1	K1	2(K2&K2)	1(K2)
2	CO2	Upto K2	2	K1&K2	1	K1	2(K2&K2)	1(K2)
3	CO3	Upto K4	2	K1&K2	1	K2	2(K3&K3)	1(K4)
4	CO4	Upto K4	2	K1&K2	1	K2	2(K3&K3)	1(K4)
5	CO5	Upto K4	2	K1&K2	1	K2	2(K3&K3)	1(K4)
No. of Questions to be Asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30
(Figures in parenthesis denotes, questions should be asked with the given K level)								

Distribution of Marks with K Level							
K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either/ or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5	4			9	7.5	17
K2	5	6			11	9.17	
K3			25	20	45	37.5	37
K4			25	30	55	45.83	46
Marks	10	10	50	50	120	100	100
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.							

Summative Examinations - Question Paper – Format

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q.No	**CO**	**K Level**	**Questions**
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K2	
17) b	CO2	K2	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K3	
19) b	CO4	K3	
20) a	CO5	K3	
20) b	CO5	K3	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q.No	**CO**	**K Level**	**Questions**
21	CO1	K2	
22	CO2	K2	
23	CO3	K4	
24	CO4	K4	
25	CO5	K4	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MATHEMATICS
(For those who joined in 2021-2022 and after)

Course Name	**MATHEMATICAL MODELLING**			
Course Code	**21PMTE36**	**L**	**P**	**C**
Category	**Elective**	6	-	6
Nature of course:	**EMPLOYBILITY**	**SKILL ORIENTED**	ENTREPRENURSHIP	

COURSE OBJECTIVES:

- To understand the need for mathematical modelling
- To know the modelling in First order Ordinary Differential Equations
- To apply the modelling in Second order Ordinary Differential Equations
- To know Models for Blood Flows using Fluid Dynamics
- To apply Models for Optimal Control of Water Pollution

Unit: I	18

Mathematical Modeling: Need, Techniques, Classifications and Simple Illustrations: Simple Situations Requiring Mathematical Modeling - The Technique of Mathematical Modeling - Classification of Mathematical Models - Some Characteristics of Mathematical model
Mathematical Modeling Through Ordinary Differential Equations of First Order Mathematical Modeling Through Differential Equations - Linear Growth and Decay Models - Non-Linear Growth and Decay Models - Compartment Models

Unit: II	18

Mathematical Modeling Through Systems of Ordinary Differential Equations of First Order Mathematical Modeling in Population Dynamics - Mathematical Modeling of Epidemics Through Systems of Ordinary Differential Equations of First Order - Compartment Models Through Systems of Ordinary Differential Equations – Mathematical Modeling in Economics Through Systems of Ordinary Differential Equations of First Order

Unit: III	18

Mathematical Modeling Through Systems of Ordinary Differential Equations of First Order Mathematical Models in Medicine, Arms Race, Battles and International Trade in Terms of Systems of Ordinary Differential Equations
Mathematical Modeling Through Ordinary Differential Equations of Second Order Mathematical Modeling of Planetary Motions - Mathematical Modeling of Circular Motion and Motion of Satellites

Unit: IV	18

. Some Basic Concepts of Fluid Dynamics - Basic Concepts about Blood, Cardiovascular System and Blood Flows - Steady Non-Newtonian Fluid Flows in Circular Tubes - Basic Equations for Fluid Flow - Flow of Power-law Fluid in Circular Tube - Flow of Herschel-Bulkley Fluid in Circular Tube - Flow of Casson Fluid in Circular Tube – Flow of Immiscible Power-law Fluids in a Circular Tube - Blood Flow through Artery with Mild Stenosis

Unit: V	18

Water Quality Management Models - Water Quality Management Model 1 – Water Quality Management Model 2 - Water Quality Management Model 3 - Water Quality Management Model 4 - Other Models for Water Quality Management - Other Optimal Pollution Control Models - Optimal Air Pollution Control Models - Control Models for Solid Waste Disposal Noise Pollution Control Model

	Total Lecture Hours	90

Books for Study:

1. J. N. Kapur - Mathematical modeling, New Age International (P) Limited, Publishers,New Delhi, First Edition

Unit I - Chapter 1

Unit II – Chapter 2

Unit III – Chapter 2

2. J. N. Kapur - Mathematical Models in Biology &Medicine Affiliated East-West Press Private Limited, New Delhi.

Unit IV – Chapter 3

Unit V – Chapter 4

Books for References:

1.. D.N. Burghes - Modeling through Differential Equation, Ellis Horwood and JohnWiley.

2. C. Dyson and E. Levery, Principle of Mathematical Modeling, Academic Press NewYork.

3. Giordano, Weir, Fox, A First Course in Mathematical Modeling 2nd Edition, Brooks/Cole Publishing Company, 1997.

4. B. Barnes, G. R. Fulford, Mathematical Modeling with Case Studies, A DifferentialEquation Approach using Maple and Matlab, 2nd Ed., Taylor and Francis group,London and New York,

Web Resources

1.https://www.mat.univie.ac.at/~neum/model.html

2. https://nptel.ac.in/courses/111/107/1111071

3. https://www.frontiersin.org/articles/10.3389/fgene.2015.00354/full

COURSE OUTCOMES		**K Level**
On the successful completion of the course , the students will be able to		
CO1:	Use differential equations in solving mathematical models.	**K3**
CO2:	Analyze the Occurrence, classification and characteristics of Mathematical Models.	**K4**
CO3:	Apply problem solving techniques in Mathematical Modeling to bring solutions to various real life situations.	**K3**
CO4:	Examine the principles governing the motion of satellites through notions of Mathematical Modeling and interpret the techniques in Mathematical Models to analyse the motion of fluids.	**K4**
CO5:	Explain suitable models for population dynamics, medicine and reducing various forms of Pollution	**K3**

CO & PO Mappings:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	**3**	**3**	**3**	**1**	**1**	**1**
CO 2	**3**	**3**	**2**	**2**	**1**	**-**
CO 3	**3**	**3**	**3**	**1**	**1**	**1**
CO 4	**3**	**3**	**2**	**2**	**1**	**-**
CO 5	**3**	**3**	**2**	**2**	**2**	**1**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

UNIT	SUBJECT NAME	Hours	Pedagogy
I	Mathematical Modeling: Need, Techniques, Classifications and Simple Illustrations: Simple Situations Requiring Mathematical Modeling - The Technique of Mathematical Modeling - Classification of Mathematical Models - Some Characteristics of Mathematical model Mathematical Modeling Through Ordinary Differential Equations of First Order Mathematical Modeling Through Differential Equations - Linear Growth and Decay Models - Non-Linear Growth and Decay Models - Compartment Models	18	**Chalk & Talk**
II	Mathematical Modeling Through Systems of Ordinary Differential Equations of First Order Mathematical Modeling in Population Dynamics - Mathematical Modeling of Epidemics Through Systems of Ordinary Differential Equations of First Order - Compartment Models Through Systems of Ordinary Differential Equations – Mathematical Modeling in Economics Through Systems of Ordinary Differential Equations of First Order	18	**Chalk & Talk**
III	Mathematical Modeling Through Systems of Ordinary Differential Equations of First Order Mathematical Models in Medicine, Arms Race, Battles and International Trade in Terms of Systems of Ordinary Differential Equations Mathematical Modeling Through Ordinary Differential Equations of Second Order Mathematical Modeling of Planetary Motions - Mathematical Modeling of Circular Motion and Motion of Satellites	18	**Chalk & Talk**
IV	Models for Blood Flows Some Basic Concepts of Fluid Dynamics - Basic Concepts about Blood,Cardiovascular System and Blood Flows - Steady Non-Newtonian Fluid Flows in Circular Tubes - Basic Equations for Fluid Flow - Flow of Power-law Fluid in Circular Tube - Flow ofHerschel-Bulkley Fluid in Circular Tube - Flow of Casson Fluid in Circular Tube – Flow of Immiscible Power-law Fluids in a Circular Tube - Blood Flow through Artery with Mild Stenosis	18	**Chalk & Talk**
V	Models for Optimal Control of Water Pollution Water Quality Management Models - Water Quality Management Model 1 – Water Quality Management Model 2 - Water Quality Management Model 3 - Water Quality Management Model 4 - Other Models for Water Quality Management - Other Optimal Pollution Control Models - Optimal Air Pollution Control Models - Control Models for Solid Waste Disposal Noise Pollution Control Model	18	**Chalk & Talk**

Course Designed by: Dr. V. Ramachandran Assistant Professor &
Dr. A. Hamari Choudhi, Head & Associate Professor

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)								
Internal	Cos	K Level	Section A		Section B		Section C Either or Choice	Section D Open Choice
			MCQs		Short Answers			
			No. of. Questions	K - Level	No. of. Questions	K - Level		
CI AI	CO1	Upto K3	2	K1&K2	1	K1	2	1
	CO2	Upto K4	2	K1&K2	2	K2	2	1
CI AII	CO3	Upto K3	2	K1&K2	1	K2	2	1
	CO4	Upto K4	2	K1&K2	2	K2	2	1
Question Pattern CIA I & II	No. of Questions to be asked		4		3		4	2
	No. of Questions to be answered		4		3		2	1
	Marks for each question		1		2		5	10
	Total Marks for each section		4		6		10	10

Distribution of Marks with K Level CIA I & CIA II								
	K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2	2			4	8	20
	K2	2	4			6	12	
	K3			10	10	20	40	40
	K4			10	10	20	40	40
	Marks	4	6	20	20	50	100	100
CIA II	K1	2	2			4	8	20
	K2	2	4			6	12	
	K3			10	10	20	40	40
	K4			10	10	20	40	40
	Marks	4	6	20	20	50	100	100

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

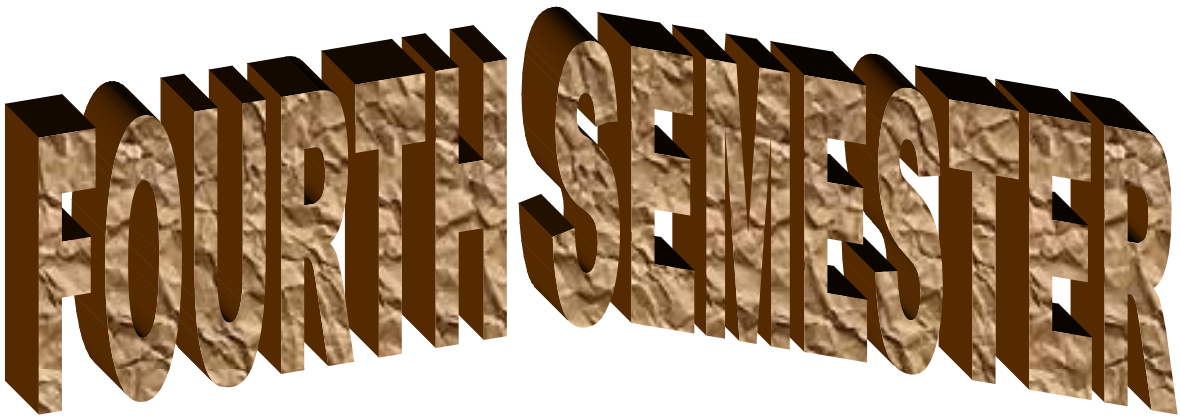
CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S.No	COs	K - Level	MCQs		Short Answers		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	**Upto K3**	**2**	**K1&K2**	**1**	**K1**	**2(K2&K2)**	**1(K3)**
2	CO2	**Upto K4**	**2**	**K1&K2**	**1**	**K1**	**2(K3&K3)**	**1(K4)**
3	CO3	**Upto K3**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K3)**
4	CO4	**Upto K4**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K4)**
5	CO5	**Upto K3**	**2**	**K1&K2**	**1**	**K2**	**2(K2&K2)**	**1(K3)**
No. of Questions to be Asked			**10**		**5**		**10**	**5**
No. of Questions to be answered			**10**		**5**		**5**	**3**
Marks for each question			**1**		**2**		**5**	**10**
Total Marks for each section			**10**		**10**		**25**	**30**
(Figures in parenthesis denotes, questions should be asked with the given K level)								

Distribution of Marks with K Level							
K Level	**Section A (Multiple Choice Questions)**	**Section B (Short Answer Questions)**	**Section C (Either/ or Choice)**	**Section D (Open Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidated %**
K1	5	4			9	7.5	33
K2	5	6	20		31	25.8	
K3			30	30	30	25	25
K4				20	20	16.7	17
Marks	10	10	50	50	120	100	100
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.							

Summative Examinations - Question Paper – Format

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q.No	**CO**	**K Level**	**Questions**
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K3	
19) b	CO4	K3	
20) a	CO5	K2	
20) b	CO5	K2	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q.No	**CO**	**K Level**	**Questions**
21	CO1	K3	
22	CO2	K4	
23	CO3	K3	
24	CO4	K4	
25	CO5	K3	


FOURTH SEMESTER

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MATHEMATICS
(For those who joined in 2021-2022 and after)

Course Name	**MEASURE THEORY AND INTEGRATION**			
Course Code	**21PMTC41**	**L**	**P**	**C**
Category	**Core**	6	-	4
Nature of course:	**EMPLOYABILITY**	SKILL ORIENTED	ENTREPRENURSHIP	

COURSE OBJECTIVES:

- To introduce the concepts of measures.
- To explain measurable sets and functions.
- To learn Riemann and Lebesgue integration.
- To analyse the four derivatives and functions
- To use Lebesgue theorem in differentiation and integration.

Unit: I		18
Measure on the Real line – Lebesgue Outer Measure – Measurable sets-Regularity.		
Unit: II		18
Measurable Functions – Borel and Lebesgue Measurability.		
Unit: III		18
Integration of Non-Negative Functions – The General Integral – Integration of Series.		
Unit: IV		18
Riemann and Lebesgue integrals – The Four Derivatives – Continuous Non – Differentiable Functions.		
Unit: V		18
Functions of Bounded Variations – Lebesgue Differentiation Theorem – Differentiation and Integration – The Lebesgue Set		
	Total Lecture Hours	90

Books for Study:

De Barra. G, **Measure Theory and Integration**, New Age International Pvt Ltd, Chennai, Reprint,2010.

Unit I – Chapter 2 Sections 2.1 to2.3
Unit II – Chapter 2 Sections 2.4 &2.5
Unit III – Chapter 3 Sections 3.1 to3.3
Unit IV – Chapter 3 Section3.4 &
Chapter4 Sections 4.1 &4.2
Unit V – Chapter 4 Sections 4.3 to 4.6

Books for References:

1. Royden, H.L., **Real Analysis**, Pretice-Hall of Indian Pvt. Ltd, 2008, NewDelhi.
2. Jain, P.K and Gupta. P.K, **Lebesgue Measure and Integration**, New Age International Pvt .Ltd, Reprint 2010,Chennai**.**
3. Malik. A. K &S.K.Gupta, **"Measure Theory and Intregration"**, I.K International Publishing House Pvt , Ltd, Reprint 2017, New Delhi.

Web Resources

1. http://math.ucsd.edu/~driver/240-00-01/Lecture_Notes/measurep.pdf

2. https://nptel.ac.in/courses/111/101/111101005/ 3. https://nptel.ac.in/courses/111/101/111101100/# 4. https://www.youtube.com/playlist?list=PLo4jXE-LdDTQq8ZyA8F8reSQHej3F6RFX		
COURSE OUTCOMES		**K Level**
On the successful completion of the course , the students will be able to		
CO1:	Explain the concepts of Lebesgue integral.	**K4**
CO2:	Analyze the geometrical meaning of measurable functions and integrations.	**K4**
CO3:	Apply the techniques of measure theory to evaluate integrals	**K3**
CO4:	Compare Riemann with other integrals.	**K4**
CO5:	Identify four derivatives and Lebesgue differentiation theorem.	**K3**

CO & PO Mapping:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	**3**	**1**	**3**	**3**	**2**	**-**
CO 2	**3**	**1**	**2**	**2**	**2**	**1**
CO 3	**3**	**1**	**3**	**3**	**2**	**1**
CO 4	**3**	**1**	**3**	**3**	**2**	**-**
CO 5	**3**	**1**	**3**	**2**	**2**	**1**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

UNIT	SUBJECT NAME	Hours	Pedagogy
I	Measure on the Real line – Lebesgue Outer Measure – Measurable sets-Regularity.	18	**Chalk & Talk, PPT**
II	Measurable functions – Borel and Lebesgue Measurability.	18	**Chalk & Talk**
III	Integration of non-negative functions – The general integral – Integration of series.	18	**Chalk & Talk, PPT**
IV	Riemann and Lebesgue integrals – The four derivatives – Continuous non – differentiable functions.	18	**Chalk & Talk**
V	Functions of bounded variations – Lebesgue differentiation theorem – Differentiation and Integration – The Lebesgue set	18	**Chalk & Talk**

Course Designed by:

Dr. R. Bhavani Assistant Professor & **Dr. S. Andal,** Assistant Professor

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)								
Internal	Cos	K Level	Section A MCQs		Section B Short Answers		Section C Either or Choice	Section D Open Choice
			No. of. Questions	K - Level	No. of. Questions	K - Level		
CI AI	CO1	Upto K4	2	K1&K2	1	K1	2	1
	CO2	Upto K4	2	K1&K2	2	K2	2	1
CI AII	CO3	Upto K3	2	K1&K2	1	K2	2	1
	CO4	Upto K4	2	K1&K2	2	K2	2	1
Question Pattern CIA I & II	No. of Questions to be asked		4		3		4	2
	No. of Questions to be answered		4		3		2	1
	Marks for each question		1		2		5	10
	Total Marks for each section		4		6		10	10

Distribution of Marks with K Level CIA I & CIA II								
	K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2	2			4	8	20
	K2	2	4			6	12	
	K3			10	10	20	40	40
	K4			10	10	20	40	40
	Marks	4	6	20	20	50	100	100
CIA II	K1	2	2			4	8	20
	K2	2	4			6	12	
	K3			10	10	20	40	40
	K4			10	10	20	40	40
	Marks	4	6	20	20	50	100	100

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S.No	COs	K - Level	MCQs		Short Answers		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	Upto K4	2	K1&K2	1	K1	2(K3&K3)	1(K4)
2	CO2	Upto K4	2	K1&K2	1	K1	2(K3&K3)	1(K4)
3	CO3	Upto K3	2	K1&K2	1	K2	2(K2&K2)	1(K3)
4	CO4	Upto K4	2	K1&K2	1	K2	2(K3&K3)	1(K4)
5	CO5	Upto K3	2	K1&K2	1	K2	2(K2&K2)	1(K3)
No. of Questions to be Asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30
(Figures in parenthesis denotes, questions should be asked with the given K level)								

Distribution of Marks with K Level							
K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either/ or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5	4			9	7.5	33
K2	5	6	20		31	25.8	
K3			30	20	50	41.7	42
K4				30	30	25	25
Marks	10	10	50	50	120	100	100
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.							

Summative Examinations - Question Paper – Format

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q.No	**CO**	**K Level**	**Questions**
16) a	CO1	K3	
16) b	CO1	K3	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K2	
18) b	CO3	K2	
19) a	CO4	K3	
19) b	CO4	K3	
20) a	CO5	K2	
20) b	CO5	K2	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q.No	**CO**	**K Level**	**Questions**
21	CO1	K4	
22	CO2	K4	
23	CO3	K3	
24	CO4	K4	
25	CO5	K3	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MATHEMATICS
(For those who joined in 2021-2022 and after)

Course Name	**FUNCTIONAL ANALYSIS**			
Course Code	**21PMTC42**	**L**	**P**	**C**
Category	Core	6	-	4
Nature of course:	**EMPLOYABILITY**	SKILL ORIENTED	ENTREPRENURSHIP	

COURSE OBJECTIVES:

- To develop the skills in analyzing the basic structure of Normed spaces.
- To use some special classes of functions.
- To explain various types of operators.
- To understand Banach and Hilbert spaces.
- To learn various standard theorems on functional analysis.

Unit: I		18

Normed Spaces, Banach Spaces – Further properties of normed spaces – finite dimensional normed spaces and Subspaces - Compactness and Finite Dimension - Linear operators

Unit: II		18

Bounded and Continuous Linear Operators-Linear Functionals – Linear Operators and Functional on Finite Dimensional Spaces –Normed Spaces of Operators and Dual Spaces - Inner Product Space, Hilbert Space - Further Properties of Inner Product Spaces

Unit: III		18

Orthogonal Complements and Direct Sums – Orthonormal Sets and Sequences –Series Related to Orthonormal Sets and Sequences – Total Orthonormal Sets and Sequences- Representation of Functional on Hilbert Spaces.

Unit: IV		18

Hilbert Adjoint Operator - Self Adjoint Operators, Unitary and Normal Operators - Zorn's Lemma - Hahn-Banach Theorem- Hahn-Banach Theorem for Complex Vector Spaces and Normed Spaces - Bounded Linear Functional on C[A, B] and Its Applications.

Unit: V		18

Adjoint Operator - Reflexive Spaces – Uniform Boundedness Theorem - Strong and Weak Convergence – Convergence of Sequences of Operators and Functional – Open Mapping Theorem - Closed Graph Theorem.

	Total Lecture Hours	90

Books for Study:

Introductory Functional Analysis with Applications by Erwin Kreyszig , John Wiley & Sons Publication (2006).

Unit I- Chapter 2:Sections 2.2-2.6
Unit II - Chapter 2: Section 2.7 -2.10
Chapter 3: Sections 3.1 - 3.2
Unit III - Chapter 3: Sections 3.3 - 3.6 &3.8
Unit IV- Chapter 3: Section 3.9 -3.10
Chapter 4: Sections 4.1 -4.4
Unit V - Chapter 4: Sections 4.5 - 4.9 & 4.12-4.13

Books for References:

1. Limaye. B.V**, Functional Analysis**, New age International PVT. Ltd, 2007, NewDelhi.
2. PawanK.Jain & OM.P.Ahuja, **Functional Analysis**, New Age International (P) Limited, NewDelhi.
3. Thamban Nair. M, **"Functional Analysis- A First course,** PHI Learning Private Limited, 2002, NewDelhi.

Web Resources

1. **https://people.math.ethz.ch/~salamon/PREPRINTS/funcana.pdf**
2. **https://nptel.ac.in/courses/111/106/111106147/https://www.youtube.com/watch?v=QzcazcGZUFQ&list=PLmx4utxjUQD4xJkiHY4pp720LyeCZyEKW**
3. **https://ocw.mit.edu/courses/mathematics/18-102-introduction-to-functional-analysis-spring-2009/lecture-notes/**

COURSE OUTCOMES		**K Level**
On the successful completion of the course , the students will be able to		
CO1:	Explain the concepts of Normed Spaces, Banach Spaces, Compactness and Dimensions	**K4**
CO2:	List the operators and its properties.	**K4**
CO3:	Analyze the Orthogonal complements, ortho-normal sets and sequences	**K4**
CO4:	Make use of the bounded linear functional, various operators and Hahn-Banach Theorem	**K3**
CO5:	Analyze Uniform boundedness, open mapping, closed graph theorem, Strong and weak convergence	**K4**

CO & PO Mappings:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	**3**	**2**	**2**	**3**	**2**	**2**
CO 2	**3**	**2**	**2**	**3**	**2**	**2**
CO 3	**2**	**2**	**2**	**2**	**1**	**1**
CO 4	**2**	**2**	**2**	**3**	**1**	**1**
CO 5	**3**	**2**	**2**	**3**	**2**	**1**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

UNIT	SUBJECT NAME	Hours	Pedagogy
I	Normed Spaces, Banach Spaces – Further properties of no med spaces – finite dimensional normed spaces and Subspaces - Compactness and Finite Dimension - Linear operators	18	**Chalk & Talk**
II	Bounded and Continuous linear operators-Linear functionals – linear operators and functional on finite dimensional spaces –normed spaces of operators and dual spaces - Inner product space, Hilbert space - Further properties of inner product spaces	18	**Chalk & Talk, PPT**
III	Orthogonal complements and direct sums – Orthonormal sets and sequences –series related to orthonormal sets and sequences – Total orthonormal sets and sequences- representation of functionals on Hilbert spaces.	18	**Chalk & Talk**
IV	Hilbert Adjoint operator - Self adjoint operators, unitary and normal operators - Zorn's Lemma - Hahn-Banach Theorem- Hahn-Banach theorem for complex vector spaces and normed spaces - Bounded Linear Functional on C[a, b] and its Applications.	18	**Chalk & Talk, PPT**
V	Adjoint operator - Reflexive spaces – Uniform boundedness theorem - Strong and weak convergence – Convergence of sequences of operators and functional – Open mapping theorem - Closed graph theorem.	18	**Chalk & Talk**

Course Designed by:

Dr. V. Ramachandran, Assistant Professor & **Dr. A. Hamari Choudhi,** Head & Associate Professor

Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)								
Internal	Cos	K Level	Section A MCQs		Section B Short Answers		Section C Either or Choice	Section D Open Choice
			No. of. Questions	K - Level	No. of. Questions	K - Level		
CI AI	CO1	Upto K4	2	K1&K2	1	K1	2	1
	CO2	Upto K4	2	K1&K2	2	K2	2	1
CI AII	CO3	Upto K4	2	K1&K2	1	K2	2	1
	CO4	Upto K3	2	K1&K2	2	K2	2	1
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	2
		No. of Questions to be answered	4		3		2	1
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	10

Distribution of Marks with K Level CIA I & CIA II								
	K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2	2			4	8	20
	K2	2	4			6	12	
	K3			10	10	20	40	40
	K4			10	10	20	40	40
	Marks	4	6	20	20	50	100	100
CIA II	K1	2	2			4	8	20
	K2	2	4			6	12	
	K3			10	10	20	40	40
	K4			10	10	20	40	40
	Marks	4	6	20	20	50	100	100

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S.No	COs	K - Level	MCQs		Short Answers		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	**Upto K4**	**2**	**K1&K2**	**1**	**K1**	**2(K3&K3)**	**1(K4)**
2	CO2	**Upto K4**	**2**	**K1&K2**	**1**	**K1**	**2(K3&K3)**	**1(K4)**
3	CO3	**Upto K4**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K4)**
4	CO4	**Upto K3**	**2**	**K1&K2**	**1**	**K2**	**2(K2&K2)**	**1(K3)**
5	CO5	**Upto K4**	**2**	**K1&K2**	**1**	**K2**	**2(K2&K2)**	**1(K4)**
No. of Questions to be Asked			**10**		**5**		**10**	**5**
No. of Questions to be answered			**10**		**5**		**5**	**3**
Marks for each question			**1**		**2**		**5**	**10**
Total Marks for each section			**10**		**10**		**25**	**30**
(Figures in parenthesis denotes, questions should be asked with the given K level)								

Distribution of Marks with K Level							
K Level	**Section A (Multiple Choice Questions)**	**Section B (Short Answer Questions)**	**Section C (Either/ or Choice)**	**Section D (Open Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidated %**
K1	5	4			9	7.5	34
K2	5	6	20		31	25.9	
K3			30	10	40	33.3	33
K4				40	40	33.3	33
Marks	10	10	50	50	120	100	100
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.							

Summative Examinations - Question Paper – Format

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q.No	**CO**	**K Level**	**Questions**
16) a	CO1	K3	
16) b	CO1	K3	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K2	
19) b	CO4	K2	
20) a	CO5	K2	
20) b	CO5	K2	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q.No	**CO**	**K Level**	**Questions**
21	CO1	K4	
22	CO2	K4	
23	CO3	K4	
24	CO4	K3	
25	CO5	K4	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MATHEMATICS
(For those who joined in 2021-2022 and after)

Course Name	**PROJECT**				
Course Code	**21PMTPR1**		**L**	**P**	**C**
Category	**Project**		6	-	4
Nature of course:	**EMPLOYABILITY**	**SKILL ORIENTED**	ENTREPRENURSHIP		

Course Description

The Project is conducted by the following Course Pattern.

Internal

Presentation
Submission } **40**

External

Project Report
Viva Voce } **60**

Total - 100

COURSE OUTCOMES		`
On the successful completion of the course , the students will be able to		
CO1:	Apply the skill of presentation and communication techniques	K3
CO2:	Motive as an individual or in a team in development of projects.	K4
CO3:	Analyze the available resources and to select most appropriate one	K4
CO4:	Make use of the fundamentals of Mathematics to search the related literature survey	K3
CO5:	Evaluate the real life problems by using Mathematics and its Application.	K5

Course Designed by:
Dr. R. Bhavani Assistant Professor & **Dr. A. Hamari Choudhi,** Head & Associate Professor

CO & PO Mappings:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	2	3	3	3	1	3
CO 2	1	2	2	1	2	1
CO 3	2	2	3	3	2	1
CO 4	3	2	3	2	1	2
CO 5	3	3	3	3	3	3

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MATHEMATICS
(For those who joined in 2021-2022 and after)

Course Name	**NUMBER THEORY**				
Course Code	**21PMTE41**		**L**	**P**	**C**
Category	**Elective**		**6**	**-**	**6**
Nature of course:	**EMPLOYABILITY**	SKILL ORIENTED	ENTREPRENURSHIP		

COURSE OBJECTIVES:

- To know the basic concepts in number theory.
- To learn number theoretical functions.
- To study Euclid's and division algorithm.
- To familiarize about primitive roots.
- To understand the fundamental theorem in number theory.

Unit: I		18

Well ordering principle, induction , binomial coefficients, Greatest integer function – Divisibility: Notion of divisibility, G. C. D , Euclid's Algorithm, L.C.M, Representations of integers

Unit: II		18

Primes: Definition, Prime counting function , Prime number theorem ,Test of Primality, Sieve of Eratosthenes, Canonical factorization, Fundamental theorem of Arithmetic.

Unit: III		18

Congruences : Congruences and Equivalence relations, Linear Congruence, Linear Diophantine equations, Chinese Remainder Theorem, Polynomial Congruences, Modular Arithmetic, Fermat's Theorem, Wilson's Theorem, Pythagorean equation.

Unit: IV		18

Arithmetic functions: Sigma, Tau functions, Dirichlet product, Dirichlet inverse, Mobius function, Euler's function, Euler's theorem

Unit: V		18

Primitive roots: Definition, properties, Existence-Quadratic Congruences: Quadratic Residues, Legendre symbols, Gauss lemma, Law of quadratic reciprocity .

	Total Lecture Hours	90

Books for Study:

Neville Robbins, **Beginning of Number Theory**, Second Edition, Narosa publications, New Delhi, 2006.

Unit I- Chapters :1,2
Unit II - Chapter : 3
Unit III - Chapter :4
Unit IV - Chapter :5
Unit V - Chapter 6: sections 1,2& 3 only.
Chapter 7: sections 1,2 and 3 only.

Books for References:

1. Ivan Niven, **Introduction to Theory of numbers**, Wiley Eastern,2009.
2. Tom M. Apostal, **Introduction to Analytic Number Theory**, Springer InternationalEdition,

3. Martin Erichson & Anthony Vazzana, **" Introduction to Number Theory",**Saurabh printers Private Ltd,2010.	
Web Resources	
1. http://www2.math.uu.se/~lal/kompendier/Talteori.pdf **2. https://nptel.ac.in/courses/111/101/111101137/** **3. https://nptel.ac.in/courses/111/103/111103020/**	
COURSE OUTCOMES	**K Level**
On the successful completion of the course , the students will be able to	
CO1: Explain the numbering concepts.	**K4**
CO2: Apply the concepts of prime numbers and principles to solve problems	**K3**
CO3: Solve the system of linear congruencies with different module using the Chinese Reminder Theorem.	**K3**
CO4: Categorize the various arithmetic functions	**K4**
CO5: Examine the quadratic residues and quadratic non-residues using congruences.	**K4**

CO & PO Mappings:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	**3**	**3**	**3**	**1**	**1**	**1**
CO 2	**3**	**3**	**2**	**2**	**1**	**-**
CO 3	**3**	**3**	**3**	**1**	**1**	**1**
CO 4	**3**	**3**	**2**	**2**	**1**	**-**
CO 5	**3**	**3**	**2**	**2**	**2**	**1**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 –**Introductory Level

LESSON PLAN

UNIT	SUBJECT NAME	Hours	Pedagogy
I	Well ordering principle, induction , binomial coefficients,Greatest integer function – Divisibility :Notion of divisibility, G. C. D , Euclids Algorithm, L.C.M, Representations of integers	18	**Chalk & Talk**
II	Primes: Definition, Prime counting function , Prime number theorem ,Test of Primality, Sieve of Eratosthenes, Canonical factorization, Fundamental theorem of Arithmetic.	18	**Chalk & Talk**
III	Congruences : Congruences and Equivalence relations, Linear Congruence, Linear Diophantine equations, Chinese Remainder Theorem, Polynomial Congruences, Modular Arithmetic, Fermat's Theorem, Wilson's Theorem, Pythagoreanequation.	18	**Chalk & Talk**
IV	Arithmetic functions: Sigma, Tau functions, Dirichlet product, Dirichlet inverse, Mobius function, Euler's function, Euler's theorem	18	**Chalk & Talk**
V	Primitive roots: Definition, properties, Existence-Quadratic Congruences : Quadratic Residues, Legendre symbols, Gauss lemma, Law of quadratic reciprocity .	18	**Chalk & Talk**

Course Designed by:

Dr. R. Bhavani Assistant Professor & **Dr. S. Andal,** Assistant Professor

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)								
Internal	Cos	K Level	Section A		Section B		Section C Either or Choice	Section D Open Choice
			MCQs		Short Answers			
			No. of. Questions	K - Level	No. of. Questions	K - Level		
CI AI	CO1	Upto K4	2	K1&K2	1	K1	2	1
	CO2	Upto K3	2	K1&K2	2	K2	2	1
CI AII	CO3	Upto K3	2	K1&K2	1	K2	2	1
	CO4	Upto K4	2	K1&K2	2	K2	2	1
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	2
		No. of Questions to be answered	4		3		2	1
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	10

Distribution of Marks with K Level CIA I & CIA II								
	K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2	2			4	8	20
	K2	2	4			6	12	
	K3			10	10	20	40	40
	K4			10	10	20	40	40
	Marks	4	6	20	20	50	100	100
CIA II	K1	2	2			4	8	20
	K2	2	4			6	12	
	K3			10	10	20	40	40
	K4			10	10	20	40	40
	Marks	4	6	20	20	50	100	100

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S.No	COs	K - Level	MCQs		Short Answers		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	**Upto K4**	**2**	**K1&K2**	**1**	**K1**	**2(K3&K3)**	**1(K4)**
2	CO2	**Upto K3**	**2**	**K1&K2**	**1**	**K1**	**2(K2&K2)**	**1(K3)**
3	CO3	**Upto K3**	**2**	**K1&K2**	**1**	**K2**	**2(K2&K2)**	**1(K3)**
4	CO4	**Upto K4**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K4)**
5	CO5	**Upto K4**	**2**	**K1&K2**	**1**	**K2**	**2(K2&K2)**	**1(K4)**
No. of Questions to be Asked			**10**		**5**		**10**	**5**
No. of Questions to be answered			**10**		**5**		**5**	**3**
Marks for each question			**1**		**2**		**5**	**10**
Total Marks for each section			**10**		**10**		**25**	**30**
(Figures in parenthesis denotes, questions should be asked with the given K level)								

Distribution of Marks with K Level							
K Level	**Section A (Multiple Choice Questions)**	**Section B (Short Answer Questions)**	**Section C (Either/ or Choice)**	**Section D (Open Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidated %**
K1	5	4			9	7.5	**42**
K2	5	6	30		41	34.2	
K3			20	20	40	33.3	**33**
K4				30	30	25	**25**
Marks	10	10	50	50	120	100	**100**
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.							

Summative Examinations - Question Paper – Format

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q.No	**CO**	**K Level**	**Questions**
16) a	CO1	K3	
16) b	CO1	K3	
17) a	CO2	K2	
17) b	CO2	K2	
18) a	CO3	K2	
18) b	CO3	K2	
19) a	CO4	K3	
19) b	CO4	K3	
20) a	CO5	K2	
20) b	CO5	K2	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q.No	**CO**	**K Level**	**Questions**
21	CO1	K4	
22	CO2	K3	
23	CO3	K3	
24	CO4	K4	
25	CO5	K4	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MATHEMATICS
(For those who joined in 2021-2022 and after)

Course Name	**COMBINATORIAL MATHEMATICS**			
Course Code	**21PMTE42**	**L**	**P**	**C**
Category	**Elective**	6	-	6
Nature of course:	**EMPLOYABILITY**	SKILL ORIENTED	ENTREPRENURSHIP	

COURSE OBJECTIVES:

- To understand the rules of sum and product
- To study the Generating functions, Partitions of integers.
- To identify the recurrence relations with constant coefficients, and Recurrence relations with two indices.
- To familiarize the concept of principle of inclusion and exclusion.
- To understand fundamental theorem.

Unit: I		18
The rules of Sum and Product - Permutations - Combinations - Distributions of Distinct Objects - Distributions of Non distinct Objects		
Unit: II		18
Generating Functions for Combinations - Enumerators for Permutations – Distributions of Distinct Objects into Non distinct Cells - Partitions of Integers – Elementary relations		
Unit: III		18
Linear Recurrence relations with Constant Coefficients - Solution by the technique of Generating Functions - Recurrence Relations with Two Indices.		
Unit: IV	The Principle of Inclusion and Exclusion - The General Formula - Derangements - Permutations with Restrictions on Relative Positions - The Rook Polynomials.	18
Unit: V		18
Equivalence Classes under a Permutation Group - Equivalence Classes of Functions -Weights and Inventories of Functions - Polya's Fundamental Theorem - Generalization of Polya's Theorem.		
	Total Lecture Hours	90

Books for Study:

C. L. Liu, **Introduction to Combinatorial Mathematics**, McGraw-Hill Inc., Newyork,1968.

Unit I - Chapter 1: Sections 1.1 to 1.6
Unit II - Chapter 2: Sections 2.1 to 2.5 and 2.7
Unit III: - Chapter 3: Sections 3.1 to 3.5 (Except 3.4)
Unit IV: - Chapter 4: Sections 4.1 to 4.6
Unit V: - Chapter 5: Sections 5.1 to 5.7 (Except 5.2)

Books for References:

1. J. H. Van Lint and R. M. Wilson, **A Course in Combinatorics**, Cambridge University Press, 2001.
2. TituAndreescu and ZumingFeng, **A Path to Combinatorics**, Springer Science & Business Media, 2004.
3. Douglas West, **Combinatorial Mathematics**, Cambridge University Press, 2020.

Web Resources

1. https://www.isinj.com/mt-

usamo/Applied%20Combinatorics%20(6th%20Edition)%20by%20Alan%20Tucker%20Wiley%20(2012).pdf 2. http://cseweb.ucsd.edu/~gill/AlgCombSite/Resources/CCSRefP1.pdf 3. https://en.wikipedia.org/w/index.php?title=Special:WhatLinksHere&target=Algorithm	
COURSE OUTCOMES	**K Level**
On the successful completion of the course , the students will be able to	
CO1: Understand the rules of Sum and Product of Permutations and Combinations.	**K2**
CO2: Discuss distributions of Distinct Objects into Non-distinct Cells and Partitions of Integers.	**K3**
CO3: Identify Solutions by the technique of Generating Functions and Recurrence Relations with Two Indices.	**K3**
CO4: Make use of the concepts of Permutations with Restrictions on Relative Positions and the Rook Polynomials.	**K3**
CO5: Analyze equivanlence classes of functions in Polya's Theory	**K4**

CO & PO Mapping:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	3	3	1	1	1
CO 2	3	3	2	2	1	-
CO 3	3	3	3	1	1	1
CO 4	3	3	2	2	1	-
CO 5	3	3	2	2	2	1

***3 –** Advanced Application; **2 –** Intermediate Development; **1 –**Introductory Level

LESSON PLAN

UNIT	SUBJECT NAME	Hours	Pedagogy
I	Permutations and Combinations Introduction - The rules of Sum and Product - Permutations - Combinations - Distributions of Distinct Objects - Distributions of Non distinct Objects	18	**Chalk & Talk**
II	Generating Functions Introduction - Generating Functions for Combinations - Enumerators for Permutations – Distributions of Distinct Objects into Non distinct Cells - Partitions of Integers – Elementary relations	18	**Chalk & Talk, PPT**
III	Recurrence Relation Introduction - Linear Recurrence relations with Constant Coefficients - Solution by the technique of Generating Functions - Recurrence Relations with Two Indices	18	**Chalk & Talk**
IV	The Principle of Inclusion and Exclusion Introduction - The Principle of Inclusion and Exclusion - The General Formula - Derangements - Permutations with Restrictions on Relative Positions - The Rook Polynomials	18	**Chalk & Talk, PPT**
V	Theory of Counting Introduction - Equivalence Classes under a Permutation Group - Equivalence Classes of Functions -Weights and Inventories of Functions - Polya's Fundamental Theorem - Generalization of Polya's Theorem	18	**Chalk & Talk**

Course Designed by:

Dr. M. Saravanan Assistant Professor & **Dr. A. Arivu Chelvam,** Assistant Professor

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)								
Internal	Cos	K Level	Section A		Section B		Section C Either or Choice	Section D Open Choice
			MCQs		Short Answers			
			No. of. Questions	K – Level	No. of. Questions	K - Level		
CI AI	CO1	Upto K2	2	K1&K2	1	K1	2	1
	CO2	Upto K3	2	K1&K2	2	K2	2	1
CI AII	CO3	Upto K3	2	K1&K2	1	K2	2	1
	CO4	Upto K3	2	K1&K2	2	K2	2	1
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	2
		No. of Questions to be answered	4		3		2	1
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	10

Distribution of Marks with K Level CIA I & CIA II								
	K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2	2			4	8	20
	K2	2	4			6	12	
	K3			10	10	20	40	40
	K4			10	10	20	40	40
	Marks	4	6	20	20	50	100	100
CIA II	K1	2	2			4	8	20
	K2	2	4			6	12	
	K3			10	10	20	40	40
	K4			10	10	20	40	40
	Marks	4	6	20	20	50	100	100

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S.No	COs	K - Level	MCQs		Short Answers		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	**Upto K2**	**2**	**K1&K2**	**1**	**K1**	**2(K2&K2)**	**1(K2)**
2	CO2	**Upto K3**	**2**	**K1&K2**	**1**	**K1**	**2(K3&K3)**	**1(K3)**
3	CO3	**Upto K3**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K3)**
4	CO4	**Upto K3**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K3)**
5	CO5	**Upto K4**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K4)**
No. of Questions to be Asked			**10**		**5**		**10**	**5**
No. of Questions to be answered			**10**		**5**		**5**	**3**
Marks for each question			**1**		**2**		**5**	**10**
Total Marks for each section			**10**		**10**		**25**	**30**
(Figures in parenthesis denotes, questions should be asked with the given K level)								

Distribution of Marks with K Level							
K Level	**Section A (Multiple Choice Questions)**	**Section B (Short Answer Questions)**	**Section C (Either/ or Choice)**	**Section D (Open Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidated %**
K1	5	4			9	7.5	**25**
K2	5	6		10	21	17.5	
K3			20	20	40	33.3	**33**
K4			30	20	50	41.7	**42**
Marks	10	10	50	50	120	100	**100**
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.							

Summative Examinations - Question Paper – Format

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q.No	**CO**	**K Level**	**Questions**
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K3	
19) b	CO4	K3	
20) a	CO5	K3	
20) b	CO5	K3	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q.No	**CO**	**K Level**	**Questions**
21	CO1	K2	
22	CO2	K3	
23	CO3	K3	
24	CO4	K3	
25	CO5	K4	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MATHEMATICS
(For those who joined in 2021-2022 and after)

Course Name	**DIFFERENTIAL GEOMETRY**			
Course Code	**21PMTE43**	**L**	**P**	**C**
Category	**Elective**	6	-	6
Nature of course:	**EMPLOYABILITY**	SKILL ORIENTED	ENTREPRENURSHIP	

COURSE OBJECTIVES:

- To study the classical theory of curves and surfaces.
- To learn the fundamental existence theorem of space curve.
- To know the local intrinsic and local non-intrinsic properties of surfaces.
- To deal with the fundamental equations of surface theory.
- To learn the applications of Differential Geometry.

Unit: I	18

Representation of space curves – Unique parametric representation of a space curve – Arc length – Tangent and osculating plane – Principal normal and binormal – Curvature and Torsion – Behavior of a curve near one of its points – The curvature and torsion of a curve as the intersection of two surfaces – Contact between curves and surfaces – Osculating circle and osculating sphere – Locus of centres of spherical curvature – Tangent surfaces, involutes and evolutes – Bertrand Curves - Spherical indicatrix - Intrinsic equations of space curves - Fundamental existence theorem for space curves - Helices.

Unit: II	18

Definition of a surface – Nature of points on a surface – Representation of a surface – Curves on surfaces – Tangent plane and surface normal – The general surfaces of revolution – Helicoids – Metricon a surface – The First Fundamental form – Direction coefficients on a surface – Families of curves –Orthogonal trajectories – Double family of curves – Isometric correspondence – Intrinsic properties

Unit: III	18

Geodesic and their differential equations – Canonical geodesic equations – Geodesics on surfaces of revolution – Normal property of geodesics – Differential equations of geodesics using normal property – Existence theorems – Geodesic parallels – Geodesic polar coordinates – Geodesic curvature – Gauss–Bonnet Theorem – Gaussian curvature – Surfaces of constant curvature.

Unit: IV	18

The second fundamental form – Classification of points on a surface – Principal curvatures – Lines of curvature – The Dupin indicatrix– Developable surfaces – Developables associated with space curves –Developables associated with curves on surfaces – Minimal surfaces – Ruled surfaces.

Unit: V	18

Tensor notations – Gauss equations – Weingarten equations – Mainardi-Codazzi equations – Parallel surfaces.

	Total Lecture Hours	90

Books for Study:

Somasundaram. D., Reprint 2019, Differential Geometry, Narosa Publishing House, Chennai.

Unit I- Chapters :1(1.1 - 1.18)
Unit II - Chapter : 2(2.1 - 2.15)
Unit III - Chapter : 3(3.1 – 3.13)

Unit IV - Chapter : 4(4.1 – 4.11) Unit V - Chapter 5(5.1 – 5.6)
Books for References: 1. Mittal and Agarwal, 2014, **Differential Geometry**, Krishna Prakasan Media (P) Ltd., India. 2. Thierry Aubin, 2001, **Differential Geometry**, American Mathematical Society, Providence,US. 3. Willmore. T.J., 2018, **An introduction to Differential Geometry**, Oxford University Press, New Delhi.
Web Resources
1.https://books.google.gm/books?id=dbIAAQAAQBAJ&printsec=copyright&source=gbs_pub_info_r **2.https://picfs.com/1aqi82** **3.https://en.wikipedia.org/wiki/Differential_geometry#:~:text=Differential%20geometry%20is%20a%20mathematical,linear%20algebra%20and%20multilinear%20algebra.**

COURSE OUTCOMES		**K Level**
On the successful completion of the course , the students will be able to		
CO1:	Demonstrate the Understanding the concept of space curves.	**K2**
CO2:	Identify metric on a surface, direction coefficients on a surface and nature of points on the surface.	**K3**
CO3:	Analyze Geodesic and their differential equations	**K4**
CO4:	List topological aspects of surfaces.	**K4**
CO5:	Analyse the Weingarton Equations, Gaussian equations, Mainardi-Codazzi equations	**K4**

CO & PO Mapping:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	**3**	**3**	**3**	**1**	**1**	**1**
CO 2	**3**	**3**	**2**	**2**	**1**	**-**
CO 3	**3**	**3**	**3**	**1**	**1**	**1**
CO 4	**3**	**3**	**2**	**2**	**1**	**-**
CO 5	**3**	**3**	**2**	**2**	**2**	**1**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 –**Introductory Level

LESSON PLAN

UNIT	SUBJECT NAME	Hours	Pedagogy
I	Representation of space curves – Unique parametric representation of a space curve – Arc length – Tangent and osculating plane – Principal normal and binormal – Curvature and Torsion – Behavior of a curve near one of its points – The curvature and torsion of a curve as the intersection of two surfaces – Contact between curves and surfaces – Osculating circle and osculating sphere – Locus of centres of spherical curvature – Tangent surfaces, involutes and evolutes – Bertrand Curves - Spherical indicatrix - Intrinsic equations of space curves - Fundamental existence theorem for space curves - Helices.	18	**Chalk & Talk**
II	Definition of a surface – Nature of points on a surface – Representation of a surface – Curves on surfaces – Tangent plane and surface normal – The general surfaces of revolution – Helicoids – Metric on a surface – The First Fundamental form – Direction coefficients on a surface – Families of curves – Orthogonal trajectories – Double family of curves – Isometric correspondence – Intrinsic properties	18	**Chalk & Talk**
III	Geodesic and their differential equations – Canonical geodesic equations – Geodesics on surfaces of revolution – Normal property of geodesics – Differential equations of geodesics using normal property – Existence theorems – Geodesic parallels – Geodesic polar coordinates – Geodesic curvature – Gauss–Bonnet Theorem – Gaussian curvature – Surfaces of constant curvature.	18	**Chalk & Talk**
IV	The second fundamental form – Classification of points on a surface – Principal curvatures – Lines of curvature – The Dupin indicatrix– Developable surfaces – Developables associated with space curves – Developables associated with curves on surfaces – Minimal surfaces – Ruled surfaces	18	**Chalk & Talk**
V	Tensor notations – Gauss equations – Weingarten equations – Mainardi-Codazzi equations – Parallel surfaces.	18	**Chalk & Talk**

Course Designed by:

Dr. A. Arivu Chelvam Assistant Professor & **Mrs. S. Ragavi,** Assistant Professor

Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)								
Internal	Cos	K Level	Section A		Section B		Section C Either or Choice	Section D Open Choice
			MCQs		Short Answers			
			No. of. Questions	K – Level	No. of. Questions	K - Level		
CI AI	CO1	Upto K2	2	K1&K2	1	K1	2	1
	CO2	Upto K3	2	K1&K2	2	K2	2	1
CI AII	CO3	Upto K4	2	K1&K2	1	K2	2	1
	CO4	Upto K4	2	K1&K2	2	K2	2	1
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	2
		No. of Questions to be answered	4		3		2	1
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	10

Distribution of Marks with K Level CIA I & CIA II								
	K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2	2			4	8	20
	K2	2	4			6	12	
	K3			10	10	20	40	40
	K4			10	10	20	40	40
	Marks	4	6	20	20	50	100	100
CIA II	K1	2	2			4	8	20
	K2	2	4			6	12	
	K3			10	10	20	40	40
	K4			10	10	20	40	40
	Marks	4	6	20	20	50	100	100

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S.No	COs	K - Level	MCQs		Short Answers		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	**Upto K2**	**2**	**K1&K2**	**1**	**K1**	**2(K2& K2)**	**1(K2)**
2	CO2	**Upto K3**	**2**	**K1&K2**	**1**	**K1**	**2(K3&K3)**	**1(K3)**
3	CO3	**Upto K4**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K4)**
4	CO4	**Upto K4**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K4)**
5	CO5	**Upto K4**	**2**	**K1&K2**	**1**	**K2**	**2(K2&K2)**	**1(K4)**
No. of Questions to be Asked			**10**		**5**		**10**	**5**
No. of Questions to be answered			**10**		**5**		**5**	**3**
Marks for each question			**1**		**2**		**5**	**10**
Total Marks for each section			**10**		**10**		**25**	**30**
(Figures in parenthesis denotes, questions should be asked with the given K level)								

Distribution of Marks with K Level							
K Level	**Section A (Multiple Choice Questions)**	**Section B (Short Answer Questions)**	**Section C (Either/ or Choice)**	**Section D (Open Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidated %**
K1	5	4			9	7.5	**17**
K2	5	6	20		31	9.17	
K3			30	30	60	37.5	**37**
K4				20	20	45.83	**46**
Marks	10	10	50	50	120	100	**100**
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.							

Summative Examinations - Question Paper – Format

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q.No	**CO**	**K Level**	**Questions**
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K3	
19) b	CO4	K3	
20) a	CO5	K3	
20) b	CO5	K3	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q.No	**CO**	**K Level**	**Questions**
21	CO1	K2	
22	CO2	K3	
23	CO3	K4	
24	CO4	K4	
25	CO5	K4	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MATHEMATICS
(For those who joined in 2021-2022 and after)

Course Name	**STOCHASTIC PROCESSES**				
Course Code	**21PMTE44**		**L**	**P**	**C**
Category	**Elective**		6	-	6
Nature of course:	**EMPLOYABILITY**	SKILL ORIENTED	ENTREPRENURSHIP		

COURSE OBJECTIVES:

- To understand the concepts of Stochastic Process.
- To familiarize probability distributions.
- To learn queuing models.
- To understand the discrete and continuous time Markov chains
- To provide solutions in Stochastic Processes Models.

Unit: I		18

Stochastic Processes: Some notions – Specification of Stochastic processes – Stationary process – Markov Chains – Definitions and examples – Higher Transition Probabilities

Unit: II		18

Markov Chains : – Generalization of Independent Bernoulli trails- Sequence of chain – Dependent Trails – Classification of states and chains– Determination of higher transition probabilities – Stability of a Markov System

Unit: III		18

Graph Theoretic Approach- Markov Chain with Denumerable Number of States- Reducible Chains – Markov Chains with Continuous State Space

Unit: IV		18

Markov Processes with Discrete State Space : Poisson Processes and their extensions – Poisson process and related distribution – Generalization of Poisson Process – Birth and Death Process- Markov Processes with Discrete State space (Continuous Time Markov Chains)

Unit: V		18

Stochastic Processes in Queuing – Queuing system – General concepts – the queuing model M/M/1 – Steady state Behaviour – Transient Behaviour of M/M/1 Model – Non Markovian models – Transient Behaviour of M/M/1 Model – Birth and Death Processes in Queueing Theory

	Total Lecture Hours	90

Books for Study:

Medhi.J, **Stochastic Processes**, Wiley Eastern, 1987, New Delhi. Reprint 2008

Unit I- Chapter 2 : Sections 2.1 to 2.3, Chapter 3 : Sections 3.1 to3.2
Unit II - Chapter 3 : Sections 3.3 to 3.6
Unit III - Chapter 3 : Sections 3.7 to 3.11
Unit IV - Chapter 4 : sections 4.1 to4.5
Unit V - Chapter 10 : sections 10.1 to10.4

Books for References:

1. Basu.A.K.,**Stochastic Process**, Narosa Publisher, 2007, NewDelhi.
2. Bhat. B.R, **Stochastic Model**, New Age International Publisher, 2010, Delhi,reprint.
3. ErhanCinlar, **Introduction to Stochastic Process**,First Edition, Dover Publication,2013

Web Resources	
1. https://nptel.ac.in/courses/110/101/110101141/ 2. https://nptel.ac.in/courses/111/103/111103022/ 3. https://web.ma.utexas.edu/users/gordanz/notes/introduction_to_stochastic_processes.pdf	
COURSE OUTCOMES	**K Level**
On the successful completion of the course , the students will be able to	
CO1: Classify simple stochastic process models in the time domain.	**K4**
CO2: Apply the generalization of Poisson process	**K3**
CO3: Compare Markov and Erlang process	**K4**
CO4: Identify the qualitative and quantitative analysis of Stochastic process model.	**K3**
CO5: Explain models for real life problems.	**K4**

CO & PO Mapping:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	**3**	**3**	**3**	**1**	**1**	**1**
CO 2	**3**	**3**	**2**	**2**	**1**	**-**
CO 3	**3**	**3**	**3**	**1**	**1**	**1**
CO 4	**3**	**3**	**2**	**2**	**1**	**-**
CO 5	**3**	**3**	**2**	**2**	**2**	**1**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

UNIT	SUBJECT NAME	Hours	Pedagogy
I	Stochastic Processes: Some notions – Specification of Stochastic processes – Stationary process – Markov Chains – Definitions and examples – Higher Transition Probabilities	18	**Chalk & Talk**
II	Markov Chains : – Generalization of Independent Bernoulli trails- Sequence of chain – Dependent Trails – Classification of states and chains– Determination of higher transition probabilities – Stability of a Markov System	18	**Chalk & Talk**
III	Graph Theoretic Approach- Markov Chain with Denumerable Number of States- Reducible Chains – Markov Chains with Continuous State Space	18	**Chalk & Talk**
IV	Markov Processes with Discrete State Space : Poisson Processes and their extensions – Poisson process and related distribution – Generalization of Poisson Process – Birth and Death Process- Markov Processes with Discrete State space (Continuous Time Markov Chains)	18	**Chalk & Talk, PPT**
V	Stochastic Processes in Queuing – Queuing system – General concepts – the queuing model M/M/1 – Steady state Behaviour – Transient Behaviour of M/M/1 Model – Non Markovian models – Transient Behaviour of M/M/1 Model – Birth and Death Processes in Queueing Theory	18	**Chalk & Talk**

Course Designed by:

Dr. P. Chitra Devi Assistant Professor & **Mrs. R. Sumathi,** Assistant Professor

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)								
Internal	Cos	K Level	Section A		Section B		Section C Either or Choice	Section D Open Choice
			MCQs		Short Answers			
			No. of. Questions	K - Level	No. of. Questions	K - Level		
CI AI	CO1	Upto K4	2	K1&K2	1	K1	2	1
	CO2	Upto K3	2	K1&K2	2	K2	2	1
CI AII	CO3	Upto K4	2	K1&K2	1	K2	2	1
	CO4	Upto K3	2	K1&K2	2	K2	2	1
Question Pattern CIA I & II	No. of Questions to be asked		4		3		4	2
	No. of Questions to be answered		4		3		2	1
	Marks for each question		1		2		5	10
	Total Marks for each section		4		6		10	10

Distribution of Marks with K Level CIA I & CIA II								
	K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2	2			4	8	20
	K2	2	4			6	12	
	K3			10	10	20	40	40
	K4			10	10	20	40	40
	Marks	4	6	20	20	50	100	100
CIA II	K1	2	2			4	8	20
	K2	2	4			6	12	
	K3			10	10	20	40	40
	K4			10	10	20	40	40
	Marks	4	6	20	20	50	100	100

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S.No	COs	K - Level	MCQs		Short Answers		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	**Upto K4**	**2**	**K1&K2**	**1**	**K1**	**2(K3&K3)**	**1(K4)**
2	CO2	**Upto K3**	**2**	**K1&K2**	**1**	**K1**	**2(K2&K2)**	**1(K3)**
3	CO3	**Upto K4**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K4)**
4	CO4	**Upto K3**	**2**	**K1&K2**	**1**	**K2**	**2(K2&K2)**	**1(K3)**
5	CO5	**Upto K4**	**2**	**K1&K2**	**1**	**K2**	**2(K2&K2)**	**1(K4)**
No. of Questions to be Asked			**10**		**5**		**10**	**5**
No. of Questions to be answered			**10**		**5**		**5**	**3**
Marks for each question			**1**		**2**		**5**	**10**
Total Marks for each section			**10**		**10**		**25**	**30**
(Figures in parenthesis denotes, questions should be asked with the given K level)								

Distribution of Marks with K Level							
K Level	**Section A (Multiple Choice Questions)**	**Section B (Short Answer Questions)**	**Section C (Either/ or Choice)**	**Section D (Open Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidated %**
K1	5	4			9	7.5	**42**
K2	5	6	30		41	34.2	
K3			20	20	40	33.3	**33**
K4				30	30	25	**25**
Marks	10	10	50	50	120	100	**100**
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.							

Summative Examinations - Question Paper – Format

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q.No	**CO**	**K Level**	**Questions**
16) a	CO1	K3	
16) b	CO1	K3	
17) a	CO2	K2	
17) b	CO2	K2	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K2	
19) b	CO4	K2	
20) a	CO5	K2	
20) b	CO5	K2	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q.No	**CO**	**K Level**	**Questions**
21	CO1	K4	
22	CO2	K3	
23	CO3	K4	
24	CO4	K3	
25	CO5	K4	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MATHEMATICS
(For those who joined in 2021-2022 and after)

Course Name	**FLUID DYNAMICS**			
Course Code	**21PMTE45**	**L**	**P**	**C**
Category	**Elective**	6	-	6
Nature of course:	**EMPLOYBILITY**	**SKILL ORIENTED**	ENTREPRENURSHIP	

COURSE OBJECTIVES:

To learn the physical properties of fluids
To relate the principles of continuity, momentum and energy as applied to fluid motions.
To know the concept on the Kinematics of fluid motions,
To understand three dimensional flows.
To know the two dimensional flows

Unit: I		18

General orthogonal curvilinear coordinates–Arc length in Orthogonal coordinates–Gradient in orthogonal coordinates–Divergence in orthogonal coordinates–Laplacian in orthogonal coordinates – Curl of a vector function in orthogonal coordinates –worked examples –Some cartesian tensor notation.

Unit: II		18

Real fluids and Ideal fluids – Velocity of a fluid at apoint –Streamlines and Path lines, steady and unsteady flows – The velocity potential – The vorticity vector –Local and particle rates of change – The equation of continuity – worked examples – Acceleration of a fluid–Conditions at a rigid boundary.

Unit: III		18

Pressure at a point in a fluid at rest – Pressure at a point in a moving fluid – Conditions at a boundary of two in viscid Immiscible fluids – Euler‟sequations of motion – Bernoulli‟s equation – worked examples – discussion of the case ofsteady motion under conservative body forces– some flows involving axial symmetry – Some special two-dimensional flows–Impulsive motion.

Unit: IV		18

Some Three-Dimensional flows: Introduction– Sources, Sinks and doublets–Images in rigid infinite plane–Images in solid spheres–Axi-Symmetric flows, Stoke’s Stream function.

Unit: V		18

Meaning of Two-Dimensional Flow – Use of Cylindrical Polar coordinates – The stream function– The complex potential for Two–Dimensional Irrotational, In compressible flow–Complex velocity potentials for standard two dimensional flows–Some worked examples –Two-Dimensional image systems-The Milne-Thomson circle theorem.

	Total Lecture Hours	90

Books for Study:

Frank Chorlton, 2004, **Textbook of Fluid Dynamics**, CBS Publishers and Distributors Pvt. Ltd. New Delhi

Unit I-Chapter1(Section 1.19to 1.20)
Unit II - Chapter2(Section2.1 to2.10)
Unit III -Chapter3(Section 3.1to3.7, 3.9to 3.11)
Unit IV -Chapter4(Section4.1 to4.5)

Unit V - Chapter5(Section5.1 to5.8)		
Books for References: 1.Goyal J.K. and Gupta K.P.,1998,**Fluid Dynamics**, Seventh Edition, Pragati Prakashan Publications, Meerat. 2. Paterson A.R.,1977,**A First Course in Fluid Dynamics**, Cambridge University Press, India (Pvt)Ltd. 3. Raisinghania M.D.,2006, **Fluid Dynamics**, S. Chand & Company Ltd, New Delhi.		
Web Resources **1. http://www3.dicca.unige.it/rrepetto/linked-files/fluid-dynamics-lecture-notes.pdf** **2. https://www.iare.ac.in/sites/default/files/AERO_FLUID_DYNAMICS_LECTURE_NOTES.pdf** **3. http://mdudde.net/pdf/study_material_DDE/M.Sc.MAthematics/Fluid_Dynamics_final.pdf**		
COURSE OUTCOMES		**K Level**
On the successful completion of the course , the students will be able to		
CO1:	Find the gradient , divergence , curl of orthogonal coordinates	**K3**
CO2:	Identify the Euler's equations of motion and equations of continuity	**K3**
CO3:	Solve the equations of motion of a fluid when it is at rest and in motion	**K3**
CO4:	Analyze two dimensional and three dimensional flows	**K4**
CO5:	Examine Two–Dimensional flow using cylindrical Polar coordinates	**K4**

CO & PO Mappings:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	**3**	**3**	**3**	**1**	**1**	**1**
CO 2	**3**	**3**	**2**	**2**	**1**	**-**
CO 3	**3**	**3**	**3**	**1**	**1**	**1**
CO 4	**3**	**3**	**2**	**2**	**1**	**-**
CO 5	**3**	**3**	**2**	**2**	**2**	**1**

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

UNIT	SUBJECT NAME	Hours	Pedagogy
I	General orthogonal curvilinear coordinates–Arc length in Orthogonal coordinates–Gradient in orthogonal coordinates–Divergence in orthogonal coordinates–Laplacian in orthogonal coordinates – Curl of a vector function in orthogonal coordinates – worked examples – Some cartesian tensor notation.	18	**Chalk & Talk**
II	Real fluids and Ideal fluids – Velocity of a fluid at a point – Streamlines and Path lines, steady and unsteady flows – The velocity potential – The vorticity vector –Local and particle rates of change – The equation of continuity – worked examples – Acceleration of a fluid–Conditions at a rigid boundary.	18	**Chalk & Talk**
III	Pressure at a point in a fluid at rest – Pressure at a point in a moving fluid – Conditions at a boundary of two in viscid Immiscible fluids – Euler's equations of motion – Bernoulli's equation – worked examples – discussion of the case of steady motion under conservative body forces– some flows involving axial symmetry – Some special two-dimensional flows–Impulsive motion.	18	**Chalk & Talk**
IV	Some Three-Dimensional flows: Introduction– Sources, Sinks and doublets–Images in rigid in finite plane–Images in solid spheres–Axi-Symmetric flows, Stoke's Stream function.	18	**Chalk & Talk**
V	Meaning of Two-Dimensional Flow – Use of Cylindrical Polar coordinates – The stream function– The complex potential for Two–Dimensional Irrotational, In compressible flow–Complex velocity potentials for standard two dimensional flows–Some worked examples –Two-Dimensional image systems-The Milne- Thomson circle theorem.	18	**Chalk & Talk**

Course Designed by:
Dr. P. Chitra Devi Assistant Professor & **Dr. S. Andal,** Assistant Professor

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)								
Internal	Cos	K Level	Section A MCQs		Section B Short Answers		Section C Either or Choice	Section D Open Choice
			No. of. Questions	K - Level	No. of. Questions	K - Level		
CI AI	CO1	Upto K3	2	K1&K2	1	K1	2	1
	CO2	Upto K3	2	K1&K2	2	K2	2	1
CI AII	CO3	Upto K3	2	K1&K2	1	K2	2	1
	CO4	Upto K4	2	K1& K2	2	K2	2	1
Question Pattern CIA I & II		No. of Questions to be asked	4		3		4	2
		No. of Questions to be answered	4		3		2	1
		Marks for each question	1		2		5	10
		Total Marks for each section	4		6		10	10

Distribution of Marks with K Level CIA I & CIA II								
	K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2	2			4	8	20
	K2	2	4			6	12	
	K3			10	10	20	40	40
	K4			10	10	20	40	40
	Marks	4	6	20	20	50	100	100
CIA II	K1	2	2			4	8	20
	K2	2	4			6	12	
	K3			10	10	20	40	40
	K4			10	10	20	40	40
	Marks	4	6	20	20	50	100	100

K1- Remembering and recalling facts with specific answers
K2- Basic understanding of facts and stating main ideas with general answers
K3- Application oriented- Solving Problems
K4- Examining, analyzing, presentation and make inferences with evidences
CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S.No	COs	K - Level	MCQs		Short Answers		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	**Upto K3**	**2**	**K1&K2**	**1**	**K1**	**2(K2&K2)**	**1(K3)**
2	CO2	**Upto K3**	**2**	**K1&K2**	**1**	**K1**	**2(K3&K3)**	**1(K3)**
3	CO3	**Upto K3**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K3)**
4	CO4	**Upto K4**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K4)**
5	CO5	**Upto K4**	**2**	**K1&K2**	**1**	**K2**	**2(K3&K3)**	**1(K4)**
No. of Questions to be Asked			**10**		**5**		**10**	**5**
No. of Questions to be answered			**10**		**5**		**5**	**3**
Marks for each question			**1**		**2**		**5**	**10**
Total Marks for each section			**10**		**10**		**25**	**30**
(Figures in parenthesis denotes, questions should be asked with the given K level)								

Distribution of Marks with K Level							
K Level	**Section A (Multiple Choice Questions)**	**Section B (Short Answer Questions)**	**Section C (Either/ or Choice)**	**Section D (Open Choice)**	**Total Marks**	**% of (Marks without choice)**	**Consolidated %**
K1	5	4			9	7.5	**17**
K2	5	6			11	9.17	
K3			25	20	45	37.5	**37**
K4			25	30	55	45.83	**46**
Marks	10	10	50	50	120	100	**100**
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.							

Summative Examinations - Question Paper – Format

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q.No	**CO**	**K Level**	**Questions**
16) a	CO1	K2	
16) b	CO1	K2	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K3	
19) b	CO4	K3	
20) a	CO5	K3	
20) b	CO5	K3	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q.No	**CO**	**K Level**	**Questions**
21	CO1	K3	
22	CO2	K3	
23	CO3	K3	
24	CO4	K4	
25	CO5	K4	

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MATHEMATICS
(For those who joined in 2021-2022 and after)

Course Name	**MULTIVARIABLE CALCULUS**				
Course Code	**21PMTE46**		**L**	**P**	**C**
Category	**Elective**		**6**	**-**	**6**
Nature of course:	**EMPLOYABILITY**	**SKILL ORIENTED**	ENTREPRENURSHIP		

COURSE OBJECTIVES:

- To have basic ideas of Sequences, Continuity and Limits
- To learn Partial and Total Differentiation
- To prove Taylor's theorem and do Chain rule
- To know the applications of Partial Differentiation
- To solve Multiple Integration

Unit: I		18

Sequences in R^2 – Subsequences and Cauchy sequences – Closure, boundary and interior Continuity – Composition of continuous functions – Characterizations of continuity – Continuity and boundedness – Continuity and monotonicity – Continuity and convexity – Continuity and Intermediate value property - Uniform continuity-– Limits and continuity.

Unit: II		18

Partial and Directional Derivatives – Partial derivatives – Directional derivatives – Higher-order partial derivatives – Problems

Unit: III		18

Differentiability – Differentiability and directives – Implicit differentiation – Taylor's theorem and Chain rule – Functions of three variables – Problems

Unit: IV		18

Absolute extrema – Constrained extrema –Local extrema and saddle points – Linear and quadratic approximations

Unit: V		18

Double integrals on rectangles – Basic inequality and criterion for integrability – Domain additivity on rectangles - Integrability of monotonic and continuous functions – Algebraic and order properties – Fundamental theorem of calculus – Fubini's theorem on rectangles.

	Total Lecture Hours	90

Books for Study:
S.R. Ghorpadeand B. V. Limaye, **"A Course in Multivariable Calculus and Analysis,** Springer, 2017.

UNIT I –Chapter 2 Pages 43 – 52, 55 – 63, 67 – 71
UNIT II - Chapter 3 Pages 83 – 99
UNIT III – Chapter 3 Pages 101 – 124, 138 – 156
UNIT IV – Chapter 4 Pages 157 – 184
UNIT V – Chapter 5 Pages 185 – 225

Books for References:
1. Spivak, **Calculus on Manifolds**, 5th Edition, CRC Press, 1965.
2. J. L. Taylor, **Foundations of Analysis**, American Mathematical Society, 2012.
3. W. Rudin, **Principles of Mathematical Analysis,** 3rd Edition, McGraw Hill Book Co., Kogaskusha, 1976.

Web Resources

1. https://ocw.mit.edu/courses/mathematics/18-02-multivariable-calculus-fall-2007/lecture-notes/
2. https://www.tutorialsduniya.com/notes/multivariate-calculus-notes/
3. https://www.math.nyu.edu/~cerfon/calculusIII.html

COURSE OUTCOMES		K Level
On the successful completion of the course , the students will be able to		
CO1:	Apply derivatives of functions of two or more variables	K3
CO2:	Solve the gradient and directional derivatives for a function at a given point.	K3
CO3:	Find the total differential of a function of several variables	K3
CO4:	Solve a function of two or more variables, organizing work into main steps carefully justifying determination of critical points.	K3
CO5:	Analyse multiple integrals either by using iterated integrals or approximation methods.	K4

CO & PO Mappings:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	3	3	1	1	1
CO 2	3	3	2	2	1	-
CO 3	3	3	3	1	1	1
CO 4	3	3	2	2	1	-
CO 5	3	3	2	2	2	1

***3 –** Advanced Application; **2 –** Intermediate Development; **1 -** Introductory Level

LESSON PLAN

UNIT	SUBJECT NAME	Hours	Pedagogy
I	**Sequences in R^2** – Subsequences and Cauchy sequences – Closure, boundary and interior Continuity – Composition of continuous functions – Characterizations of continuity – Continuity and boundedness – Continuity and monotonicity – Continuity and convexity – Continuity and Intermediate value property - Uniform continuity-– Limits and continuity.	18	**Chalk & Talk**
II	Partial and Directional Derivatives – Partial derivatives – Directional derivatives – Higher-order partial derivatives – Problems	18	**Chalk & Talk**
III	Differentiability – Differentiability and directives – Implicit differentiation – Taylor's theorem and Chain rule – Functions of three variables – Problems	18	**Chalk & Talk**
IV	Absolute extrema – Constrained extrema –Local extrema and saddle points – Linear and quadratic approximations	18	**Chalk & Talk**
V	Double integrals on rectangles – Basic inequality and criterion for integrability – Domain additivity on rectangles - Integrability of monotonic and continuous functions – Algebraic and order properties – Fundamental theorem of calculus – Fubini's theorem on rectangles.	18	**Chalk & Talk**

Course Designed by:

Mrs. S. Ragavi, Assistant Professor & **Dr. M. Saravanan,** Assistant Professor

Learning Outcome Based Education & Assessment (LOBE) Formative Examination - Blue Print Articulation Mapping – K Levels with Course Outcomes (COs)								
Internal	Cos	K Level	Section A MCQs		Section B Short Answers		Section C Either or Choice	Section D Open Choice
			No. of. Questions	K - Level	No. of. Questions	K - Level		
CIA I	CO1	Upto K3	2	K1&K2	1	K1	2	1
	CO2	Upto K3	2	K1&K2	2	K2	2	1
CIA II	CO3	Upto K3	2	K1&K2	1	K2	2	1
	CO4	Upto K4	2	K1&K2	2	K2	2	1
Question Pattern CIA I & II	No. of Questions to be asked		4		3		4	2
	No. of Questions to be answered		4		3		2	1
	Marks for each question		1		2		5	10
	Total Marks for each section		4		6		10	10

Distribution of Marks with K Level CIA I & CIA II								
	K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidate of %
CIA I	K1	2	2			4	8	20
	K2	2	4			6	12	
	K3			10	10	20	40	40
	K4			10	10	20	40	40
	Marks	4	6	20	20	50	100	100
CIA II	K1	2	2			4	8	20
	K2	2	4			6	12	
	K3			10	10	20	40	40
	K4			10	10	20	40	40
	Marks	4	6	20	20	50	100	100

K1- Remembering and recalling facts with specific answers
K2- Basic understanding of facts and stating main ideas with general answers
K3- Application oriented- Solving Problems
K4- Examining, analyzing, presentation and make inferences with evidences
CO5 will be allotted for individual Assignment which carries five marks as part of CIA component.

Summative Examination – Blue Print Articulation Mapping – K Level with Course Outcomes (COs)								
S.No	COs	K - Level	MCQs		Short Answers		Section C (Either / or Choice)	Section D (Open Choice)
			No. of Questions	K – Level	No. of Question	K – Level		
1	CO1	Upto K3	2	K1&K2	1	K1	2(K3&K3)	1(K3)
2	CO2	Upto K3	2	K1&K2	1	K1	2(K3&K3)	1(K3)
3	CO3	Upto K3	2	K1&K2	1	K2	2(K3&K3)	1(K3)
4	CO4	Upto K3	2	K1&K2	1	K2	2(K3&K3)	1(K3)
5	CO5	Upto K4	2	K1&K2	1	K2	2(K3&K3)	1(K4)
No. of Questions to be Asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30
(Figures in parenthesis denotes, questions should be asked with the given K level)								

Distribution of Marks with K Level							
K Level	Section A (Multiple Choice Questions)	Section B (Short Answer Questions)	Section C (Either/ or Choice)	Section D (Open Choice)	Total Marks	% of (Marks without choice)	Consolidated %
K1	5	4			9	7.5	17
K2	5	6			11	9.17	
K3			25	20	45	37.5	37
K4			25	30	55	45.83	46
Marks	10	10	50	50	120	100	100
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels.							

Summative Examinations - Question Paper – Format

Section A (Multiple Choice Questions) **Answer All Questions**			**(10x1=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
1	CO1	K1	
2	CO1	K2	
3	CO2	K1	
4	CO2	K2	
5	CO3	K1	
6	CO3	K2	
7	CO4	K1	
8	CO4	K2	
9	CO5	K1	
10	CO5	K2	
Section B (Short Answers) **Answer All Questions**			**(5x2=10 marks)**
Q.No	**CO**	**K Level**	**Questions**
11	CO1	K1	
12	CO2	K1	
13	CO3	K2	
14	CO4	K2	
15	CO5	K2	
Section C (Either/Or Type) **Answer All Questions**			**(5 x 5 = 25 marks)**
Q.No	**CO**	**K Level**	**Questions**
16) a	CO1	K3	
16) b	CO1	K3	
17) a	CO2	K3	
17) b	CO2	K3	
18) a	CO3	K3	
18) b	CO3	K3	
19) a	CO4	K3	
19) b	CO4	K3	
20) a	CO5	K3	
20) b	CO5	K3	
NB: Higher level of performance of the students is to be assessed by attempting higher level of K levels			
Section D (Open Choice) **Answer Any Three questions**			**(3x10=30 marks)**
Q.No	**CO**	**K Level**	**Questions**
21	CO1	K3	
22	CO2	K3	
23	CO3	K3	
24	CO4	K3	
25	CO5	K4	